The factors influencing mathematics students to choose teaching as a career

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DECLARATION

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ABSTRACT

This quantitative and qualitative study, prompted by the poor state of mathematics education in South Africa, explores the factors that influenced 40 Postgraduate Certificate in Education (PGCE) students with mathematics as a subject from three Universities in the Western Cape of South Africa to choose teaching as a career. The participants stated their reasons for their career choice by answering an open ended question and they also completed a FIT-choice questionnaire, constructed and validated by Professors Watt and Richardson of the Monash University in Australia. The motivations identified by the questionnaire are based on the concepts of Self-efficacy, Self-determination Theory (SDT) and Expectancy Value Theory (EVT).

The students from diverse socio-economic backgrounds speaking different home-languages responded similarly. They rated intrinsic motivations such as “want to make a difference in the lives of children” and “contribute to the development of the country” highest and extrinsic motivations such as salary and job security were rated lowest.

The study argues that insight into the factors that influence students to choose mathematics teaching as a career will assist in managing the recruitment and retention of quality mathematics teachers to address the shortage of Science Technology Engineering and Mathematics (STEM) teachers and graduates that exists globally as well as in South Africa. The importance of subject knowledge and pedagogical competency of teachers is highlighted.

mathematics teachers; factors; career choice; shortage; motivation

OPSOMMING

Hierdie kwantitatiewe en kwalitatiewe studie wat deur die swak gehalte van wiskunde onderrig in Suid-Afrika geïnspireer is, ondersoek die faktore wat 40 Nagraadse Onderwysstudente (NOS) met wiskunde as vak van drie Universiteite in die Weskaap Provinsie van Suid-Afrika beïnvloed het om onderwys as beroep te kies. Die deelnemers het ‘n ope vraag beantwoord sowel as ‘n “FIT-choice” vraelys ingevul om die redes vir hul beroepskeuse te verklaar. Die vraelys is deur Professore Watt en Richardson van die Monash Universiteit in Australië opgestel en gevalideer. Die motiverings wat deur die vraelys geïdentifiseer word is op die konsepte “Self-efficacy, Self-determination Theory (SDT)” en “Expectancy Value Theory (EVT)” gegrond.

Die studente van uiteenlopende sosio-ekonomiese agtergronde wat verskillende moedertale praat het soortgelyke reaksies op die vraeslys gehad. Hul het intrinsieke motivering soos “om ‘n verskil in die lewens van kinders te maak” en “maak ‘n bydrae tot die ontwikkeling van die land” hoog aangeskryf terwyl ekstrinsieke motivering soos salaris en werksekuriteit as minder belangrike faktore uitgewys is.

Die studie argumenteer dat insig in die faktore wat studente beïnvloed om wiskunde onderwys as ‘n beroep te kies die bestuur van die werwing en retensie van kwaliteit wiskunde onderwysers sal ondersteun sodat die tekort aan Wetenskap, Tegnologie, Ingenieurswese en Wiskunde (die sogenaamde “STEM” velde) onderwysers en gegradueerdes wat wêreldwyd sowel as in Suid-Afika bestaan, aangespreek sal word. Die belangrikheid van vakkennis sowel as die pedagogiese bevoegdheid van onderwysers word na vore gebring.

DEDICATION

I dedicate this thesis to my four children, Mari-Lise, Tanya, Jeanne-Marie and Carl, and my late husband Carel who always encouraged me to further my studies.

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LIST OF ACRONYMS

ANA	Annual National Assessment
BHEF	Business-Higher Education Forum
CDE	Centre for Development and Enterprise
CPUT	Cape Peninsula University of Technology
DBE	Department of Basic Education
DHET	Department of Higher Education and Training
DoE	Department of Education
EC	European Commission
EFA	Education for All
ELSEN	Education for Learners with Special Education Needs
EU	European Union
EVT	Expectancy-Value Theory
FET	Further Education and Training
FIT-choice	Factors Influencing Teaching Choice
FTEN	First-time Enrolments
GPK	General Pedagogical Knowledge
HE	Higher Education
HEI	Higher Education Institution
HEQC	Higher Education Quality Committee
IEA	International Association for the Evaluation of Educational Achievement
ITE	Initial Teacher Education
M+4	Matric plus four years tertiary education
MSP	Mathematics and Science Partnerships
MST	Motivational Systems Theory

NBT	National Benchmark Test
NDP	National Development Plan
NSC	National Senior Certificate
NSFAS	National Students Financial Aid Scheme
NTG	New Teacher Graduates
OBE	Outcome Based Education
OECD	The Organisation for Economic Co-operation and Development
OIT	Organismic Integration Theory
OSCE	Organisation for Security and Cooperation in Europe
PGCE	Postgraduate Certificate in Education
PISA	Programme for International Student Assessment
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SDT	Self-Determination Theory
SSA	Statistics South Africa
STEM	Science, Technology, Mathematics and Engineering
TEDS-M	Teacher Education and Development Study in Mathematics
TFA	Teach for America
TIMMS	The Trends in International Mathematics and Science Study
UCT	University of Cape Town
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNISA	University of South Africa
US	University of Stellenbosch
UWC	University of the Western Cape
VET	Vocational Education and Training

CHAPTER 1

INTRODUCTION

Why do mathematics majors choose teaching as a career? This question lies at the heart of this inquiry and is important for several reasons.

One, there is clear evidence that far too few students choose teaching as a career and even fewer choose mathematics teaching as a speciality. There is a global shortage of STEM (science, technology, engineering and mathematics) teachers. A number of OECD (The Organisation for Economic Co-operation and Development) countries experience the shortage as noted by Lawrence and Palmer (in Watt, Richardson and Pietsch 2009:286). A national Australian study found a lack of interest in mathematics and science graduates to become teachers in Australia. According to Jacobs (in Watt et al. 2009:286-287) even the education systems in some highly developed countries (such as Australia and the US) are not able to provide sufficient numbers of qualified STEM teachers to satisfy the increasing employment demand.

The ageing of the teaching force, the discontentment of mathematics and science teachers and the high demand and low supply of STEM professionals in other high status and lucrative careers are some of the reasons causing shortages in the number of teachers in the STEM field. It is important to determine what causes the lack of interest in the field and discontentment of the teachers, and how to increase the supply of STEM teaching graduates.

Two, the global need for STEM-related skills in careers and everyday life is rising where the most affluent nations have to keep economically abreast by growing their modern "knowledge based economies", that is to recognise the place of knowledge and technology in their economies. Scholars affirm that the STEM disciplines are the ". . . drivers of technological advancement, innovation and provide the foundational infrastructure to secure a robust economic future" (Watt et al. 2009:285). The America COMPETES (America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science) Act, passed by Congress on 2 August 2007, has as one of its priorities the recruitment of more STEM teachers as reported by Stine

(2008:27). The supply of STEM graduates in the USA has declined exponentially over two decades leading to serious concern about maintaining economic growth and development. Developing countries are also in need of more graduates from STEM. India and China are investing in the STEM field on a large scale to ensure that the demand for skilled graduates is met (Watt et al. 2009:286). Countries that maintain their economic growth are those with education as a priority. Sufficient highly skilled science and engineering graduates are therefore essential for the economic development of South Africa (Wolmarans, Smit, Collier-Reed and Leather 2010:274).

Three, as mathematics provides the grounding for all the STEM fields, the training of a sufficient number of competent mathematics teachers is seen as a priority by governments and industry globally. McCarthy and Oliphant (2013:5) argue that mathematics is a crucial prerequisite for entering into tertiary education and for careers in the global knowledge based economy. The 50% unemployment rate of the youth in South Africa is according to McCarthy and Oliphant (2013:3) closely linked to the poor quality of mathematical competency. Not having the necessary mathematical skills closes many occupational doors. The goal to enrol all children in schools in developing and underdeveloped countries as Education for All (EFA) envisages and the necessity for equal education for girls also increase the demand for teachers as the number of pupils increase. The number of countries that have achieved gender parity in both primary and secondary education from 2000 to 2015 has increased from 36 to 62. (EFA 2015:3). Higher enrolment figures affect the class sizes negatively because of the lack of teachers.

Four, the quality of the mathematics education in schools depend on the quality of the teachers. To be able to fulfil the demand for STEM graduates, the education of children by teachers with content and pedagogical proficiency in mathematics is critical. Deacon (in McCarthy and Bernstein 2011:13) writes that South African and international research show that capable and motivated young people should be recruited into teaching carefully in order to provide pupils with good teaching. “The solution lies in having particular types of teachers who are better supported and better paid” (McCarthy and Bernstein 2011:13). How does one identify the “particular type” teacher? Deacon

makes the following key points: There is a shortage of 15 000 new teachers in South Africa annually, but "[t]he quality of teachers is more important than the extent of the shortage" and more teachers ". . . will not necessarily improve the performance of learners, especially in scarce subjects such as mathematics and science" (McCarthy and Bernstein 2011:13). What are the qualities of quality teachers? The training that mathematics teachers receive must be scrutinised to make sure that they are properly prepared for the job. It is important to select students that are competent in mathematics to be trained as teachers for all phases.

Ingersol and May (2010:2-3) state that the challenge of providing quality mathematics and science teachers was a high priority in the educational field during the last twenty years. They refer to reports such as the John Glenn National Commission on Mathematics and Science Teaching for the 21st Century, (2000), the National Research Council (2002), and the National Academy of Sciences (2007) and state that the relatively poor USA educational performance, the minority achievement gap and lack of national economic competitiveness can be attributed to the diminishing number of qualified mathematics and science teachers. The result of the shortage of these teachers force schools to lower standards in order to fill the vacancies, especially in economically and minority disadvantaged communities, by hiring under qualified teachers, enlarging class sizes, larger workload for current teachers or scrapping certain subjects (Dolton, P. 2004:15). Initiatives to increase the supply of teachers have been implemented such as career-change programs, programs to attract academically talented candidates into teaching in understaffed schools (Teach for America), recruiting teachers from abroad and financial incentives e.g. scholarships, student loan forgiveness, housing assistance, and tuition reimbursement. The Teach for All programmes in Australia, Chile, China, India, Peru, the United Kingdom and the United States explore other routes to attract highly qualified graduates and then train them to be teachers.

Five, schools in remote and disadvantaged areas mostly get the wrong end of the stick with not having access to quality teachers and necessary resources to ensure efficient teaching and learning to take place.

"I can say I was fortunate to have this advantage, but a lot of my colleagues were not. The graduates in extreme cases can hardly read and write themselves. – Daniel, teacher, Kaduma State, Nigeria" (EFA 2015b:253).

Teachers are deployed disproportionally with the subsequent shortage of teachers with good subject knowledge in disadvantaged areas aggravating the inequality in teaching and learning. The Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) survey found that " . . . in South Africa teachers with better subject knowledge in mathematics and reading were more commonly deployed to urban and better-resourced schools" (EFA 2015b:249).

It is therefore important to investigate what the reasons are for highly qualified mathematics students to choose teaching as a career. What will make the career of a specialist in mathematics more attractive? What are the characteristics, motivations and perceptions of these students to become mathematics teachers? How can quality mathematics teachers be retained? And how do governments supply disadvantaged schools with teachers with strong subject knowledge?

1.1 Rationale

A Congressional Research Service (2006) report in the USA stated that a ". . . large majority of secondary students fail to reach proficiency in math and science, and many are taught by teachers lacking adequate subject matter knowledge" (Daugherty 2010:21). The performance of 15-year old students in the OECD countries in mathematics, have not improved since a decade ago although USD 230 billion was invested by OECD into teaching children mathematics in the industrialised world. " . . . . 23% of their 15-year-old students performed below the baseline Level 2 on the Programme for International Student Assessment (PISA) endorsed by the OECD 2012 mathematics assessment, showing that these students can barely use basic mathematical procedures and conventions to solve problems involving whole numbers" (OECD PISA 2012 2014:4).

It is clear from the international literature that student achievement is affected by teacher subject knowledge and self-efficacy which in turn is dependent on academic

ability and the quality of teacher training (Shen et al. 2004:227). Hawk in (Shen et al. 2004:227) finds that students of “fully certified” mathematics teachers perform better than those who are not “fully certified in the subject”. The quality of the training of teachers is thus of utmost importance. To become a quality mathematics teacher it is essential that the mathematical ability and competency of the students selected to study teaching must be of a high standard. Competency in the subject and high-quality training as a teacher lead to self-efficacy which is defined by Bandura as “. . . people’s beliefs about their capabilities to produce designated levels of performance that exercise influence over events that effect their lives” (Bandura 1994:1). Satisfaction with one’s career depends *inter alia* on the level of self-efficacy that one experiences because it boosts achievement and a person’s happiness and well-being. If you believe in your capabilities you will perceive difficult tasks as challenging and not threatening (Bandura 1994:1-2).

Experts agree that among all factors that contribute to a successful education system, the most important element is the competence and efficiency of the teachers. (Allen 2005:8). Sanders and Rivers (2007:12-13) refer to studies done in the USA which suggest that “[s]tudents placed with high-performing teachers will progress three times as fast as those placed with low-performing teachers.” This effect is also found to be cumulative, increasing the gap between the performances of pupils taught by high-performing teachers compared to low-performing teachers (Snodgrass 2010:136). To address the supply problem by employing teachers with lower or inapplicable qualifications, or to raise the teaching load of qualified teachers, will lower the quality of teaching (Santiago 2002:20-21; Ingersoll and May 2010:2). “Targeted quantitative and qualitative research is needed for a proper diagnosis of the problems impeding the effective recruiting, training and retaining of qualitative, competent and committed teachers, and how best to address them” (Simkins 2015:28).

Poor matric results in mathematics and science in South Africa can be ascribed to the shortage of mathematics and science teachers and the lack of pedagogic skills and knowledge of the subject (McCarthy and Bernstein 2011:10). McCarthy and Oliphant (2013:7,13) urge that for South Africa to be able to have a knowledge economy and

create better jobs, it will have to give top priority to the improvement of mathematics teachers' training. They conclude that "[i]f there is one key result to emerge from our research it is that South Africa's mathematics teachers – at most grades – are near to the bottom of world standards." Simkins (2015:30) agrees that this is the most urgent priority.

The provision of more teachers without focusing on the quality of their subject and pedagogical knowledge and practical training will not improve the overall standard of education in South Africa. According to a working paper by the European Commission (EC) (2012:32) a trend towards remodelling ITE for students in the European Union (EU) to learn in school settings by spending more time in classrooms with more support by experienced teachers, exists. The practical teaching must however be carefully planned and implemented to be effective. Cautious decisions by governments are vital when recruiting teachers. They should not just try to fill vacancies. When teaching as a career becomes less attractive, the risk of employing teachers with inadequate qualifications, low self-efficacy and low motivation to innovate is high. It is difficult to undone the long-term effects of a cohort of poor teachers. The low status of teaching as a profession has a significant influence on the quality of teachers that can be recruited and retained (EFA 2015a:4).

To be able to achieve better results (thus to improve the quality of education) and to educate our children for the future, the key is to have able, committed teachers facilitating the learning of basic skills, problem solving, critical thinking and be role models of values and ethics.

Dow (2003:60) claims that there is insufficient well-researched knowledge about students' attitudes and motivations concerning the study and teaching of science, technology and mathematics to guide policy. Studies of teacher motivations in different cultural settings and socio-economic levels in different countries produced different results according to Richardson and Watt (2010:141). Research in the USA in the 1990's indicated that ". . . altruistic, service-oriented goals and other intrinsic motivations" were the main factors influencing students to choose teaching as a career. Working with children, making a social contribution and "potential intellectual fulfilment"

were the highest ranked as reasons to become a teacher by participants in France, Australia, Belgium (French community), Canada (Quebec), the Netherlands, the Slovak Republic and the United Kingdom. However, extrinsic motivations were rated highest in Brunei, Zimbabwe, Cameroon and Jamaica where the culture and socio-economic status of the residents of the countries differ from Europe and North America. It is therefore important to do a study in the South African context as a developing country in Africa.

To be able to fulfil the demand for qualified mathematics teachers by attracting the best candidates, specific recruitment strategies must be developed (Snodgrass 2010:136; Simkins 2015:30). When one knows what factors attracted or influenced students who have already chosen mathematics as their specialising subject at university level, to choose teaching as a career, those strategies can be geared to accomplish the goal to increase the number of high quality, professional and committed mathematics teachers in South Africa.

Student teachers motivation to choose teaching as a career also correlates with their job satisfaction which contributes to the retention of these teachers in education (Richardson and Watt 2010:140). Therefore the motivation for their choice should be analysed to ensure that we have committed teachers in the system in future (Simkins 2015:31).

This study will make a contribution to the current literature by identifying the factors that influenced post graduate diploma in education (PGCE) students of mathematics at three universities in the Western Cape in South Africa that have chosen teaching as a career. As only students with a degree can enrol for a PGCE, these students are likely to be of a better academic quality than those who study education as a first degree on entering university. The importance of the research is commended by the current shortage of mathematics teachers and the lack of subject knowledge and pedagogical competence of the current mathematics teaching force which is evident in the poor performance of South African pupils in national and international numeracy assessments.

1.2 Research question

“What are the factors (motivations) influencing PGCE university students with mathematics as a subject to choose teaching as a career?” I will investigate whether the factors influence teachers in South Africa differ from the factors influencing teachers from the rest of the world by referring to literature on the topic.

1.3 Conceptual framework

I have used The Factors Influencing Teaching Choice Scale (FIT-choice scale) in my research about mathematics students’ motivations to study teaching because it was developed specifically to determine the factors influencing pupils to choose teaching as a career and has been used in a number of international studies. The FIT-choice scale is grounded in motivational theory allowing the measurement and comparison of motivations for different individuals and settings (Watt et al. 2012:791).

According to the OECD (2005) researchers identified intrinsic, extrinsic and altruistic motivations as the most important groups of reasons influencing teachers’ career choice. The Self-Determination Theory (SDT) defines two types of motivation: intrinsic and extrinsic motivation. The Expectancy-Value Theory (EVT) model is according to Watt and Richardson (2007:170) the most complete model on motivation to explain academic and career choices. The development of the FIT-choice scale was based on the SDT as well as the EVT model. A discussion of self-efficacy, defined as ‘the belief in a person’s capabilities to achieve a certain goal or result’ has relevance in the study of intrinsic motivation. “Self-efficacy beliefs determine how people feel, think, motivate themselves and behave” (Bandura 1994:1).

1.4 Research methodology

The FIT-Choice Scale was developed and validated by Helen M. G. Watt and Paul W. Richardson of Monash University in Melbourne, Australia in 2006. The three instruments used to obtain data are: a personal details form to collect biographical data, an open ended question and a questionnaire based on the FIT-choice scale with three sections namely “motivations about teaching”, “beliefs about teaching (perceptions)” and “your decision to become a teacher”. I have collected data from a cohort of 40

PGCE students form the Western Cape Province in South Africa with mathematics as a subject at the University of Stellenbosch (US), the University of Cape Town (UCT) and the University of the Western Cape (UWC) during the first semester of 2015. Descriptive statistics, the Cronbach's Alpha coefficient, one-way ANOVA's and Student's t-tests were used to analyse the data.

1.5 Significance of this study

The need to increase graduate production and secure quality teaching training is an urgent concern. Patterson and Arends (2009:99) highlight two dimensions of teacher training and teacher graduate production that will impact on the National Policy Framework for Teacher Education and Development in South Africa, namely the need to "improve our understanding of the factors that influence the movement of teacher education candidates from home to teacher training, and then their spatial distribution once qualified and working as teachers, and to investigate the slump in enrolment of young African women in initial professional education and training."

It was found by Ashiedu and Scott-Ladd (2012:28-30) that intrinsic motivations were the highest ranked as attractors to teaching as a career by both the retired group and teachers from the current group who wish to stay in the profession. Respondents who wanted to leave ranked intrinsic motivations low. "This suggests that far more emphasis needs to be placed on intrinsic motivators when selecting entrants to the teaching profession, and implementing strategies to maintain intrinsic motivation throughout a teacher's career" (Ashiedu and Scott-Ladd 2012 :28). The recommendations by the authors are: One, that to retain teachers who are motivated by intrinsic factors, the school, parent and society should ensure that extrinsic rewards are given to the teachers to keep them intrinsically motivated. An example is that teachers are employed in remote areas for short periods only and incentives are given. Two, beginner teacher should be supported better. Three, effective Human Resource Management Practices must be provided. Four, the best headmasters attracted by higher salaries must be appointed for low social-economic schools. "Understanding the values that underlie their choice may assist in better targeted attraction and improved retention outcomes" (Ashiedu and Scott-Ladd 2012 :30).

Low, Lim, Ch'ng and Goh (2011:198) found that the type of motivation of pre-service teachers is related to the degree of commitment towards their long term future as teachers. Therefore verifying the factors influencing students to choose teaching as a career may be utilised to predict retention rates for certain cohorts of teachers. The ministries of education can then plan for shortages.

Research on the behaviour of people making career choices with regards to factors influencing their decisions is valuable to career counsellors to guide individuals to make effective choices. Chatterjee (2013:196-198) has studied the factors that are required to make suitable choices by using Motivational Systems Theory (MST) in India. MST suggests that success and achievement are enabled by goals, self-efficacy and context beliefs.

Studying the motivations, expectancies, values and career choice satisfaction of pre-service teachers in South Africa can assist in the development of processes for the recruitment of teachers by linking the motivations to teacher types. Different types of teachers have different profiles of professional engagement and motivations for teaching (Watt et al. 2014: 39-40). Understanding the motivations for different types of beginner teachers will also aid in the preparation and support of those who are at risk to reconsider their choice of teaching as a long term career. Beginner teachers will feel more efficacious, satisfied with their choice and not experience burn-out if their expectations are fulfilled (Watt et al. 2012:800-801). Simkins (2015:7,26) questions the fact that pupils in South Africa are accepted to study teaching "without any reference to what motivates them to become teachers." The academic quality as well as the motivation of students are crucial in the selection of students to study teaching.

Why focus on mathematics teachers?

The poor performance of South African pupils in mathematics in the local 2012 South African Annual National Assessment (ANA), which are internationally benchmarked national tests, the Trends in International Mathematics and Science Study TIMMS (2011) as well as the poor Grade 12 mathematics results, are indicators of the urgency to find ways to improve the mathematical competency of pupils. The lack of

mathematical expertise among teachers in economically disadvantaged schools and in rural areas offers compelling evidence that more mathematics teachers need to be trained.

The problem of the shortage of quality teachers globally also exists therefore in South Africa. Both developed and developing countries have a shared challenge in attracting school students to STEM career fields including teaching those subjects. In South Africa the shortage of competent mathematics teachers is critical.

Identifying the factors and values that influence mathematics students to become teachers will broaden the knowledge base of what motivates young mathematicians to choose teaching as a career, to assist role players in managing the following:

One, to determine ways to attract more mathematically competent pupils to choose teaching as a career. More effective recruitment strategies can be developed by defining the target group more specifically and accurately.

Two, the characteristics of people choosing mathematics teaching will provide valuable information to policy makers and change agents for strategic education planning in a society where there is an increase in the demand for STEM graduates in other fields.

Three, recruitment of mathematics teachers from other careers by identifying the occupations from which students “switch” to teaching as a career, can be pursued.

Four, these findings can also be utilised by career counsellors and educators when they advise pupils about their future studies (Hall et al. 2011:32 and Chatterjee 2013:196-197).

Five, when the motivations of students are determined, the selection of students to study teaching can be based on those factors that correlate with dedication to teaching in order to ensure long term commitment. The retention of teachers depends *inter alia* on whether the initial perceptions and motivations of beginner teachers are realised.

CHAPTER 2

STATE OF MATHEMATICS EDUCATION IN SOUTH AFRICA

2.1 Performance of pupils

In a Centre for Development and Enterprise (CDE) report on a study about the crisis of education in South Africa, Spaull (2013:29) states that in spite of the very poor mathematics performance of Grade Nine pupils in the TIMMS 2011 study, 89% of South African Grade Nine teachers felt ‘‘ . . . very confident in teaching mathematics, in stark contrast to teachers in Finland (69% very confident), Singapore (59% very confident) and Japan (36% very confident), the best performing countries (Mullis, Martin, Foy and Arora 2012, p. 314).” On the other hand, the 2011 TIMSS results show that the average Grade Nine pupil from South Africa, who did the Grade Eight mathematics assessment, is two years’ learning behind the average Grade Eight pupil, when compared to the results of pupils from 21 other middle income countries (McCarthy and Oliphant 2013:7).

Simkins (2013:12) provides data on the Grade Nine mathematics scores by percentage range in the 2012 ANA tests.

Table 1: ANA 2012 Grade Nine mathematics percentage range

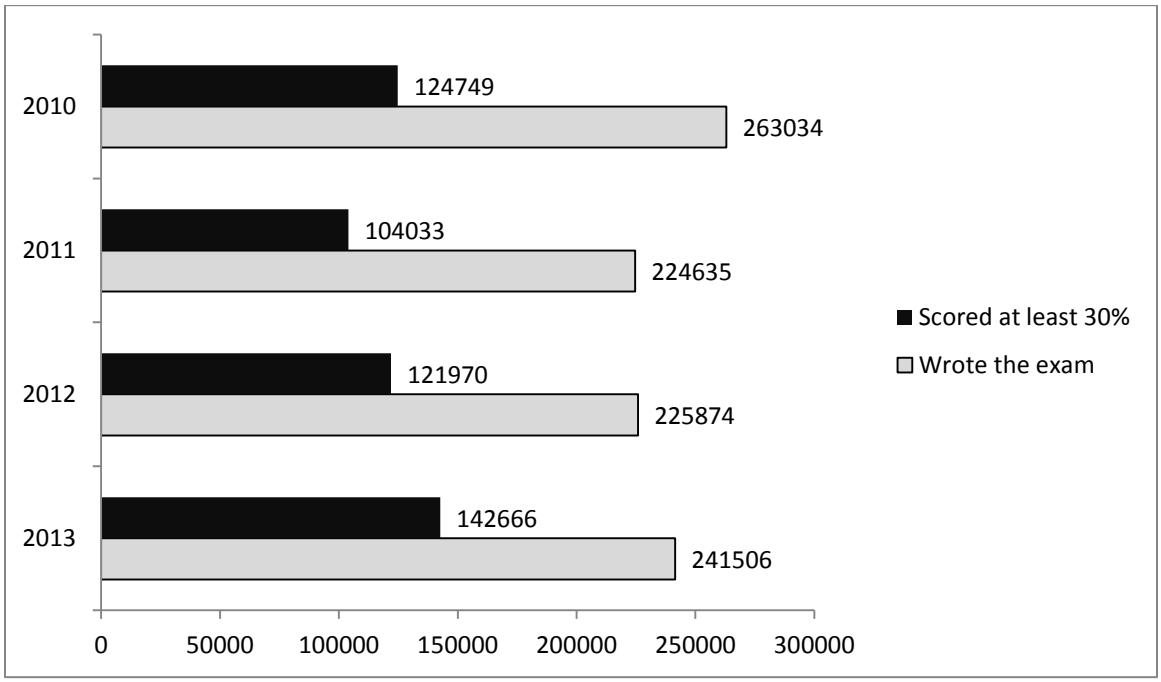
Range (%)	Percentage of scores
less than 30	91.9
30 - 39	3.8
40 - 49	2.1
50 - 59	1.1
60 - 69	0.6
70 - 79	0.3
80 and over	0.2
Total	100

There was an improved performance in mathematics results from 2013 to 2014 in all the grades except Grade Nine pupils who achieved an average of 10.8% in maths, a 27% decline from 14% in 2013. In 2012 the average Grade Nine mathematics mark was

13%. Less than 3% of Grade Nine pupils writing the 2014 tests achieved more than 50% for mathematics.

The graph below represents the 2010 to 2013 number of pupils who wrote the National Senior Certificate (NSC) mathematics examinations compared to the number who scored 30% or more for their examinations.

Figure 1: NSC Mathematics Results 2010 - 2013



Source: Department of Basic Education 2014

Only 3.4% of the cohort of Grade 12 pupils who wrote the 2013 NSC mathematics examination in South Africa obtained a mark above 80% for mathematics. The Western Cape Province had the highest percentage, 56.8% of pupils scoring above 40% and the lowest percentage, 26.4% of pupils scoring above 40%, was from the Eastern Cape.

The 2014 matric results for mathematics, mathematics literacy and physical science were of poorer quality than the results in 2013. There has been a steady decline in the number of full-time Grade 12 pupils who take mathematics as a subject - down from 270,598 in 2010 to 231,180 in 2014. The mathematics pass rate also declined from

59.1% in 2013 to 53.5% in 2014. What is of even more concern is that only 35.1% of learners scored above 40% in mathematics in 2014.

Universities voiced their concern about the mathematical knowledge of school-leavers in a study on the trend of students with mathematics as a major subject by Engelbrecht and Harding (2009:84). The quality of their school mathematics is an indicator of the students' success at university. "A developing country such as South Africa cannot afford a school system that leaves students under prepared for university studies" (Engelbrecht and Harding 2009:84).

A new syllabus, the Curriculum 2005, based on Outcomes Based Education (OBE) was launched in 1997 to replace the previous dispensation's "apartheid" school system. Scholars agreed that the current education environment was not ready for such a "sophisticated reform" (Jansen (1998:321).

The first group of matriculants who followed the OBE curriculum wrote their NSC examination in 2008. There was a significant increase in the number of pupils who obtained level seven (80% to 100%) marks for mathematics and therefore resulted in an increase in the number of pupils qualifying for courses at universities with mathematics as a subject. There was a clear decline in the pass rate of students in their first year at university in 2009. Dennis and Murray (2012:1) report on the mathematics results of the National Benchmark Test Project (NBT) which was implemented in August 2009 for the 2010 entrants at certain institutions as follows: 8% of the cohort achieved the proficient level (62% to 100%), 21% achieved the upper intermediate level (49% to 61%), 36% the lower intermediate level (34% to 48%) and 35% the basic level (0% to 33%). "These results indicate that 92% of the students who applied for entry into universities in 2010 would need some form of mathematics support" (Dennis and Murray 2012:1) and are thus not prepared for the mathematics courses at university. The CAPS curriculum, replacing the 2005 OBE based curriculum, was thus developed and introduced to streamline the number of subjects as well as to improve the content of the subjects offered. The first CAPS based NSC examination was written in 2014.

Competency in mathematics is a prerequisite for a number of STEM related careers such as engineering, actuarial studies, science and mathematics teaching. The number of school leavers competent in mathematics cannot satisfy the demand that exists for graduates in the STEM field.

2.2 Language barriers

South Africa has eleven official languages. These languages are area specific in some regions, but in most of the metropolitan areas a multitude of languages are spoken.

Table 2: Distribution of first language speakers in South Africa in 2011

Language name		Speakers as a 1st language	
English	Endonym	Count	Percentage of population
Zulu	isiZulu	11,587,374	22.7%
Xhosa	isiXhosa	8,154,258	16.0%
Afrikaans	Afrikaans	6,855,082	13.5%
English	English	4,892,623	9.6%
Northern Sotho	Sesotho sa Leboa	4,618,576	9.1%
Tswana	Setswana	4,067,248	8.0%
Sotho	Sesotho	3,849,563	7.6%
Tsonga	Xitsonga	2,277,148	4.5%
Swazi	siSwati	1,297,046	2.5%
Venda	Tshivenḓa	1,209,388	2.4%
Ndebele	isiNdebele	1,090,223	2.1%
Sign language		234,655	0.5%
Other languages		828,258	1.6%
Total		50,961,443	100%

Source: Census 2011

For example, in 2006 one primary school in the Secunda region in Mpumalanga, which is an industrial and mining area, had pupils with all eleven official languages as well as French and Portuguese as their mother tongue. Most of these children are taught in their second language, English. Many parents believe that the sooner their children are fluent in English the better. They then enrol them in English medium classes. It is therefore not always possible to adhere to the policy of mother tongue education up to Grade 3 before switching to (usually) English as the language of instruction. Afrikaans and English mother tongue children have an advantage because they are taught in their home language from the start. Teachers with African languages as their mother tongue study and teach in their second language. The dominance of English in a mathematics classroom with pupils with a different mother tongue, affects the discourse of concepts and understanding negatively. These pupils only responded to procedural discussions. Setati (2002:7-8,16-17) also alleges that speakers of African languages prefer to have their children schooled in English as they perceive mother tongue instruction to be inferior and associated with apartheid. English is seen as the “language of power and the language of educational and social-economic advancement” in South Africa. Mathematics pupils often have a problem understanding certain concepts explained in their second language, English, while the teachers find it difficult to explain concepts “in the vernacular because it brought confusion and a misinterpretation of ideas” as reported in a study done by Mji and Makgato (2006:261-262).

Scholars are in agreement that mother tongue learning is the ideal. Internationally, the 1996 Hague Recommendations Regarding the Education Rights of National Minorities proposed that ". . . in primary school, the curriculum should ideally be taught in the minority language (mother tongue)" (Organization for Security and Co-opation in Europe (OSCE) 1996:4). Alidou et al. (in EFA 2015a:8) states that mother tongue teaching is the most important concern of educational development in multilingual communities. The quality of education is lowered if children are taught in an unfamiliar language because classroom communication and interaction are limited.

2.3 Quality of teachers

Carnoy, Chisholm and Chilisa (2012:xii-xvi) studied a sample of Grade six learners and their mathematics teachers in two neighbouring areas of South Africa (the North West Province) and Botswana. The areas have similar cultures and socio-economically conditions. The study focused on teachers and teaching and found that the teachers in Botswana teach at a higher level, scored higher in the mathematics tests for teachers and covered more of the syllabus, 60% compared to 40%, than the teachers in North West Province. However both countries teachers were not rated as high quality due to their low level of mathematical content and pedagogical knowledge overall.

Indicators of school performance reveal poor teaching of mathematics in most schools which is caused by the poor quality of the teachers, especially in the lower grades. McCarthy and Oliphant (2013:3-5) argue that the effect of poor teaching in the lower grades cannot be remedied by the time the pupils reach the secondary phase (Grade Ten to Twelve). When compared to other Eastern and Southern African countries, Grade Six mathematics teachers in South Africa are at the ". . . bottom end of the spectrum". The majority of Grade Six teachers in South Africa could not answer mathematics questions from the Grade Six curriculum in data collected in 2007. It is impossible to teach what you do not know and even worse when you teach what you think you know and do not know. The large dropout rate in Grade Nine is thus explained. The South African government and researchers agree that the poor learner achievement in mathematics in South Africa is mainly caused by the deficiency of mathematics teachers' subject and pedagogical content knowledge (Simkins 2015:4).

The EFA report agrees that if teachers have poor subject knowledge, their pupils will struggle to learn. Altinok in EFA (2015b:237) found that an increase of about 100 points in the teachers' score in the 2007 SACMEQ test for Grade 6 students, increase the pupils score by 38 points. Moloi and Chetty in EFA (2015b:237) report that students taught by a teacher from the top 10% of teachers compared to one from the bottom 10% can score 110 points more. This is similar to the difference between the Mpumalanga province's scores and those of the Western Cape, respectively with the third lowest and highest scores of the nine provinces in South Africa.

The SACMEQ survey further revealed that teachers with better mathematics subject knowledge are mostly deployed in urban schools that are better resourced than those in deprived areas serving disadvantaged students. The disadvantaged pupils fall further behind when they are taught by teachers with poor subject knowledge (EFA 2015b:250).

2.4 Quality of teacher training

Contrary to international trends where the training of teachers is moving away from Universities, the Higher Education Institutions (HEI's) in South Africa are mainly responsible for teacher training. The number of teacher training institutions has been decreased from 150 to 23 state funded institutions by 2001 (Parker and Adler 2005:62).

A cycle of mediocrity in the standard of mathematics teaching is maintained by the following factors according to Mji and Makgato (2006:254): teaching practices that have not been revamped, poor basic content knowledge and under-qualified and unqualified teachers. Only half of the mathematics teachers have specialised in mathematics in their teacher training programme (EFA:2005). Most of the HEI's exclude mathematicians in the training of mathematics teachers as the education faculty is solely responsible for the education of teachers. The level and kind of subject knowledge that teachers of mathematics need is discussed by Parker and Adler (2005:69-70). Do mathematics teachers require subject knowledge at the university mathematics level or is school curriculum knowledge sufficient? They suggest that a FET teacher must be "an able mathematical thinker and actor"; must be "interested in learning from research in the field" and be able to "utilise their knowledge to help learners develop productive mathematical identities" (Parker and Adler 2005:73).

Simkins (2015) writes in the CDE report on "Supply and Demand 2013 – 2025" that the quality of ITE (Initial Teacher Education) programmes is of utmost importance and that poor teacher training at some HEI's is a key contributing factor to the poor performance of pupils. The programmes offered by the institutions vary. A review by the Higher Education Quality Committee (HEQC) between 2005 and 2007 found that only 7 of the 22 PGCE and 6 of the 15 four-year B Ed programmes offered at HEI's met the minimum

standards set by the review process. This has an impact on the current workforce's performance as teachers. The professional development of teachers and subject specific training for employed teachers are also found to be not adequate. Efficient in-service training is necessary for teachers to stay motivated, adapt to change and to reflect on teaching practices and is key in the performance of teachers and the learning of pupils. The insufficient practice teaching component of the Initial Teacher Education (ITE) programmes was highlighted as a major problem (Simkins 2015: 3, 6-7; EFA 2015a:9)

The South African Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET) co-ordinated and introduced the "Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011 – 2025 (the "Plan") to address the incongruence of teacher training at the various training institutions in 2011. The four outputs that the Plan focus on are: " . . . addressing the individual and systemic needs of teacher development, attracting increasing numbers of high-achieving school-leavers into teaching, enhancing teacher support at the district level, and expanding and making more accessible the formal teacher education system."

Simkins (2015:5-6) identified two weaknesses in the Plan. Firstly, the plan does not make provision for multiple pathways to become a teacher, especially to improve accessibility and a wider reach, as is the new trend internationally. Secondly, the developmental needs of teacher educators at the HEI's are not addressed.

The current teaching force in South Africa has therefore received training that varies in quality and content.

2.5 Entrance requirements for education students

In contrast to a country like Finland where the best students are enrolled for teacher education, the ITE programmes in South Africa have low entrance requirements when compared to other courses (Sahlberg 2011:73; Simkins 2015:7). Cosser (in Van Broekhuizen 2015:22-23) argues that students may enrol for an ITE course not because they are passionate about teaching, but that they qualify for the programme due to the

comparatively low entry requirements. These students may choose not to pursue teaching at the end of their studies.

Students who choose mathematical literacy as a subject in Grade Ten are usually those who do not cope with the content and understanding of mathematics in grades seven to nine. They are therefore not proficient to become teachers of mathematics. Yet they qualify to study to become primary school teachers. Teachers with poor mathematical ability often have to teach the subject in schools where the class teacher is responsible for all the subjects.

The admission requirements at different HEI's vary. In the Western Cape the admission requirements to study B Ed at the Further Education and Training (FET) level at the Cape Peninsula University of Technology (CPUT) are:

- An achievement rating of at least 4 (50 – 59%) or better in four subjects from the designated subject list of which one must be an official language of South Africa and a rating of at least 3 (40 – 49%) in another official language of South Africa. One of the above languages should be the language of learning and teaching at the CPUT.

- Depending on the area of specialisation, an achievement rating of at least 3 (40 – 49%) in one of ten designated subjects which include Mathematics and Mathematical Literacy.

Source:www.cput.ac.za 2015

To enrol for the PGCE course with mathematics as a teaching subject at the University of Cape Town (UCT), the University of Stellenbosch (US) and the University of the Western Cape (UWC), the students must have a degree with mathematics as one of two school subjects. To take mathematics as a degree subject at the US the requirement is a minimum achievement rating of 6 (70 – 79%) in their NSC examination.

The mathematics qualifications of the students enrolling at the UCT, US and UWC are therefore at a potentially higher level overall than those enrolling at the CPUT.

2.6 Teacher supply and demand

Data sources available for the CDE's research on the supply and demand of teachers from 2009 to 2013 to make projections for the future, were ". . . inaccurate, incomplete or inconsistent" as reported by Simkins (2015:8). The Annual Schools Survey database was mostly used in the analysis.

Data on 400 756 South African teachers between the ages of 22 and 65 in 2013 produced *inter alia* the following results reported by Simkins (2015:17-19):

- 81% were fully qualified to teach
- 15% had an M+4 qualification as required by for New Teacher Graduates (NTG's)
- 70% were female
- The average teacher in service had 17 years of experience, but educators who retired from teaching at age 65 had an average of 34 years of experience
- The age distribution was very uneven: 45% of teachers were in the age range of 40 to 49 years. The number of teachers with an age of between 45 and 49 was four times more than the number between 30 and 34 years of age.

According to the report, the greatest subject needs are for languages and mathematics teachers, especially in grades four to seven. In the FET phase the biggest demand will be for mathematical literacy teachers and there is an alleged over-supply of mathematics teachers in the FET phase (Simkins 2015:17-19).

However, one-quarter of the secondary schools in South Africa do not offer mathematics as a subject in grades 10 to 12 due to a lack of qualified teachers as stated by the Department of Basic Education of South Africa (DBE) in 2015. The question arises whether the number of mathematics teachers will be sufficient if the goal of all schools offering mathematics as a subject realises. Also, how does one address the current lack of mathematical proficiency of FET teachers? Lowering the entrance requirements in order to increase the enrolment of students to train as mathematics teachers for the FET phase will not contribute to the provision of quality teachers with the required content and pedagogical knowledge.

CHAPTER 3

LITERATURE REVIEW: WHAT WE KNOW ABOUT TEACHERS AND CAREERS

This section reviews the literature on supply and demand of teachers, the shortage of teachers globally and nationally, the quality of teachers as well as researchers' findings on the factors and motivations for choosing teaching as a career.

The investigations about these motivations commenced in Britain during the depression years and after World War 2 and have increased in number over the last decade (Watt et al. 2012:792). The reasons for the shortages and the factors influencing teaching as a career choice are identified in general and in the STEM fields and discussed. Finally I draw attention to an important gap in the literature on student motivations for teaching as a career and indicate how my study might contribute to address that gap.

3.1 Shortage of teachers in the International context

3.1.1 General shortage

The reasons for the shortage of teachers in general have been investigated internationally. An OECD (2005) report concludes (in Rots, Aelterman, Devos and Vlerick 2010:1619) that the shortage of teachers is a recurring problem in several Western countries. Rots et al. (2010:1619) argue that the shortage is a result of insufficient number of students deciding to choose teaching as a career ("recruitment problem"), a significant number of teachers leaving the profession within the first couple of years ("attrition problem"), and graduates from education training institutions not entering the teaching profession ("job entrance problem"). Cooper and Alvarado (2006:1) report that only 60% of qualifying teachers in the USA actually enter the profession after they graduate and in the UK 40% leave the profession within the first three years, although the number of students that train to become teachers is sufficient, many do not go into teaching and others leave the profession within a couple of years. In developing countries the population growth rate results in a higher demand of teachers. Shortage of secondary school teachers exists in the Netherlands (also in all OECD countries) caused by high attrition rates and discrepancy between original

motivations and actual tasks (Fokkens-Bruinsma and Carinus 2012:249). Teacher attrition is also caused by migration. Research indicates that teachers who migrate tend to move to schools with higher student performance (Cooper and Alvarado 2006:18). The effect on the long term is thus loss of teaching quality and poor student achievement. The teaching corps in many countries is ageing, which contributes to the attrition of teachers when they retire (Kilinc, Watt and Richardson 2012:199; Watt and Richardson 2006:28). The member countries of the European Union (EU) experience teacher shortages due to the ageing of the teaching force and their consequent retirement. These countries also experience a gender imbalance. There is a shortage of male staff up to lower secondary level and a shortage of female staff in higher secondary educations and leadership positions. The report recommends that teachers, school leaders as well as trainers of teachers should be attracted, recruited, educate, retained and supported to fulfil the demands in future. (EC 2012:6:7).

In the USA the National Commission on Teaching and America's Future (1996) (as quoted by Hong 2010:1530) states: ". . . need to hire more than two million teachers to handle huge enrolment increases, replace an ageing teacher workforce ready to retire, and respond to the chronic attrition of new teachers that plagues American schools". Although the need is increasing, the attrition of teachers still occurred. According to the National Commission on Teaching and America's Future (2003) (in Hong 2010:1530), the attrition rate of teachers has increased faster than the supply of teachers. In particular, the group of greatest concern in the area of teacher attrition is beginning teachers.

There is a shortage of minority (non-white) teachers in many Western Countries as expressed by the respondents to a survey done by Webb and Hodge (2003:146). They indicated the need for more African American role models in the adapted physical education (APE) profession. Hoodless notes (in Butt, MacKenzie and Manning 2010:70) " . . . a growing concern about the under-representation of people from minority ethnic groups in all the professions, both in the UK and inter-nationally . . ."

Although teaching in China has a higher level of status than in many Western Countries, Ding & Sun and Chen; Robinson & Yi; Su, Hawkins, Huang, & Zhao reported (in Lin,

Shi, Wang, Zhang and Hui 2012:228) that rural areas experience high teacher shortages, especially in areas which are being developed economically. According to Robinson and Yi (in Lin et al. 2012:228) incentives (increased remuneration, subsidised housing and social security benefits) are therefore offered to potential teachers by the Chinese Central Government in exchange for three-year contractual agreements to teach in rural schools.

Watt (2006:28) fears that the shortage of teachers may lead to allowing lower qualifications and that the quality of teaching may decrease as the class sizes and the workload of teachers increase. It is therefore essential to ensure that teaching becomes an attractive career choice for school leavers as well as those who want to change their career to teaching.

Research that was done in the late 1990's and early 2000's concludes that there is a positive correlation between the quality of a teacher and students' academic performance. "Attention has turned from concern over having a sufficient number of teachers to a concern about having a sufficient number of quality teachers" (Cooper and Alvarado 2006:5).

The European Union is also focusing on finding the best teachers to fill vacancies in future. The best performing education systems in the world select their prospective teachers from the top tier of school graduates. They believe to find a balance between attractive working conditions and high selection criteria is the best way to enhance the learning of pupils by committed teachers. Teachers must also be prepared to be lifelong learners and enhance their professional development in a rapidly changing working environment (EC staff working paper 2012: 28-29).

Countries like the UK, Australia, France and Germany have shortages in general or specific areas. Japan, the Czech Republic, Portugal and Hong Kong SAR have an adequate supply of teachers according to Cooper and Alvarad (2006:4). Kilinc et al. (2012:200) point to the fact that Turkey has an oversupply of teachers which results in students competing for teaching posts, however shortages exist in certain areas namely preschool, special education and English language teaching. Mathematics, science,

visual arts and music teaching have no shortage of teachers in Turkey. The Turks focus specifically on the quality of mathematics and science teaching to keep up with the modernisation of their country. Cooper and Alvarado (2006:4) report that although the USA has enough teachers overall, there is a shortage of mathematics, science, special education and bilingual education teachers, and not enough good teachers to teach at schools with large numbers of “at-risk” students.

The goal of Education for All (EFA), a United Nations (UN) initiative to provide quality basic education for all children, youth and adults, is to increase enrolment of primary education. It had the following effect on the demand for teachers: “School enrolment is soaring, but there aren’t enough teachers to provide every child with a primary or lower secondary education. If nothing changes many countries will still be facing serious teacher shortages in 2030 at both levels, according to new projections from the UNESCO Institute for Statistics” (EFA 2015b:222). The biggest demand for teachers is in sub-Saharan Africa where in addition to creating 2.1 million new primary teaching posts, by 2030 sub-Saharan Africa must fill about 2.6 million posts vacated by teachers leaving the profession. This area accounts for 63% of the additional primary school teachers demanded by 2030 as well as half of the required lower secondary school teachers with Nigeria being identified as the country with the highest demand namely 13% of the global total. Low enrolments of pupils can only be increased if a sufficient number of teachers are available to teach them. South and West Asia require one million secondary school teachers by 2030. The number of pupils per teacher ranges from 40 in Nigeria, Pakistan and Yemen to 76 in Malawi caused by a sharp increase of enrolments to 97%. These figures do not reflect the impact on higher secondary education where the demand for specialised subjects such as the STEM subjects is crucial in the development of pupils to fulfil the global demand for skills. (EFA 2015b:222).

A shortage of teachers from minority groups exists, especially teachers speaking the home language of these minorities. The children from these minority groups are then disadvantaged because they are not taught in their mother tongue. In India teachers

with lower qualifications are often hired to fill the posts for the low caste groups. The same problem exists in Mexico according to Chudgar and Luschei in EFA (2015b:250).

Low teacher salaries when compared to other professional occupations' remuneration, contributes to the fact that the best students are less likely to choose teaching as a career. The best students and those with experience are actually more likely to leave the profession due to a decrease in motivation and the slower increase in teachers' salaries when compared to other occupations. This phenomenon led to the attrition of almost 50% of teachers with less than six years of teaching in the USA between 1999/2000 and 2003/2004 as stated by Gilpin in EFA (2015b:260). After 15 years of experience the salary of a lower-secondary teacher in the USA is only 67% of the average of a full-time, full year worker with a tertiary qualification. In 32 of the 42 countries that took part in PISA 2006, the mathematics scores of pupils who want to become teachers were below average (as reported by Bruns et al. in EFA 2015b:260). Countries where teachers earn more than the average for full-time employees with a tertiary education include Canada, Luxemborg, New Zealand and the Republic of Korea.

The EFA report (2015:249 – 251) states that the imbalanced deployment of teachers in developing countries in sub-Saharan Africa with poor teacher to learner ratios has an influence on the quality of education in the region due to large class sizes. The challenge is to deploy teachers where the demand is the highest. Although maximum and minimum class sizes are prescribed in many countries, actual allocation of teachers does not always adhere to the official specifications. Pupils therefore leave school early without acquiring the necessary basic skills. Data from the Bangladesh education management information system, show that the percentage of pupils reaching the last grade of primary school is 60% in areas where there are 75 students per teacher, compared to 75% where there are 30 students per teacher. The problem does not only exist in the sub-Saharan region. Mexico and Peru also have the problem that teachers with poor subject knowledge are allocated to more disadvantaged pupils. Four factors influence the unequal deployment of teachers, namely geographical location; ethnicity and language; gender and subjects taught. Malawi has serious teacher shortages and has surpluses in urban schools and severe shortages in rural areas caused by the

inefficient allocation of teachers. In India and in South Africa there are not enough teachers able to teach in the local languages which disadvantage the learning of minorities. Often fewer female teachers are deployed in disadvantaged areas. In Rwanda 10% of primary school teachers are female in the rural Burera district compared to 67% in the Gisagara district. There is a shortage of teachers in specific subjects such as mathematics, science and foreign language. Sub-Saharan Africa does not have sufficient trained teachers to fulfil the demand. For example, Nigeria needs

70 000 teachers per year by 2020 and only two-thirds of the current teaching force have minimum qualifications.

To explain the attrition of beginner teachers, Watt et al. (2014:23) investigated the difference in the initial motivations of three distinct types of pre-service teachers ("highly engaged persisters, highly engaged switchers and lower engaged desisters") in Australia and the USA, countries with similar cultures. Their question was whether the identification of the different types of teachers and their initial motivations will assist in determining who will remain in teaching after the critical first five years when many countries experience high attrition rates. They believe that "[b]eginning teacher's motivations constitute an understudied dimension of their professional engagement and career development aspirations." Their findings are that teacher types had different initial motivations in their choice of teaching as a career and also in how they perceived teaching as a career (Watt et al. 2014:31,39).

3.1.2 Shortage of STEM teachers

"STEM education" includes educational activities from pre-school to post-doctorate in order to develop a society that is STEM literate. Kennedy and Odell (2014:246-247) also predict that there will be a global shortage of STEM qualified employees and teachers. Students need to be groomed more proficiently in the STEM fields to fulfil the global demand. Kennedy and Odell state that "[i]mproving teaching and learning in STEM education has become an economic factor in developing countries, emerging economies, and in long established economies such as Europe and the United States" (Kennedy and Odell 2014:248). They report that 20% of graduates in Asia are studying

in the STEM fields compared to only 2% in Europe. President Obama's Council of Advisors on Science and Technology made the following five recommendations to "prepare and inspire" students of the future. One, improve leadership on STEM education; two, establish a baseline on the curriculum of STEM education; three, ". . . cultivate, recruit, and reward STEM teachers that prepare and inspire students"; four, create activities to include students from diverse backgrounds; and five, support all the role players to transform the environments of learning into exciting STEM settings.

Texas has introduced the T-STEM (Texas STEM) initiative targeting 14 to 18 year olds to improve mathematics and science performance of students in order to increase the number of students choosing careers in the STEM field. They also focus on empowering the teaching force to transform their learning methods for the 21st century (Kennedy and Odell 2014:250).

STEM disciplines are essential drivers in current competitive global knowledge-based economic development, especially in the affluent nations. believe that The developing countries are also in need of more graduates from STEM. India and China are investing in the STEM field on a large scale. The number of students in the USA participating in science and mathematics education have declined exponentially, contrary to the period up to the 1990's when the USA were leaders in the field of science, and technological and engineering innovation. Australia experiences the same decline and therefore advocate for the attraction and training of STEM teachers to increase the number of pupils choosing STEM subjects and also to enhance the quality of teaching and learning of these scarce subjects. According to Lyng and Blichfeldt (in Watt et al. 2009:286), some schools in Norway can no longer offer science as a subject because of the scarcity of qualified science teachers. They found a lack of enthusiasm by STEM graduates to choose teaching as a career. The TIMMS report revealed that the highest proportion of teachers who indicated that they would switch to another occupation were from Australia and New Zealand (Watt, Richardson and Pietch 2009:285-286).

The challenge of providing quality mathematics and science teachers was a high priority in the educational field during the last twenty years. Ingersol and May (2010:2-3) refer to reports such as the John Glenn National Commission on Mathematics and Science

Teaching for the 21st Century, (2000), the National Research Council (2002), and the National Academy of Sciences (2007) and state that the relatively poor USA educational performance, the minority achievement gap and lack of national economic competitiveness can be attributed to the diminishing number of qualified mathematics and science teachers. The result of the shortage of these teachers forces schools to lower standards in order to fill the vacancies, especially in economically and minority disadvantaged communities. Initiatives to increase the supply of teachers have been implemented such as career-change programs, programs to attract academically talented candidates into teaching in understaffed schools (Teach for America), recruiting teachers from abroad and financial incentives e.g. scholarships, student loan forgiveness, housing assistance, and tuition reimbursement.

The issue of attracting more young people to choose careers in the STEM disciplines is important in order to maintain the USA's competitive edge in the global marketplace as stated by Merril and Daugherty (2010:21). They identify the lack of subject knowledge of mathematics and science teachers as contributing factors to the low proficiency of pupils in these subjects. In order to address the problem, the United States Department of Education has funded Mathematics and Science Partnerships (MSP) focusing on developing the STEM Education and Leadership Program.

The USA based Business-Higher Education Forum (BHEF) report (2010:8) confirms the earlier argument (BHEF, 2005, 2007) about the vital role of teachers in increasing the numbers and proficiency of science and mathematics pupils. Hanushek (2002) in the 2010 BHEF states that: "Teachers account for approximately 8.5% of the variation in student performance during elementary and high school" and "Moving a student from a teacher in the 50th percentile to one in the 85th percentile increases a student's performance on standardized mathematics tests by 7% in a given year" (BHEF report 2010:8).

Newton, Jang, Nunes and Stone (2010:21-22) quote from the Council on Science and Technology and the Center for the Future of Teaching and Learning in the USA that the three most critical problems in urban schools, serving mostly socially and economically disadvantaged pupils, are " . . . recruiting, preparing, and retaining high quality

secondary mathematics and science teachers" (Newton et al. 2010:21). Some critics allege that the fast tracking of candidates into education through alternative routes of training, low admission standards and poor recruitment of student teachers leave teachers who are not sufficiently prepared for their job. Teach for America (TFA) on the other hand, are recruiting and fast tracking undergraduates with STEM majors from "elite" universities in order to address the critical shortage of high quality secondary school mathematics and science teachers. The researches have proposed a program (Cal Teach) at the University of California Berkeley in an attempt to help find solutions for the shortage problem which is particularly serious in California.

The Cal Teach program focuses firstly on teachers' insightful and contextual subject knowledge and understanding. STEM majors however have a wide choice of occupations available with higher remuneration than a teaching career. To enter the teaching profession they have to study for an additional year which has financial implications. Secondly, students are made aware of teaching as a career and recruited when they enter the university. Thirdly, the program facilitates the placing of students in schools as interns while they study and assist qualified students from Cal Teach to be employed as fulltime teachers. Lastly, there is an effort to attract diverse students (including more females, poor students and students of colour) into Cal Teach (Newton et al. 2010:25-27). Cal Teach also make an " . . . effort to create a professional community among various stakeholder groups who share responsibilities for educating, supporting, and retaining our students" (Newton et al. 2010:36)

The International Association for the Evaluation of Educational Achievement (IEA) supported research being done on Teacher Education and Development Study in Mathematics (TEDS-M) by Tatto, Peck, Schwille, Bankov, Senk, Rodriguez, Ingvarson, Reckase and Rowley. The 17 countries that participated in TEDS-M were Botswana, Canada (four provinces), Chile, Chinese Taipei, Georgia, Germany, Malaysia, Norway, Oman (lower-secondary teacher education only), the Philippines, Poland, the Russian Federation, Singapore, Spain (primary teacher education only), Switzerland (German-speaking cantons), Thailand, and the United States of America (public institutions only). Tatto et al. (2012:17) report that as knowledge demands change globally, mathematics

teaching in schools faces many challenges. They therefore collected empirical data to be used to inform policy and practice with regards to recruitment of quality mathematics teachers.

Teacher working conditions have an influence on the ability to recruit teachers. Where teachers have to deal with a lack of resources, overcrowded classrooms, heavy workload, poor infrastructure, and diversity of home languages and ability as experienced in Botswana and the Philippines, it is difficult to attract motivated quality teachers. The USA is reported as a country with a high degree of inequality with a high turnover of teaching staff. Chinese Taipei and Singapore are examples of countries where teachers have a high status compared to other public and private professional occupations and are supported by the government with favourable conditions, and good salaries and incentives. Malaysia provides special incentives for mathematics teachers to take up positions in remote areas. The teachers in the Philippines receive a salary close to the poverty threshold (Tatto et al. 2012:38-39).

Supply and demand varies from country to country. Singapore, Canada, Germany, Switzerland and Chile have a fairly balanced supply and demand situation, whilst some other countries have an oversupply of mainly generalist teachers. There is however a need to increase the number of well-qualified specialist mathematics teachers across all levels in Botswana, Malaysia, Norway, Oman, Philippines, and Thailand as reported by Tatto et al. (2012:40).

A qualitative study by Ashiedu and Scott-Ladd (2012:17-19) on teacher attraction and retention to address the future shortage of teachers in Australia in English as a second language, mathematics and the sciences, as well as filling posts in remote areas, concludes that the reasons for the attrition can be linked to what motivated the teachers in the first place to become teachers. Their sample consisted of five retired teachers who were interviewed by asking open ended questions and thirty-one current teachers who completed a questionnaire. Job satisfaction, which is influenced by extrinsic and intrinsic motivations, is one of the main reasons why people become teachers and remain in the profession.

3.2 The quality of teachers

Students entering the teaching profession need a quality education at secondary level and they have to be competent in the subjects they want to teach. The entry requirements for education students should be at a high level to ensure that the best possible candidates enter the profession. That will also enhance the status of teaching as a profession. Unfortunately teachers in some countries are regarded as individuals who did not perform at a sufficient level to pursue a more prestigious career. Egypt has introduced tougher entry requirements, an interview assessment as well as an entrance examination. In more affluent countries teacher candidates are selected from the top echelon of performers but in many poor countries candidates with poor academic background enter teaching. It should be noted that the quality of the teacher's academic qualification must be taken into account. Fehrler (in the EFA report 2015a:234) states that no correlation between teachers' academic qualifications and student achievement was found in a study of sub-Saharan Africa countries. The SACMEQ data from 2007 also found that a university education may not give teachers adequate knowledge of basic reading and mathematics. Governments need to adapt recruitment strategies to include candidates from the disadvantaged areas, while maintaining or improving standards. Good subject knowledge is imperative for a teacher to be efficient. (EFA 2015:234). The EU has identified the challenge of enlarging the pool of students to select candidates for teaching while tightening the criteria for the selection of these candidates. (EC 2012:29)

Teachers need to keep up to date with the latest research and must be provided with opportunities for professional development. " . . . teaching staff in the 21st century need a radically broader and more sophisticated set of competences than before " (EC 2012:5).

"Clear frameworks of teacher competencies are vital to ensure that all Initial Teacher Education programmes develop new teaching staff who can deploy a common core of teaching competences, and who have the capacities and motivation to carry on renewing these throughout their careers" (EC 2012:31).

What defines a quality teacher for the 21st century?

The charateristics of more effective teachers are given below:

Professionalism	Commitment, Confidence, Trustworthiness, Respect
Thinking/reasoning	Analytical thinking, Conceptual thinking,
Expectations	Drive for improvement, Information-seeking, Initiative
Leadership	Flexibility, Accountability, Passion for learning

Source: EC/ OECD 'Teachers' Professional Development: Europe in international comparison' 2010 (in EC 2012:26-27)

The EC working paper (2012:24-27) categorises the competences of effective teachers as follows:

- Knowledge and understanding of subject matter, pedagogical content, pedagogics, the curriculum, educational sciences, aspects of educational policies, inclusion and diversity, use of technology, developmental psychology, group dynamics and learning theories and assessment methods.
- Skills including the planning of teaching, the use of technology, managing groups, monitoring adapting and assessment, data handling, research techniques, collaboration with colleagues and parents, negotiation skills, the ability to adapt to different educational contexts and skills for learning.
- Dispositions which include epistemological awareness, be willing to change and be professionally developed, commitment to the learning of all students, promote students' attitudes and practices, being critical to one's own teaching, collaborative disposition and a sense of self-efficacy.

Babcock et al. state in the EFA report (2015b:237) that countries that performed best in the TEDS-M in 2007/08 , including Singapore and the Taiwan Province of China, offer a

better balance between training in subject knowledge and pedagogical training than other countries in their teacher education programmes.

The inequalities in the level of education and differences in the educational goals between developed countries and developing countries such as sub-Saharan Africa are vast. The majority of teachers in the EU are highly experienced and committed professionals.

3.3 Shortage of teachers in the South African context

The current shortage of teachers and problems with meeting future demand are global phenomena caused by high attrition rates and the diminishing number of young people choosing teaching as a career. South Africa is confronted by the same problem of teacher supply in specific subjects, phases and geographical regions.

3.3.1 General shortage

Roger Deacon, an independent education researcher reports (in McCarthy and Bernstein 2011:10) that "South African teachers are largely female (67%), mostly African (77%), older than 40 (67%), generally qualified (95%), and have more than 15 years' experience on average (53%)." Data released by the CDE report in March 2015 show that of the 425 023 teachers in ordinary schools in 2013, 296 292 were female (69.7%).

The Department of Basic Education reported on 18 May 2013 that there are 19 000 vacant teacher posts. In a quantitative study by Charles Simkins (2011:14-15) on the supply and demand of teachers up to 2050, where population growth and teacher production levels are compared, the researcher concludes that there will be a significant shortage of teachers, in key subjects such as mathematics, science, commerce and technology specifically.

Geyser and Wolhuter state (in Wolhuter et al. 2012:180-181) that only 34.5% of a certain year's intake of teachers was still in the profession after five years. Attrition is a major problem that needs to be addressed.

The age profile of teachers in South Africa is a concern because 45% of teachers fall in the 40 – 49 years range which is four times higher than the number between ages 30 and 34 (Simkins 2015:17-18). This difference is due to the decline in enrolments in education training institutions between 1994 and 2000. There will be a smaller cohort of experienced teachers to provide candidates for senior management positions in the near future.

The National Development Plan (NDP) of the South African government of 2011 recognises the need for "competent, highly qualified and highly motivated" teachers to be able to improve "education, training and innovation". Van Broekhuizen (2015:1,30) reports that the goals set by the NDP are threatened by " . . . an absolute shortage of teachers and a relative shortage of adequately qualified and competent teachers, particularly in key areas like mathematics and the physical sciences." The exact magnitude of the current and future demand for new teachers is however often uncertain. The predictions of the demand for new teachers by different researchers vary between 20 000 to 30 000 new teachers per year. These forecasts depend on various other factors such as increasing pupil enrolments and pupil to teacher ratio. The latter influence the quality of teaching and should be decreased significantly in order to improve learning, which will then lead to a higher demand of quality teachers. Van Broekhuizen (2015:31) thus concludes that South Africa is not currently fulfilling the demand for quality qualified new teachers.

3.3.2 Reasons for shortage

Van Broekhuizen (2015:1) recognises the need, as identified by the CDE and Arends, to investigate the reasons for the prevalent teacher shortages in South Africa and to find ways to rectify the problem. It is also necessary to determine how the current provision of teachers by IHE's will influence the supply of qualified teachers in the future.

- Closure of colleges

  The closure of the colleges of education contributed to the decline in the number of graduates of education. There was, as stated by Patterson and Arends (2009:xiii), a decrease in the output from teacher education from 1995 to 2004. Simkins

(2015:4) reports that the decline was caused by a misunderstanding of the 1995 National Teacher Education Audit findings. Some colleges were absorbed by universities, but the closure of most of the colleges resulted in a decrease in the number enrolments from black African students particularly. The main reasons were inaccessibility because of location, the perceived low status of teaching and the availability of more career options in various other occupations. The merging of colleges and education departments of universities as well as the restructuring of universities resulted in differences in the curricula and in the levels of quality in the training of teachers. Some of these universities were historically disadvantaged.

As students often enrol at institutions close to home, the unequal spread of HEI's between provinces may influence the enrolment figures for candidates from these provinces (Van Broekhuizen 2015:47).

- Severance packages

The South African government offered voluntary severance packages to teachers because of a perceived over supply of teachers in the mid-nineties. Between July 1996 and January 1997, 21 335 applications for severance packages were received, with 5840 received in December and 4763 in January 1997 (South African Government Information Statement 1997). This led to a decline in the number of students choosing teaching as a career.

- Loss of inspiration leading to absenteeism

Wolhuter, Van der Walt and Potgieter (2012:180-181) argue that the high attrition rate of teachers globally can be attributed to the loss of inspiration for teaching. Absenteeism, which is a serious problem, can be attributed by a low morale and poor work ethic, but also a lack of inspiration, as stated by Steyn et al. (in Wolhuter et al. 2012:180-181) who found that the rate of absenteeism rises to 25.5% in some historically black schools. The figure in historically white schools is 1.7% on average. Patterson and Arends (2009:1-2) state that the prevalence of HIV/AIDS is contributing to absenteeism because of illness and demoralization of the teaching

work force. The mortality rate because of HIV/AIDS is contributing to the rate of the attrition of experienced teachers.

- Migration

The migration of skilled professionals from South Africa is happening but data on the extent of the migration have not been verified (Bertram et al. 2006:1).They also state that the migration figures provided by Statistics South Africa (SSA) and the data from the five main destination countries do not correlate. Although no official figures of migration of South African teachers are available, Appleton and De Villiers (in Arends and Phurutse 2009:2) claim that a significant number of teachers have migrated from South Africa since 1994. Patterson and Arends (2009:13) found that 27.4% of newly qualified teachers were considering teaching abroad, but the majority indicated that they would return to South Africa within two years. Bertram et al. (2006:6-7) define the phenomenon of returning after two years as a "brain circulation" rather than a "brain drain" and found in their study that African teachers were the least likely to choose to teach abroad, while white and Indian teachers and primary school teachers are more likely to want to teach abroad. The three main reasons for the migration were ". . . the opportunity to earn a higher salary and to travel, followed by professional development. It appeared that these 'pull' factors (i.e. the positive aspects of teaching abroad) were playing a much stronger role than the so-called 'push' factors (i.e. the negative reasons for staying in SA), such as unemployment in South Africa, the crime rate and bad working conditions. "Just over a third of the newly qualified teachers in this study were choosing not to teach in South Africa, or not to teach at all" (Bertram et al. 2006:11).

- New generation

The fluidity of the career decision-making of young professionals is a characteristic of the "X and Y generations" as discussed by Mayer (2006:66-67). More teachers younger than 30 years resign in comparison to older teachers. "The notion of being a teacher for life has eroded" (Arends and Phurutse 2009:2,15).

- Misalignments

Simkins identified and reflected on misalignments in the supply and demand of teachers in the Foundation Phase, mathematics and languages in a CDE report (2015:22-24). He concluded that although the predicted total demand of teachers will be met by the supply at a learner educator ratio of 29.2 learners to one teacher for the whole system, misalignments with subjects and phases do exist which is a major concern. There is a shortage of Foundation Phase teacher graduates in all mother tongue groups, but graduates whose mother tongue is an indigenous African Language, is critically low. The proportion of African mother tongue pupils in the Foundation Phase in 2007 was 83%, but the expected proportion of Foundation Phase teacher graduates in 2009 with an African language as their mother tongue is 13%.

The worst shortage in the Intermediate Phase is in languages and mathematics. In the FET phase there is a shortage of language teachers, an oversupply of mathematics teachers and a shortage of mathematical literacy teachers up to 2017 according to the 2015 CDE report by Simkins.

Data analysed by Van Broekhuizen (2015:2) suggest that although the total number of teachers supplied in the near future may be sufficient, “it remains unlikely that the system will be producing the types of ITE graduates that are most needed in South African schools.”

- Career switching

The number of new ITE graduates differs from the number of potential new qualified teachers. Graduates may decide not to enter the teaching profession at all or they may not find employment as a teacher in their preferred geographical location and then find another job. According to the CDE report (2011) Van Broekhuizen (2015:32) states that more than 25% of all newly qualified potential teachers in South Africa are never employed as teachers in South African schools.

3.3.3 Factors influencing supply and demand

- Completion rates

Although the enrolments in ITE programmes have risen noticeably since 2006, also when compared to the increase in non-ITE programmes, the number of teacher graduates still does not meet the demand (Van Broekhuizen 2015:2). Over the period of his study (2004 to 2013) Van Broekhuizen (2015:13-17) found that the first time enrolments into education doubled, but the ITE graduations increased by only 49%. He concludes that "[t]he public Higher Education (HE) system was producing fewer ITE graduates in relative terms in 2013 than it did in 2004." It should also be noted that the increase from 2008 to 2013 of undergraduate ITE qualifications, which doubled, differ substantially from the increase in postgraduate qualifications, which tripled. Increasing the throughput rates will only have a positive effect on the supply of qualified teachers if a sufficient number of suitable students are recruited.

The University of South Africa (UNISA), a long distance HEI, has the largest share of First-time Enrolments (FTEN) in ITE of nearly 48% by 2013, but on the other hand the lowest throughput rates. UNISA students also take much longer to complete their studies. The overall increase of FTEN in South Africa since 2006 may be attributed to the increase of the UNISA enrolments (Van Broekhuizen 2015:18).

- Race and gender

Race issues play a major role in the discussion on teacher shortages. Patterson and Arends (2009:xii-xiv) report that there is a decline in the number of young African women in the enrolment into teacher education while the number of white females constitutes 50% of the cohort of under 26 year olds. They suggest that some of the young African women who would have opted for a teaching qualification in the past, now decide to enrol for studies in other professional fields. The implementation of the Employment Equity Act after 1994 opened more career opportunities for formerly disadvantaged citizens in South Africa. Crouch and

Lewin, and Peltzer et al. argue in Patterson and Arends (2009:15) that for ". . . black Africans the opportunities in the formal economy are opening up at a faster rate than in teaching" and that black education graduates were opting for other careers such as training and marketing.

Bertram et al. (2006:11) found in their research that about 75% of pre-service teachers were white and that former white schools recruit well-qualified teachers from schools in low economic areas leaving gaps in the poorer schools that are then filled by less qualified teachers.

Declining Black participation in ITE programmes was a concern in the early 2000's decreasing by about 50% between 2000 and 2006, but the FTEN for the group increased by more than 400% between 2000 and 2013 which is at a higher rate than the increase in other programmes. An estimate of comparative data for 2013 show that, of the 15 610 ITE graduates produced, 60% were Black, 8% Coloured, 5% Asian and 27% White. The data also indicate that although 61% of teachers in South Africa are female at present, the proportion of males compared to the other race groups was the largest in the Black group in 2013. "More than 33% of Black ITE graduates were male, compared to 23% for Coloureds, 15% for Asians/Indians and 17.5% for Whites" (Van Broekhuizen 2015:41). Van Broekhuizen suggests that Black males may be more partial to teaching as a career influenced by their weak secondary school performance limiting their choice of career or greater access to funding than other race groups. It is stated that 80% of all ITE graduates between 2004 and 2013 comprised of approximately 40% Black females, 20% Black males and 20% White females. These figures do not reflect the demographics of South Africa as a whole (Van Broekhuizen 2015:38-42).

- Home Language

The shortage of mother-tongue teachers especially in the FP is a major concern. The DBE estimated in 2011 that at least 4300 African, 750 Afrikaans and 450 English mother-tongue teachers should be produced per year. In 2006 only 50 and in 2009 only 168 African mother-tongue speakers specialising in FP were

produced. Van Broekhuizen (2015:45) suggests that the HE system is not producing enough African-language FP teachers and he predicts that the supply will not fulfil the demand in the near future. Secondary school exit examinations in South Africa are written in either English or Afrikaans. All African mother-tongue pupils must therefore switch to one of these two languages after they have completed their FP education.

- Geographical location

There is a general consensus that rural areas and poor communities experience the largest shortage of teachers. Van Broekhuizen (2015:46,52) reports that teacher production is unequal when comparing provinces. Gauteng, KwaZulu-Natal and the Western Cape provided 63% of all ITE graduates from contact HEI's in 2013. Geographical location has an influence on the willingness of teachers to teach in economically depressed communities because few teachers are prepared to work in difficult conditions. Rural provinces and schools consequently have problems recruiting and retaining suitably qualified teachers. These are the areas that produce poor results as measured by Grade 12 pass rates according to Arends and Phurutse (2009:41-42). The Rural Teacher Education Programme post third and fourth year primary teacher students to selected rural schools for in 'service learning' (Mitchell and Yang in EFA 2015a:8).

> *"It seems clear that the state needs to work actively to recruit more Africans to study to become teachers, as well as create incentives for teachers to work in rural schools and under-resourced schools (where the teacher shortages will probably be felt most acutely)."* Bertram et al. (2006:12)

- Socio-economic status

There is growing empirical evidence that ". . . good teaching makes a huge difference to learning, regardless of the socio-economic status of the learners" (Arends and Phurutse 2009:45). The authors state that formal structures, policies and strategies to recruit and retain teachers in South Africa do not exist.

Educational disadvantage and inequalities in education can be addressed by improving the skills, knowledge and competencies of beginner teachers. It is thus not just about recruiting more teachers, but more qualified and competent teachers according to Arends and Phurutse (2009:3).

- Recruitment of new ITE students

Van Broekhuizen (2015:22) highlights the status of teachers and the attractiveness of teaching as a career as well as the availability of financial support as factors influencing the recruitment of students into teaching as a career.

- Financial Aid

A contributing factor to the increase in the enrolments of students into Initial Teacher Education Institutions is the availability of the Funza Lushaka Bursaries which was introduced in 2007. The number of graduates from these institutions has increased from 6 978 in 2009 to 13 708 in 2012. The Funza Lushaka Bursary Programme is a multi-year, service-linked bursary scheme designed to raise the number of newly qualified teachers entering South African schools. The aim was to recruit students mainly from poor and/or rural areas.

The National Students Financial Aid Scheme (NSFAS) was introduced in the mid-1990's to assist disadvantaged students from poor socio-economic backgrounds financially. To boost the enrolments of ITE students, the DOE increased the proportion of NSFAS loans and bursaries allocated to students choosing to study teaching (Van Broekhuizen 2015:27-28).

- Retention of employed teachers

The low status of teachers in South Africa compared to other occupations has a negative influence on the long term commitment of teachers to the profession. The DOE in 2005 state the above as a reason why the attrition rates are higher than the graduation rates of new teachers. Van Broekhuizen (2015:22) draws on

research done by Deacon (2010), Armstrong (2009) and Manik (2014) to list some of the factors that influence the retention of teachers: “poor working conditions, low levels of job satisfaction, lack of career advancement opportunities, overcrowded classrooms, inadequate parental involvement and support, excessive administrative duties, and perhaps most importantly, comparatively low salaries.”

3.4 Quality of teachers in South Africa in general

The continual higher competency levels required in the rapidly changing global labour market give rise to higher expectations of the quality of teachers. Teachers in future therefore need to be competent in all aspects of knowledge and understanding of their specialisation areas and have the skills to be an effective teacher that “ . . . also draws upon key personal qualities, attitudes and values” (EC staff working document 2012: 22-26).

What is a quality teacher? The World Summit on Teaching noted in the EC staff working document (2012) that teachers cannot just focus on the skills that are easy to teach and test, but must assist pupils to acquire “ . . . ways of thinking (creativity, critical thinking, problem-solving, decision making and learning); ways of working (communication and collaboration); tools for working (including information and communication technologies); and skills around citizenship, life and career and persona and social responsibility for success in modern democracies” (EC staff working document (2012:22).

“The challenges facing Teacher Education and Development (TED) in South Africa are considerable. They include a lack of access to quality TED opportunities for prospective and practising teachers; a mismatch between the provision of and demand for teachers of particular types; the failure of the system to achieve dramatic improvement in the quality of teaching and learning in schools; a fragmented and uncoordinated approach to TED; the tenuous involvement of teachers, their organisations and other role-players in TED planning; and inefficient and poorly monitored funding mechanisms” (The Department of Basic Education and Higher Education and Training 2011:1).

According to Shen, Mansberger and Yang (2004:227), teacher subject specialisation knowledge is affected by the teacher's academic ability, impact of teacher preparation programs on teacher effectiveness and certification standards which all contribute to student achievement.

Two thirds of the teaching force has a three years tertiary education qualification. The current requirement to qualify as a teacher is an M+4 qualification (either a B Ed or an undergraduate degree plus a PGCE).

A review by the HEQC revealed that the minimum standards were not met by the majority of HEI's. The policy on "The Minimum Requirements for Teacher Education Qualifications" was then developed in 2011 to standardise and increase the quality of the education of teachers. The focus is on subject content knowledge, pedagogical content knowledge and a much needed larger emphasis on practice teaching training (Simkins 2015:6-7).

One of the major contributions to the quality or lack of quality of teachers is the difference in the admission criteria for different teacher education courses. A student who follows the PGCE route must be graduated to be accepted into the PGCE programme. The admission criteria for the four year B Ed programme at most universities is lower in comparison with most other disciplines and therefore attract weaker students (Simkins 2015:7).

Of those who enter the teaching profession each year 48% are returning to teaching and are typically less qualified than the newly graduated students. Two thousand more qualified teachers left the system between 2012 and 2013 than those who were added. Of the 40-year old teachers who left 93% were qualified and 56% of 40-year olds who returned were qualified. To improve the average number of qualified teachers in the system, current qualified teachers should be retained according to Simkins (2015:18).

The qualifications of teachers in South Africa in 2013 as reported by Simkins (2015:18):

Table 3: Qualification Levels of Teachers

Level of Qualification	Percentage
Unqualified	19%
M+3	66%
M+4	15%

3.5 Shortage of Mathematics teachers in South Africa

The need for more pupils to complete their secondary education will increase teacher demand in the future as stated by Patterson and Arends (2009:1-2). They also conclude that the chronic shortage of mathematics and science teachers affects specifically rural schools and schools in lower socio-economic areas.

McCarthy and Bernstein (2011:10) note that research has shown that the scarce subjects are mathematics, science, technology and languages. There is also a need for Foundation Phase (grades R-3) and Intermediate Phase (grades 4-6) teachers, ELSEN teachers, and teachers in rural schools. The extent of these shortages and the most critical shortage have not yet been established by 2011. Poor matric results in mathematics and physical science (physics and chemistry) can be ascribed to the shortage of mathematics and science teachers and the lack of pedagogic skills to teach the subject and knowledge of the subject (McCarthy and Bernstein 2011:10). The 2015 CDE report by Simkins has fulfilled the need for information by collecting and analysing data on the shortages and the supply of and demand for teachers in South Africa.

McCarthy and Bernstein (2011:8) drawing on the 2007 McKinsey report, and other major studies, conclude that "[n]o schooling system can rise above the limits imposed by the quality of its teachers." In South Africa this is an alarming conclusion in the light of the short supply and poor quality of many science and mathematics teachers. They also refer to a recent study where about 60% of 73 Science teachers in South Africa's Dinaledi schools (schools which are provided with additional resources in physical

science and mathematics) in North West and Kwazulu-Natal lack basic problem solving skills.

> *"Researchers and government agree that the subject content knowledge and pedagogical knowledge of most South African teachers is poor and that this is a major cause of inadequate learner achievement" Simkins (2015:3).*

Insufficient numbers of graduates in mathematics are choosing teaching as a career. According to Adler and Davis (2006:276-277) the number of PGCE students with mathematics as a subject has decreased from 1996 to 2006. One of the biggest challenges that face mathematics teaching in South Africa is the lack of mathematical subject knowledge as well as pedagogical knowledge of teachers of all phases. A lack of in-depth knowledge leads to teachers teaching only what they know well, and teaching procedures rather than reasoning and the understanding of mathematical concepts (Adler and Davis 2006: 277,290).

Engelbrecht and Harding (2009:73) state that the shortage of qualified mathematics teachers is a major concern. The mathematics "teacher talent pool" is drained by the private sector offering higher salaries, performance based compensation and more opportunities for promotion. The researchers believe that the lack of career counselling about the possible careers for mathematics graduates is problematic. A study on the trends in the number of students with mathematics as a major subject at 15 universities in South Africa was conducted in 2000 and followed by a further study of 12 universities concluded in 2009. They reported a decrease in the number of mathematics majors during the first study which was followed by an increase in the period 2000 to 2007. The number has however decreased again from 2008 to 2009. According to Wolmarans et al. (2010:274-275) in their analysis of first-year student performance in mathematics and physics at UCT, only 16% of the 20 – 24 year olds in South Africa took part in higher education by 2005. This is an improvement since the end of apartheid, but not nearly sufficient to fulfil the demand for these graduates. The pool from which science and engineering students are chosen is even smaller since only 7.9% of the 2008 matriculants achieved more than 60% for mathematics. This cohort represents the top

performers in mathematics, however, when 906 first year engineering and 648 science students wrote the mathematics National Benchmark Test at the beginning of 2009, only 7% of the engineering students achieved at the 'proficient' level and 20% had only basic mathematical skills. The 2008 NSC examination was the first examination for the pupils who followed the OBE curriculum from the beginning of their school career. The pass rate of these top students for mathematics in their first semester at university is alarmingly low. After testing the stability of the university's mathematics course by comparing the mid-year mathematics results of students who wrote international school examinations from 2005 to 2009, it can be concluded that the level of the university's mathematics course did not change. The pupils who wrote the South African NSC examination's pass rate dropped from 41% in 2005 to 18% in 2009 while the group that wrote international school examinations' pass rate increased from 34% to 42%. Wolmarans et al. (2010:277-281) report that the decline of the performance of students in Mathematics at UCT actually began before 2008 and cannot be attributed to the OBE syllabus only. Data on the effect of the new Curriculum Assessment Policy Statements (CAPS) syllabus should be available soon. The first group of CAPS pupils wrote their NSC examination in 2014. The overall poor performance of first year students and the small pool to choose graduates from lead to the shortage of mathematics graduates in South Africa from which mathematics students with the necessary subject knowledge can be recruited to choose teaching as a career.

The poor results of the ANA's indicate the urgency in the need for improving the mathematical skills of pupils at pre-secondary level by improving the competency of mathematics teachers. The mathematical knowledge and instructional skills of teachers must be developed by improving the education of mathematics teachers at teacher training institutions and the continued professional development of the current teaching force.

The Department of Basic Education (DBE) stated in July 2015 that only 4484 of the 5927 (that is 75.7%) schools in South Africa offer mathematics as a subject in Grades 10 to 12. The remaining quarter of the schools offer mathematical literacy only, which excludes those students from studying university courses where mathematics as a

subject is a prerequisite. In the Bohlabela district in Mpumalanga (one of the nine provinces in South Africa) only 10 of the 128 schools offer mathematics in the FET phase. The Western Cape has the highest number of schools offering the subject, namely 91.1%. The other provinces' figures are Eastern Cape at 63.4%, Northern Cape at 69.8%, KwaZulu-Natal with 72.8%, the Free State with 80.3%, the North West Province at 84.9%, Limpopo at 85.8% and Gauteng with 89.5%. The DBE cites "non-availability of qualified competent teachers" of FET phase mathematics as a reason for a quarter of the schools in South Africa not offering mathematics as a subject.

The attraction and recruitment of able mathematics students and the retention of qualified, competent mathematics teachers is therefore a field of study that could provide information to the policymakers and planners to improve the overall performance of mathematics.

3.6 Factors influencing international students to choose teaching as a career

Konig and Rothland (2012:289) state that motivation is an essential part of professional teachers. Teacher shortages worldwide led to studies on factors influencing young people to choose teaching as a career, also explaining the high attrition rates.

Research over the last five decades has presented very similar motivations for choosing teaching as a career. Up to the development of the FIT choice scale as a theoretical scale that could be used internationally, the methodologies used lacked validity and restricted comparisons between countries. This led to contradictory results according to Hovatter (in Patterson and Arends 2009:6-7) because different research questions were formulated leading to a wide variety of factors and different populations in the research. The studies were also based on instruments which were pre-coded and depended on the factors included by a specific researcher. The factors used were not weighted, therefore the relative importance of the factors were not determined. Jarvis and Woodrow (2005:29) used an open-ended approach to cover any factors that were not part of the pre-coded instruments.

In the 1990's Brookhart and Freeman reviewed the findings and suggested (in Watt et al. 2012:792) that ". . . altruistic, service-oriented goals and other intrinsic motivations are the source of the primary reasons entering teacher candidates report for why they chose teaching as a career".

Factors influencing African American students to become Adapted Physical Education (APE) teachers were investigated by Webb (2003:146-147) and the researcher found that early professional exposure to APE and increasing African American role models in this specific field were the two factors that influenced the choice of becoming an APE teacher . The results can however not be generalised and the number of factors considered is limited. By asking students from Manchester Metropolitan University training for secondary-level teachers in a survey to give the one reason why they have chosen to study teaching, Jarvis, J. and Woodrow, D. (2005) divided the factors into six categories: Love for subject (16%), stable/challenging/rewarding career (45%), want to work with children (12%), always wanted to teach (10%), change in career (4%) and enjoy teaching (6%). They did find that 68% had considered an alternative career. Trainees in the scarce subjects of mathematics, science, design and technology, and modern foreign languages were more interested in career switching and placed more value on financial incentives, career structure, and employment security.

Watt, Richardson, Klusmann, Kunter, Beyer, Trautwein, and Baumert (2012:791) believe that the need to understand the motivations for students to choose teaching as a career and to stay in the profession, has increased "as teacher's daily job has become more complex and demanding". Teachers have to contend with increasingly "diverse student populations, higher social expectations of schools, expanding fields of knowledge, and new types of responsibilities" according to the OEDC (2005) report (in Watt et al. 2012:791).

Resources, the curriculum and leadership are important factors influencing the quality of teaching, but the teachers in the classroom are the driving force. There are numerous factors affecting the decision to choose teaching as a career and to stay in the job namely wages, work conditions, job location, ease of entry into teaching and teacher

self-efficacy as stated by Loeb and Myung (2010:473). The factors that influence, motivate and inspire people to choose a particular career have been studied by vocational and behavioural psychologists over the years. The decision is complex and maybe not always completely rational. They argue that the decision to choose teaching as a career can be influenced by policy decisions, labour market impacts, and also " . . . individual's abilities, interests, values, options, advice and opinions of family and friends" (Kilinc et al. 2012:199).

A large number of students choosing teaching as a career are motivated by the satisfaction of helping children learn, to assist them to fulfil their potential and become good citizens of the world. Some of them have been motivated by their own teachers to forward their subject knowledge and passion for learning to young people (EFA 2015a:233 – 234).

3.6.1 Intrinsic, Extrinsic and Altruistic Motivations identified

According to Watt and Richardson

> *". . . the highest rated motivations for choosing teaching included perceived teaching abilities, the intrinsic value of teaching, and the desire to make a social contribution, shape the future, and work with children/adolescents. The lowest rated motivation was choosing teaching as a 'fall-back' career, followed by social influences of others encouraging them to undertake teaching as a career. Other motivations were rated in between for the desire to enhance social equity, having experienced positive prior teaching and learning experiences, job security, job transferability, and time for family" (2006:44).*

These can be categorised as stated by the OECD (2005) (in Watt et al. 2012:792) where researchers

> *". . . highlighted intrinsic, extrinsic and altruistic motivations as the most important groups of reasons influencing teachers' career choice. Identified motivations have included working with children and adolescents, making a social contribution, making a difference, job security, job benefits, enjoyment of*

teaching, compatibility with other interests and activities, compatibility with family life, and self-education" (Watt et al. 2012:792).

According to the 2005 OECD report (in Watt et al. 2012:792), studies in France, Australia, Belgium (French Community), Canada (Québec), the Netherlands, the Slovak Republic, and the U.K. suggest that " . . . a desire to work with children and adolescents, the potential for intellectual fulfilment, and a means by which to make a social contribution," are rated as the main reasons for pursuing a teaching profession. Studies in other different socio-cultural contexts e.g. Zimbabwe, Cameroon and Jamaica, show that so-called extrinsic factors such as remuneration, employment security and professional status are important motivators in choosing teaching as a career according to Watt et al. (2012:792).

Watt (2006:46) infers that pre-service teachers rate teaching as a career requiring very hard work with high emotional demand whilst having a low social status with a low salary. They also indicated that teaching requires a high level of expert and technical knowledge. The satisfaction ratings of their career choice are high on average.

Contrary to research in the 1960's by Haubrich in Watt (2006:51) and the general public opinion, most pre-service teachers do not choose teaching as a fall-back career nor are they persuaded by others to become teachers.

Mayer (2006:58) argues that the ageing population in Australia due to lower birth rates and larger longevity will have an impact on the teaching profession, which is also older than the rest of the professional workforce. He asks the following about the younger generation:

> *"Do they have similar aspirations and expectations of career and profession as those who are tracking towards retirement? What will attract younger generations of people to the teaching profession? And more importantly, what will sustain them in a teaching career?"* Mayer (2006:58).

Mayer (2006:58-59) refers to three cohorts of generations: the so-called Baby Boomers (born from around the mid 1940's to the mid 1960's) and the GenXers (born 1965-

1979/80) whereas a third generation, generation Y is entering the workforce. Mayer discusses the influence of the different generations' characteristics on their decision to study teaching as a career and focuses on Generation X. Mayer (2006:66-67) lists the characteristics of the younger generation as more likely to: value family and personal values more than high income, have high aspirations and therefore may change jobs often, perceive their job as being fulfilling and an opportunity for advancement, take a non-linear route from their training to their job, want to be trusted and work independently, be more tolerant for social differences, and seek opportunities to be lifelong learners. The teaching profession will therefore need to provide opportunities for flexible movement and work practices within the teaching profession, autonomy in their work practices and career progression by providing scope for development beyond the classroom. It is now seven years later and generation Y is already entering the job market. What are the characteristics of the new generation?

A current career trend is the expectation and likelihood of new entrants to the job market to have multiple careers during their lifetime. It can therefore not be assumed that the younger generation of teachers will remain in teaching their whole life. Teaching has also been affected by changes in the nature of work. The new fluid work order involves more flexibility, changing employers more frequently and career advancement based on individual learning related portable skills rather than on years of service in one company. Teachers may therefore decide to change careers when they have fulfilled their professional goals (Watt 2014:38).

3.6.2 Applications of the FIT-choice scale

- China

  Similar and differing initial motivations to teach between samples of 257 pre-service teachers from a university in the USA and 542 from another university in China using the FIT-Choice scale was examined by Lin et al. (2012:238-240). In the USA high attrition rates, shortage of qualified teachers and high turnover rates, specifically in low-income sectors of the population, motivate the study. Although teaching in China has a higher status, teacher shortages and high attrition exist in

the rural areas, especially in developing areas, as stated by Lin et al. (2012:228). The different contexts of the two countries is explained by Lin et al. (2012:230-231) as USA public schools being decentralised and teachers have autonomy about content and teaching methods whereas the Chinese teachers work in a centralised context and follow a centralised curriculum. The Chinese teach collaboratively, have larger but fewer classes whereas the teachers in the USA work more in isolation. "There is a mutual and unquestioned expectation from teachers, parents and students themselves that students should be motivated and achieve success through the exertion of effort and hard work to grasp content knowledge" in China (Lin et al. 2012:231). The findings infer that both groups rated teaching as low in status and salary, but differ in demand. China rated teaching to be lower in demand than the US. The US pre-service teachers reported higher motivations from social utility values, teaching abilities, intrinsic career value, and prior teaching and learning experiences whereas the Chinese sample reported higher fall-back career motivations (Lin et al. 2012:237-240).

- Netherlands

Fokkens-Bruinsma and Carinus (2012:251) investigated whether the FIT scale is suitable in the Dutch context and they examined the relationship between motivations and affective professional commitment by comparing two cohorts of pre-service teachers at the start and at the completion of their studies. They concluded that the main factor to motivate the pre-service teacher was self-perception of teaching-related ability and did not rank the salary and status high. The FIT-Choice scale was found to be suitable. The relationship between motivations and professional commitment was illustrated by the conclusion that more time with family will give less time for professional commitment and that the factors "working with children, prior teaching and learning experiences and ability" contributed to the level of affective commitment (Fokkens-Bruinsma and Carinus 2012:262-264).

- Croatia

Croatia also faces problems with a shortage of quality teachers and an ageing teaching population. Previous research by C˘udina-Obradovic (in Jugovic et al. 2012:272) resulted in the emergence of the importance of intrinsic, altruistic and extrinsic influences on the choice of teaching as a career in Croatia. "Motivation and Personality of Pre-service Teachers in Croatia" as studied by Jugovic et al by using personality dimensions of the five-factor model (neuroticism, extraversion, openness to experience, agreeableness and conscientiousness as developed by McCrae and Costa) linking personality dimensions to the aspects of factors that influence students to study teaching. The study by Jugovic et al. (2012:274) can provide information to career counsellors to "fit" person and profession as they expect that intrinsic and social utility values will be linked to high scores on extraversion, openness and agreeableness and neuroticism to extrinsic motivators such as task demand and task return. Although "conscientiousness is not conceptually related to the specific occupational demands of the teaching profession, but has been consistently the most predictive dimension for overall performance and intrinsic satisfaction across occupations" as stated by Barrick & Mount,; Judge, Higgins, Thoresen, & Barrick (in Jugovic et al. 2012:274). The findings of the study by Jugovic et al. (2012:282) by using the Croatian version of the FIT-Choice scale show that in practice "more extroverted, agreeable and conscientious individuals are likely to be more intrinsically motivated for teaching" and that "preservice teachers who have different personality traits have somewhat different motivations for becoming teachers and thus could require a different approach during their preservice teacher education."

- Germany

Konig and Rothland (2012:289-290) investigated how future teachers in Germany endorsed the motivations identified by the FIT-Choice scale and also the relationship between the motivation of pre-service teachers and their general pedagogical knowledge (GPK) by testing pre-service teachers twice using the

TEDS-M instrument. The authors believe that research on motivation should, together with determining the “why” teachers choose the profession, also study the motivation for their professional development. It was alleged that strong intrinsic motivation may lead to more interest in development of their own knowledge than teachers with higher extrinsic values. The perception that only intrinsic or altruistic values are important for teachers is challenged by the research that shows that extrinsic motivation also play a role and should be considered when recruiting students to become teachers. The motivation that teaching is seen as a fall-back career changed between the first and second study by Konig and Rothland. Evidence is given that intrinsic motivation is positively correlated with GPK and extrinsic has a negative correlation with GPK after the first test. However extrinsic motivation has a positive effect on learning gain in contrast with intrinsic motivation (Konig and Rothland 2012:292-293,306).

- Switzerland

Watt (2012:194-195) refers to the study by Berger & D’Ascoli about investigating the determinants of career choice in becoming a VET (Vocational Education and Training) teacher among 483 German- and French-speaking Swiss VET teachers. The career switchers who were motivated by social utility value perceived their previous job as socially important and those who were motivated by more time for family, reported that their previous job had good working conditions. They are therefore not changing jobs because of dissatisfaction with their previous job. They see the switch rather as career development.

- Australia

Over a third of the students graduating to become teachers, according to research done by Watt (2006:50) at three universities in Australia, are career switchers and come mostly from entertainment and science and technology fields. More than 50% of them came from careers with similar occupational status.

- Turkey

In Turkey Topkaya and Uztosun (2012:129-131) using an adapted FIT-Choice model, aimed in their study to identify the motivations for pre-service teachers to study English as well as finding correlations between motivations and gender and motivations and grade levels. Overall, the sample in this study featured high levels of career motivations. Therefore, it could be concluded that in terms of occupational motivations these student teachers were enthusiastic to enter teacher education with social utility values and intrinsic career values rated the highest which is contradictory to the extrinsic values that are prevalent in developing countries according to Klassen et al. (in Topkaya and Uztosun 2012:130-131). The participants in the study rated fall-back career the lowest indicating that teaching is not a poor choice. This correlates with research on other subjects. They rated the influence of prior teachers as role models as one of the main reasons for choosing teaching as a career. No statistically significant relationship between career choice and gender was found although males did emphasise financial rewards, job security and lengthy holidays as important factors. There was also no significant difference between grade levels.

The FIT-Choice model was used in Turkey (as a non-Western society) to investigate the motivations in the Turkish socio-cultural context, focusing on the STEM subjects among pre-service teachers training to become teachers for different age-groups. Given the oversupply of teachers in Turkey and the high entry scores of prospective students, the possibility that teaching is a fall-back career was expected by Kilinc et. al (2012:206). They found that the two most important factors are altruistic social utility values and a secure job. The first factor can be explained by the collectivist culture in Turkey and the second is more typical in developing countries where young people from lower income families may strive for job security. Good teacher role models are important because their own teaching and learning experiences play an important role in their choice of a career. Time for family and job transferability were rated moderately followed by the influence of friends and others to choose teaching as a career. Science-related

teacher candidates scored higher on fall-back career and were lower on almost all other teaching motivations. It is therefore important to focus on recruiting young people for the science-related field in teaching (Kilinc et al. 2012:216).

3.6.3. Culture

Klassen, Al-Dhafri, Hannok, and Betts (2011:579-581) asked whether " . . . motives for teaching vary according to cultural context". Their study enquires the motivation of pre-service teachers to teach in Canada and Oman in order to determine whether the motivations are universal or culture specific. These two countries have different educational, cultural, religious and social contexts. They applied the FIT-Choice model and Hofstede's theory of cultural values and dimensions which is defined by Hofstede and McCrae (in Klassen et al. 2011:580-581) as "the collective programming of the mind that distinguishes one group or category of people from another". Hofstede defined cultural beliefs and practices as "power distance, uncertainty avoidance, individualism, masculinity" and later added "long term orientation." The first three were chosen by Klassen et al. (2011:581) to examine the motivation of pre-service teachers. They concluded that pre-service teachers from different cultural backgrounds do have some similar motivations to choose teaching as a career, namely perceptions of competence, intrinsic career value, and reasons of personal utility. Omani pre-service teachers however valued socio-cultural influences as a significantly stronger source of career motivation than the Canadians. The findings of the above research are important for policy makers. Teachers of certain cultures may connect with pupils in a more formal way than others, but may still be an excellent teacher. It is very important to be aware of the differences in the motivation to become teachers in different cultures (Klassen et al. 2011:587).

Kyriacou and Coulthard found (in Lai et al. 2005:155) that altruistic, intrinsic and extrinsic reasons were prevalent in choosing teaching as a career. Previous studies were mostly culturally specific to Western Societies. Lai et al. (2000) did a pilot study of sixth-form students in Hong Kong and found that 50% of sample students were interested in considering teaching as a career. The students perceived teaching as a respected career with adequate salaries similar to the population in China and Taiwan,

but contradictory to previous findings in Western Countries according to Johnston et al. (in Lai et al. 2005:156). Lai et al. (2000) also found that gender, academic performance and streams of study influenced interest in teaching as a career.

A longitudinal study over a four year period about the experiences of small group of British Asian women on an Initial Teacher Training (ITT) secondary Postgraduate Certificate in Education (PGCE) course in the West Midlands of the UK was done by Butt et al. (2010:70) to determine why most of the minority ethnic students in teaching completed the course. They also wanted to gain further knowledge to promote careers in teaching within this community. Previous research showed that too few young people from minority ethnic groups enter into teaching and therefore these teachers have insufficient influence in the education of children from these groups. Other reports show that teacher trainees from minority groups often do not complete their studies, they experience their training as being negative, they perceive to have limited career prospects and they fear racism. These fears are deterring them from choosing teaching as a career. The researchers wanted to determine how much the minority group's ethnicity influenced their choice of teaching as a career. The findings from the first year of the study were in contrast to previous studies in that the cohort of British South Asian women in the sample as well as their family and community experienced teaching as having high professional status. They reported that teaching as a career allowed them to balance their work and family life and give them the opportunity to change their social status. Bhopal (in Butt et al. 2010:76) concludes that "for some South Asian women education acts as a catalyst for women's access to the labour market and their route to independence." Most of the trainees in the sample indicated intrinsic motivations to teach. Teaching as a career for men, however, still does not have the same appeal and status. The students did not agree with a quota system to ensure that more students from other ethnic groups must be enrolled. They felt nervous because they did not know whether they were accepted on merit or to fill a quota (Butt et al. (2010:69-70,76).

In the longitudinal study by Butt et al. (2012:190-191) interviews were again conducted in their Newly Qualified teacher year and also in their third year of teaching. The questions focused on whether the respondents' original thoughts about teaching have

substantially changed. The findings suggest that they have not changed their opinions significantly. These include: career advancement and an acceptable work-life balance. They also did not experience any racism.

The motivation of teachers to teach in special and inclusive education and their motivation for professional development in China was investigated by Feng (2012:333,338) using the Self-Determination Theory (SDT) model. This model measures motivations on a scale of intrinsic, extrinsic to amotivation. China has been focusing on special and inclusive education only after 1980. In the past the Chinese government assigned jobs to school leavers, but since the 1990's the job markets were opened to young job-seekers. Although education and teachers had a high status in China in the past, the majority of school leavers did not see teaching as a preferred career. The Chinese government decided to improve the status of teaching which resulted in an increase in the supply of teachers and they also offered incentives to lure teachers to be deployed in rural areas. Feng found that in special and inclusive education, teachers were mostly extrinsically motivated and would prefer to have a different job or teach in a mainstream school. However, as they gained more experience, they had less concerns about their jobs. Although the training is not sufficient and they did not initiate further development: "Teacher career motivation in special and inclusive education is country- and culture- specific. Western values such as individualisation, self-advocacy and diversity have not as yet found equivalents in China" Feng (2012:334).

Career choices are influenced by the culture of the society that people live in according to a study of the career identities of first-year female coloured students by Ackerman and Botha (in Geldenhuys and de Lange 2007:127).

3.6.4 Gender

In the US according to (Allen 2005:v) 79% of the teachers corps are female. Women choose teaching as a career because it gives them the opportunity to leave the job temporarily to raise a family. Patterson and Arends (2009:16) conclude that a teacher returning to teaching does not experience the same "depreciation of their human

capital" as in other career fields – the salary scales are fixed. They note however, that in the USA more educated women are choosing careers traditionally dominated by males.

Butcher and Lewis found (in Lai. 2005:161-163) that male students in year 12 were more influenced by status, salary and career opportunities whilst Lai concluded that more females (55%) than males (47%) were interested in teaching in Hong Kong.

Enrolments at the three universities in Australia are mostly females with early childhood teacher education almost exclusively female, increasing for primary school teacher education and for secondary education more than 50% are female (Watt 2006:30,40). To increase the ratio of male to female teachers, policy makers need to know that men and women are motivated differently when choosing teaching as a career. The perceived low salaries of teachers deter men to choose to become a teacher. The South Asian population in the UK does not perceive teaching as an appealing career for men as noted by Butt (2010:77).

According to the World Bank (2005:4) one third of girls in Turkey did not attend school versus only one tenth of boys. Kılınç et al. (2012:217-218) explain that although equal rights for women are guaranteed legally, they still experience inequalities in practice and because teaching is seen as a female job in Turkey, the motivations between males and females to choose teaching as a career are different.

> *". . . women were more satisfied with their choice of a teaching career than men, less likely to choose it as a fall-back career, and reported less experience of social dissuasion, perhaps because they were more intrinsically motivated and might consider that they are enacting a role which society expects and values. They also regarded teaching as a more expert career and higher in task demand" (*Kılınç et al. 2012:218).

Policies to attract more males into teaching because of the declining numbers have been initiated in Malaysia. Azman (2013:114) investigated the initial motivations of males and females to enter the teaching profession. To determine the factors why they choose teaching as a career is of essence in developing economies with competitive job

markets. Azman (2013:116) surveyed both male and female pre-service teachers as well as sixth form pupils and states that The Ministry of Education and higher education institutions in Malaysia are focusing on the recruitment of well-qualified students to be trained to enter the profession. The decline in male teachers are caused by perceptions that teaching is a career for females and the lack of male role models as reported by the Ministry of Education (in Azman 2013:117-118). Male role models are needed to reduce disciplinary and learning problems with boys and can also help to break down traditional gender stereotypes as alleged by Connell; Brophy; Zalizan et al. (in Azman 2013:117-118).

The findings of the study by Azman (2013:125-126) show that gender influences the choice of teaching as a career and that the factors can be classified as altruistic, intrinsic and extrinsic. A few of the factors are culture specific, but some of the factors may be similar in other cultures and can be used to specifically attract more males to the profession. One of the negative factors influencing men not to be interested in teaching is the lower social status of the profession over the last 15 years. Both males and females have mainly positive perceptions about teaching and their rankings were similar across all three motives. Azman (2013:127) suggests that all concerned should make a concerted effort to change the image of teachers and schools to enhance the status of teaching as a career. Extrinsic factors should also be emphasised in the recruitment of teachers. ". . .emphasize teaching as an intellectually demanding, cognitively stimulating career and as a profession in which men can realise their talents and abilities would likely be a more prominent factor in attracting men to enter the teaching profession."

> *"Only when male teachers feel secure and not 'out of place', and when they derive satisfaction from their work in school, will promising high school and young male adults start considering the possibility of becoming future teachers"* Azman (2013:127).

Azman (2013:127) suggests that the results of the survey should be correlated with the results of a Meyers–Briggs personality indicator to see if there are significant differences

between males choosing education as a career and males choosing other fields, and to do further research by using comprehensive qualitative methods and longitudinal studies.

3.6.5 Income groups and institutional setting

In Hong Kong students from families with higher average monthly income were less interested to choose teaching as a career (Lai et al. 2005:162). In Australia Watt (2006:50) determined that prospective teachers generally come from a lower socio-economic status family.

The training institution plays a role in the decision to choose a specific career in Switzerland. Pupils from more academically inclined families mostly opt for university studies in order to teach in secondary schools. More females and pupils from lower income groups choose a teachers college where primary and lower secondary teachers are trained (Denzler and Wolter 2009:434-438).

People who choose teaching in Turkey according to Kilinc (2012), often come from families with middle to low levels of socio-economic status and lower levels of educational achievement.

3.6.6 Academic ability

According to research in Allen (2005:v) graduates with the highest intellectual ability are less likely to choose teaching as a profession. Lai et al. (2005:162) conclude that in Hong Kong 60% of pupils with low university admission rates were interested in teaching, 46% with medium rates and 48% with high admission rates. In Finland, however, teaching is a sought-after profession and only 10% of applicants for positions in teacher education can be accommodated. Teaching is also perceived as a prestigious profession and top academic achievers choose teaching as a career as Sahlberg (2011:71) expresses in his book. One of the reasons why top high school leavers are attracted to teaching in Finland is that they are challenged enough in the teachers education programme because it requires a master's degree (Sahlberg 2011:77). See (2004:225) construes that high performing students tend not to choose

teaching as a career due to a perception of low remuneration. Offering bursaries may not influence them to study teaching. See therefore suggests that to improve retention teaching must be perceived as a satifying and financially worthwhile career and have long term prospects of a higher status to attract high-quality students. Recruitment campaigns should emphasise factors that are seen to be important in students' career choice.

Students in South Africa who choose teaching as a career obtain lower marks in admission tests than students who want to enrol for other courses, therefore they possibly choose teaching as a last resort (Wolhuter et al. 2012:182).

Governments' policies on quality assurance have a direct effect on the quality of pupils performance in mathematics. Chinese Tapei and Singapore are countries that "ensure the quality of entrants to teacher education, but also have strong systems for reviewing, assessing, and accrediting teacher education providers. They have also developed strong mechanisms for ensuring that graduates meet high standards of performance before gaining certification and full entry to the profession" (Tatto et al. 2012:54).

Tatto et al (2012:101) report that a limited number of education courses internationally attract students from the top performers of their class. Future teachers were rated as average or below-average achievers in mathematics by the respondents in the study.

The mathematical knowledge that future teachers have was investigated by Tatto et al. (2012:129) because it influences the mathematical performance of their students. They believe that the level and depth of their mathematics knowledge at the end of their teacher training is a measure of the success of their training as mathematics educators.

> *"I chose to be a teacher because I believe that education has the power to transform the society we live in. What motivates me to be a good teacher is to be an active agent in this change that is so necessary for my country, to fight against discrimination, injustice, racism, corruption and poverty. Our responsibility as teachers is enormous, and our commitment to provide quality education must be renewed every day. – Ana, teacher, Lima, Peru"* EFA (2015a:233)

The EFA report concurs by reporting that the 2011 TIMMS results for Grade 4 from 45 countries found that the better the quality of the teacher, the better the achievement of the pupils. A student in Poland from a school with poor quality teachers was 25% more likely to achieve below the mathematics benchmark when compared to a student from a school with good quality teachers. The effect on pupils in Turkey where 42% of schools have low quality teachers is even larger. It is therefore important to attract the best and most motivated students to study teaching in order to improve the performance of pupils in mathematics. Teaching is seen as a fall-back career for academically under-achieving pupils in some countries and therefore does not attract the best candidates into teaching. An imbalance in gender, the disabled, ethnic minorities, people with disadvantaged backgrounds or people from conflict-affected areas in the composition of the students that are recruited often occurs. The challenge is to attract the right mix as well as high quality teachers (EFA 2015a:233 – 234).

The positive effect of good teachers on learning and achievement is larger on pupils from low socio-economic backgrounds according to Nye et al. in EFA (2015b:1). "…qualified, well trained and supported teachers can enable poor and marginalised children overcome many of their disadvantages" (EFA 2015b:2).

3.6.7 Deterrents

Demand and supply of teachers have been widely researched in Australia and other OECD countries because the recruitment and retention of quality teachers is essential to improve schooling. Reasons for leaving the profession can be listed as: "workload, wanting new challenges, salary, personal circumstances, teaching out-of-field, lack of school administration support, student discipline, lack of input into decision making, insufficient autonomy, and pressures from high stakes testing" Mayer (2006:67). According to Watt (2006) salaries reaching a plateau also contributes to students not being interested in teaching or leaving the profession after a number of years.

Teachers leave teaching due to " . . . inadequate support from school administration, student motivation and discipline problems, and limited teacher input and influence over school policies. These factors also affect the motivation and commitment of those

teachers who stay in the school" and ". . . the most academically able new teachers are most likely to leave" (Cooper and Alvarado 2006:18).

Hong (2010:1530) studied the perception of professional identity of pre-service teachers in the USA as a means to determine what causes teachers to leave the profession. The six factors of professional identity are "value, efficacy, commitment, emotions, knowledge and beliefs and micro-politics". The study showed that pre-service teachers do not have realistic perceptions of what teaching entails and that teachers who leave the profession showed most emotional burn-out.

The retention of STEM teachers in the United States is a concern. They are more likely than teachers from other disciplines to leave the profession as stated by Guarino et al. (in Watt et al. 2009:306-307). The deterrents are listed as dissatisfaction with working conditions: "large class sizes, heavy workload, courses at a low level of instruction, low salary, and an emphasis on paperwork and non-teaching activities" according to Kirby et al. (in Watt et al. (2009:306-307) "If teaching is to be an attractive career to well-qualified graduates, then teacher education and employing authorities will need to take into account those motivations that have attracted people into teaching, and seriously address issues and practices in schools that sap teacher motivation and undermine commitment" (Watt et al. 2009:306-307).

The EFA (2015a:4) report states that although data on the attrition of teachers are scarce, evidence from the UNESCO Institute of Statistics identifies a tendency in developing and developed countries of teachers leaving the profession. Rates range from 13% of primary school teachers in Ghana in 2012 to 41% of new teachers leaving the profession within the first five years of teaching since the late 1980's in the USA while 13.1% of first-year teachers left the profession in 2008. Ingersoll et al. mentions in the EFA (2015a:4) report that first year teachers leaving the profession after six months of teaching ". . . cited dissatisfaction with working conditions, including salaries, classroom resources, students misbehaviour, accountability, opportunities for development, input into decision making and school leadership" as deterrents. Members of the European Union (EU) state that to retain the attractiveness of teaching as a profession is a challenge. They list low status of the profession, low starting salaries, a

poor working environment, not being able to work autonomously with a prescribed curriculum and thus feel not in control, high work load, not enough collaboration with colleagues, too much bureaucracy with an overload of changing policies and new initiatives, pressure to meet targets, too many tests, not enough support from parents and disciplinary problems with the pupils which cause stress, as “dissatisfiers” for teaching (EC staff working paper 2012:31).

3.6.8 STEM disciplines

“Why do people still choose a teaching career in STEM?” is a question that Watt, et al. (2009:285,288,304-307) wanted to answer by doing a study on beginning teachers education candidates at three Australia universities and in the United States at two universities on the motivations of STEM students to choose teaching as a career by using the FIT-Choice Scale. They investigated the characteristics, motivations and perceptions of those teachers. There is a higher percentage of males than females in mathematics and science teaching in Australia. The males are older and closer to retirement. They come from lower income families and very few had parents who are teachers.

Early career science and mathematics teachers in Australia were asked about the factors that influenced them to enter and continue teaching as a career by White (2009:5). Most of the participants cited “Desire to help children learn”, “Pass on knowledge”, “Job satisfaction” and “Enjoyment” as motivations. About half of the respondents listed “Holidays” and “Employment opportunities” as reasons for their choice. Very few were influenced by the reports about teacher shortages. The majority (68%) said that they foresee teaching as a long term career and just below half intended to teach until retirement.

The turnover in mathematics and science teachers in the USA varies from school-to-school. The migration is “from poor to not poor schools, from high-minority to low-minority schools, and from urban to suburban schools”. The factors influencing the migration of mathematics teachers were “the degree of individual classroom autonomy held by teachers, the provision of useful professional development, and the degree of

student discipline problems. For science teachers, the strongest factors were the maximum potential salary offered by school districts, the degree of student discipline problems in schools, and useful professional development" (Ingersoll and May 2010:1).

Incentives to attract STEM teachers include higher salaries. A study by Milanowski (2003) investigates the influence of salary as well as personality, interest and value factors which are formed early in life, on potential mathematics and science teachers. The results show that altruistic reasons for career choice and a limited influence of higher salaries prevail, as expected. Three factors influencing Mathematics tutors to consider teaching as a career are altruism, self-efficacy and their perception of teaching as a complex act, as described by Smith (2010:17).

When scarce subject (Mathematics, Science and English) teachers in England and Wales were asked in a telephone survey by Barmby (2006:1) about the reasons why they chose teaching as a career and for reasons why they want to leave the profession, the factors were intrinsic and altruistic for going into teaching, but workload and pupil behaviour were the factors dissuading them to become teachers or causing them to want to leave teaching. During the same year teachers in Australia listed multiple motivations for becoming teachers namely rewarding nature, opportunities for social interaction, love of mathematics, job security and work conditions. Only one in six cited

An exploratory study of a sample of 40 undergraduate mathematics students from the School of Science and Engineering at the University of West Florida (UWF) in Pensacola, Florida by Piotrowski and Hemasinha (2012:46-49) investigated the career interest and occupational choice of these students. Nearly half (48%) of the sample put teaching and academic research as a first choice and 27% chose secondary school teaching.

Tatto et al (2012:125-127) investigated the reasons for students for becoming mathematics teachers. They listed nine possible reasons, including teaching as an activity, happiness of the individual, and a need to assist others. The students were asked to identify the most significant reasons that influenced their choice. High

proportions of future teachers chose the fact that they like to work with the youth, but the proportion was less for future secondary education teachers and also for future teachers in Chinese Taipei, Georgia, and Thailand. They chose long-term job security as their main reason. Their love of mathematics was the most frequent choice for primary school teachers in Botswana only. Nine of the countries' senior phase teachers chose the love for mathematics as their first or second most favoured choice. High percentages of future teachers from Germany, Chile, Norway, Switzerland, and the USA said they chose teaching as a career because they believed they are good teachers. Seeing teaching as a challenging occupation was identified as an important reason by future teachers in Chile, Germany, Norway, the Philippines, and Switzerland. Large proportions of future teachers of different levels from various countries indicated that they have been motivated by the influence that they may have on the youth. The reasons that were less frequently chosen are the students own good mathematical performance at school, whether teaching posts were available and the lowest rating was for being attracted to teaching because of the remuneration.

Most mathematics teachers are reported by Tatto et al (2012:127) to be females in at least half of the participating countries. They are mostly from a middle-class socio-economic background and have been successful in their basic schooling. The majority did not see themselves as having been high achievers in secondary school except those from a few countries planning to teach at secondary schools.

3.6.9. Motivation and commitment

Students from four tertiary institutions in South-west England and Wales took part in a study conducted by See (2004:213) to identify the "key social and economic determinants" of choosing teaching as a career in the United Kingdom. The researcher compared those already interested in teaching and those who have not considered teaching as a career. See concludes that family background, the students perceptions of teaching and the value-driven factors of the occupation are the main motivations, while financial incentives have less influence. "Those who are committed to teaching are more likely to be motivated by intrinsic rewards" See (2004:213). They are also not

deterred by low salaries and low status. The participants who have not considered teaching as a career are largely extrinsically motivated.

Research into the commitment and motivation of Australian student teachers, how the motivation and commitment change as well as the influence of initial teacher training on that motivation and commitment were conducted by Sinclair (2008:84). She proposed that the study will provide insight to do the following:

- "Attract suitable student teachers to teaching by broadening the knowledge base of what motivates individuals to teach in today's more complex society where there are increasing demands on teachers and increasing opportunities for individuals to engage in other professions.
- Design better initial teacher education courses by understanding the positive and negative effects of initial teacher education on motivation and commitment.
- Help offset forecasted teacher shortages by enhancing the retention of student teachers throughout their initial teacher education courses and into the teaching profession" (Sinclair 2008:84).

She concluded that the intrinsic and extrinsic motivations identified can be utilised by higher education providers to attract student teachers by a multifaceted approach. "Being motivated to teach by the opportunity of working with children, for authority or leadership and the social nature of teaching work, may enhance student teacher retention as factors such as commitment to children, and the possibilities for professional freedom and supportive colleagues, have been found to positively impact teacher retention" Sinclair (2008:95). Students motivated by the possibility of authority or leadership positions may be recruited and professionally developed as future educational leaders. On the other hand, student teachers who rank perceived short working days and long vacations as factors that influenced them to choose teaching as a career, may be more likely to leave the profession when they experience the reality of teaching.

Recent research by Watt et al (2014:23-24) on teaching motivations and perceptions in comparison with three distinct teaching profiles of professional engagements and career development aspirations in the USA have suggested that understanding which future teachers are professionally engaged, committed and will persist as teachers, will help with recruitment and retention planning in the teaching profession. They foresaw that different motivational profiles would predict different long term career outcomes. Teacher attrition and retention studies done previously focused mainly on economic demand and supply fluctuations, as well as the beginning teachers' lack of preparedness to cope with the demands of teaching. The USA study was compared to the results of an earlier study in Australia in 2008 where "highly engaged persisters, highly engaged switchers and lower engaged desisters" had different motivations for choosing teaching as a career.

The profiles of future teachers identified in the USA study are: "Highly engaged persisters", "Lower engaged desisters" and "Classroom engaged careerists". The researchers found that there are different types of teachers with regard to professional engagement and career development aspirations.

The significance of the findings is to ask questions and find answers on the retention and attrition of teachers in their critical first five years of teaching by identifying their reasons for choosing the career. Will they leave if their goals are not met? Will excessive bureaucratic policies frustrate them? Do they experience fulfilment in their expectation to work with the youth to make a difference? Watt suggests that processes for teacher recruitment, teacher educations programmes and the induction and mentoring of beginner teachers must be redressed. She believes that "If we can better understand them, for different types of future teachers, we can focus upon how best to prepare, engage and sustain future teachers to deal with the realities of their early teaching careers" Watt (2014:38-39).

3.7 Factors influencing South African students to choose teaching as a career

Chuene, Lubben and Newson (1999:23-24) investigated the reasons for choosing mathematics teaching as a career. Their study was conducted in the Northern Province

of South Africa and they have drawn their sample of 17 pre-service teachers from two teachers' colleges. Five of the participants were female. The researchers perceive teaching as a "self-recruiting" career because of students own experiences of mathematics teachers at school. They also believe that the reasons for choosing mathematics teaching as a career are linked to, but should not be equated to commitment to teaching. Most of the participants chose extrinsic reasons namely the relatively low entry requirement, the lower fees compared to other institutions and the opportunity to improve their mathematical knowledge for future career options.

Approximately 50% of the students stated altruistic reasons for their career choice with a third wanting to help children overcome their fear of mathematics. One fifth of the respondents wished to lessen the scarcity of mathematics teachers. Half of them gave intrinsic reasons with the major reason being their love of the subject mathematics, whilst 25% thought they were good at the subject. A similar percentage of them perceived mathematics teaching as being "easy" and consider mathematics a practical subject. Those who chose extrinsic reasons did not see mathematics teaching as a long term career.

"What inspires South African student teachers for their future profession?"

Wolhuter et al. (2012:178-179) describe the behaviour of successful teachers who remain in the profession as those who are spirited, motivated, committed and resilient but decided to investigate the "concept of inspiration (devoid of stress) compared to resilience (in times of stress)" (Wolhuter et al. 2012:179). Inspirational contexts identified are: "family; friends; fellow students and peer group; religion and faith; teaching practices; lectures & lecturers; mentors; miscellaneous (media, culture, literature, hobbies, part time work.)" Teaching does not enjoy high esteem. In the past teaching was an accessible route to higher education and social upward mobility. Inspirational factors were rated in descending order of importance as follows: "extended family, church/religious organisation, teacher education institution (the mental construct of the ideal lecturer)" and from the factor analysis: "teaching practice and interaction with learners, sport and voluntary work." Remuneration was ranked low and the overall

results show that teachers in South Africa care for others and have compassion with an ecumenical inclination. The population for this study was students on the three campuses of one South African University and students from year 1 to year 4 took part in the survey (Wolhuter et al. 2012:181-187).

Park (2006:144-145,153-154) focuses on aspects that either deter or attract pupils to study teaching as a career. He argues that in order to increase the number of teachers, teaching as an attractive career should be promoted among pupils. The deterrents from this study were identified in order of importance as: lack of respect for teachers, low salaries of teachers, poor discipline causing unfavourable working conditions, the perceptions of unhappy teachers, and unsafe environments due to violence in schools. Others deterrents are: lack of job opportunities, lack of promotion prospects, no provision of job security, career not challenging enough, do not want to work with children, teachers work too hard, low status of teachers in the community, study period too long.

The attractors are in order of importance: Like to work with children, opportunity to work with people, wanted to share knowledge that they are enthusiastic about, being part of the development of society and the contribution that teachers make to community development, want to be a principal in future, good future prospects, inspired by enthusiastic teachers, easy to get work as a teacher abroad, long vacations, high status of teachers, short working day, vocational security and good salaries.

The effect of the labour market as an approach to get insight in the choice of occupation is discussed by Patterson and Arends (2009:13). They assume that “an individual will assess the net monetary and non-monetary benefits from a particular occupational choice” according to Kirby et al. and then make a decision based on the net benefits of a number of options. This is in contrast with the findings of Park (2006:144-145,153-154) where good salaries are low on the list of factors influencing Grade 11 pupils to study teaching. Longitudinal trace studies that follow up on actual career choice, study and career trajectories will be valuable in the quest to understand the career aspirations and choice patterns of young people.

Patterson and Arends (2009:8) distinguish between “recruitment” and “attraction”. Recruitment is part of a human resources function process to finally appoint teachers whereas attraction is seen as canvassing pupils to choose teaching as a career. They suggest that ways to attract more young people to teaching should be found.

The report on a 2013 survey completed by 19.7% of final year ITE students from 21 Universities in South Africa, compiled by Deacon (2015:33-34), included 15 reasons for students wanting to be a teacher. “Respondents’ top three reasons for becoming a teacher were altruistic and/or intrinsic: ‘help improve the quality of education in South Africa’ (90.2% agreed or strongly agreed), ‘share my knowledge and enjoyment of a subject’ (89%) and ‘help make a difference’ (88.2%)” (Deacon 2015:8). Between 70% and 80% of the students gave moderate to strong ratings for ‘work in a respected profession’, perceiving their current course as a ‘step to further study’ and being ‘inspired by teachers who taught me’ as extrinsic reasons while rating ‘always wanted to be a teacher’ as an intrinsic reason . Average support was given to the extrinsic reasons ‘job security and a way of supporting my family’, ‘holidays and working hours’ and ‘opportunities to travel and work in other countries.’ Between 35% and 50% of the students were strongly in disagreement with ‘not knowing what job to do’, ‘holding a teaching bursary’, ‘thinking teaching is easier than most other jobs’ and ‘being unable to get into their first choice of study.’ Deacon has noted the implications of the following findings: Firstly, that 75% of respondents wanted to study further which may either enhance the quality of their teaching or they may pursue another career. Secondly, the students’ perception that teaching is a respected profession can be utilised in the recruitment and retention of teachers in future. Thirdly, 25.5% of the students indicated that teaching is not their first choice. Deacon suggests that the selection process for students in education should be more stringent and the teaching profession should be made more attractive by offering incentives. Lastly, 10% of the respondents indicated that they chose teaching “because they didn’t know what other job to do” which implies a need for more widespread and effective career guidance at school and at university. It should be noted that the participation percentage of the final year PGCE and B Ed

students in the survey varied from 0.3% from the University of Johannesburg to 78.5% from the University of Limpopo (Deacon 2015:13-14).

3.8 Conclusion

The problem of a shortage of quality teachers globally also exists in South Africa. Most of the research was done by surveying pre-service teachers, except in Hong Kong and in Malaysia where pupils in their last years at school were used and in South Africa where the deterrents and attractions of teaching as a profession were researched among Grade 11 pupils. The shortage of male teachers is prevalent in most studies, except in many African countries where males still dominate. Both developed and developing countries have a shared challenge in attracting school students to STEM career fields including teaching those subjects. Language teachers are also a scarce commodity in a number of countries.

Allen (2005:18) presents questions and solutions for the USA that may be applied wider to make sure that quality young people are recruited, properly trained and retained. He proposes that the characteristics of current successful teachers who have remained in the profession for a reasonable time be compared with qualified teachers that have left the profession and those who have not entered the profession at all. This will then assist in developing and transforming teacher training programmes. The most competent teachers should be employed. The system should allow individuals of different gender, race, belief and socio-economic background to have equal opportunities to become teachers and should also recruit students with the potential to be competent and committed teachers from these different groups.

> *"On the other hand, if it could be determined what might motivate talented non-teachers to enter the profession, effective recruitment strategies may be developed"* (Allen 2005:18).

Patterson and Arends (2009:99) concluded that the need to increase graduate production and secure quality teaching training is an urgent concern. They highlighted two dimensions of teacher training and teacher graduate production that will impact on

the National Policy Framework for Teacher Education and Development in South Africa, namely the need to “improve our understanding of the factors that influence the movement of teacher education candidates from home to teacher training, and then their spatial distribution once qualified and working as teachers, and to investigate the slump in enrolment of young African women in initial professional education and training” (Patterson and Arends 2009:99).

In South Africa the shortage of mathematics teachers is critical. Previous research was mostly focused on the factors that influence the choice of teaching as a career in general and was not subject specific. Research on the factors that influence the choice of mathematics teaching as a career is limited in South Africa.

The lack of mathematical expertise in economic disadvantaged schools and in rural areas is compelling evidence that more mathematics teachers need to be trained. Despite a few existing studies on the motivation of teachers in South Africa (Chuene et al.1999:23-24; Wolhuter et al. 2012:178-187; Park 2006:144-154; Deacon 2015:33-34; and Patterson and Arends 2009:99) we do not know why a student teacher of mathematics in a middle-income country like South Africa, with its complex and divided racial history, choose mathematics teaching as a career. Are they intrinsically motivated or is teaching seen as a “fall back career”? What is the influence of the perceived lack of status and the role of remuneration in their choice of career? Do these students realise that competency in the subject is essential and that teaching is a “high demand” profession? What are the demographics of the current cohort of pre-service mathematics teachers in South Africa?

Studying the factors that influence mathematics students to become teachers will assist in finding ways to attract more mathematically competent pupils to choose teaching as a career. Recruitment strategies to ensure that students are attracted which fit the profile of long term commitment to the profession, can be established.

CHAPTER 4

CONCEPTUAL FRAMEWORK

4.1 Expectancy-Value Theory (EVT)

The core principle of the EVT model is the expectancy of a person to succeed in an activity as well as the value that the person assigns to the activity, predict the extent of the engagement in the activity. The EVT was originally developed by Eccles et al in 1983 (in Watt and Richardson 2007:170; Watt et al. 2014:24) to investigate the pattern of gender choice of mathematics as a subject in secondary school and later utilised within the specific context of teaching as a career choice. The EVT is seen as the most prominent motivational model to use to study choice and persistence. The model uses *values* and *ability beliefs* as motivations to envisage academic choices and behaviours. Eccles and Wigfield (2002:110) describe *ability beliefs* as how a person will do on different tasks, and *values* as reasons for doing the task or how a task meets individual needs. These values' components are intrinsic value (the enjoyment of performing the task), utility value (the usefulness of a task), attainment value (subjective significance of good performance) and cost (the effort required to complete the task) as specified by Eccles (in Watt & Richardson 2007:171; Watt 2006:309).

4.2 Self-Determination Theory

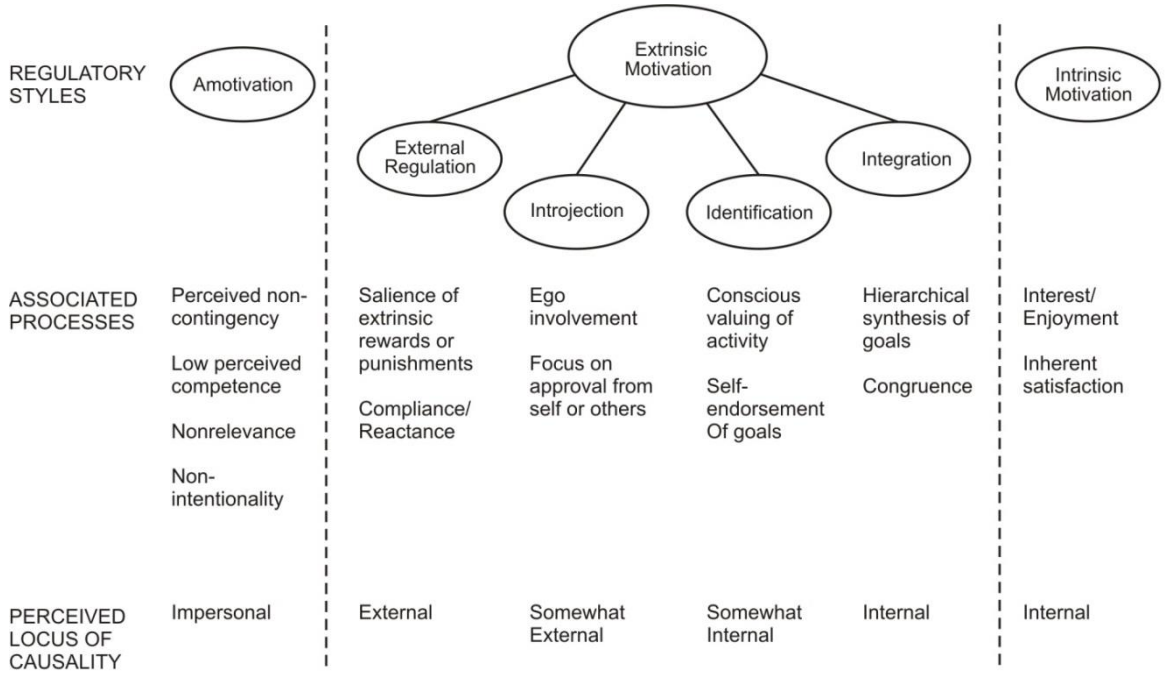
Edmund Henry Barker defined self-determination in 1832 inter alia as "Determination by one's own mind or by its own powers; determining or deciding without extraneous power or influence; as, the self-determining power of the will; the esteem or good opinion of one's self; by inherent powers, without external impulse."

Ryan and Deci (2000b:54) define to be motivated as "to be moved to do something." They argue that motivation varies in level (how much) and in orientation (type). The latter is based on the different objectives for certain actions and is distinguished as intrinsic motivation and extrinsic motivation in the Self-Determination Theory (SDT) which was developed by Ryan and Deci at the University of Rochester.

When something is done because it is interesting or enjoyable it is defined as intrinsic motivation. The activity is thus performed for its inherent satisfaction and the reward is in the activity itself. The most often used measurements of intrinsic motivation are "free choice" and the use of self-reports of interest and enjoyment of the activity. For intrinsic motivation to be maintained or enhanced, people must experience feelings of relatedness, self-efficacy (competence) and their behaviour to be self-determined (autonomy) according to the Cognitive Evaluation Theory presented by Deci and Ryan (2000b:58). In Finland teachers have autonomy in the classrooms and experience self-efficacy which leads to intrinsic motivation – "driven mainly by moral purpose" and not by extrinsic motivation (Sahlberg 2011:71). That may be the reason why teaching is such a sought after career in Finland.

Extrinsic motivation on the other hand, refers to doing something because of a "separable outcome". The SDT proposes in Deci and Ryan (2000b:60) that extrinsic motivation can vary according to its relative autonomy e.g. external control in doing something to avoid repercussions, and personal endorsement of an activity. Different forms of extrinsic motivation are described by the Organismic Integration Theory (OIT).

Figure 2: Increasing Degrees of Self-determination (OIT of motivation from left to right.)



Source: Deci and Ryan 2000b:61-62

- Amotivation is “the state of lacking an intention to act” which is caused by a feeling of incompetence, not expecting a desired outcome and perceiving the activity as having no value.

- External regulation behavioural tasks are only performed to receive an external reward or consequence.

- Introjected regulation is still controlling but activities are performed in order to “avoid guilt or anxiety or attain ego-enhancements of pride.”

- Identification regulation is more self-determined where the person experience the behaviour as being important on a personal level.

- Integrated regulation occurs when the reasons for an activity are internalized, but the outcome is still separate from the behaviour.

- Intrinsic motivation is a “prototype of self-determined activity”.

Altruism is a selfless or philanthropic attitude or way of behaving marked by unselfish concern for the welfare of others.

4.3 Self-efficacy

Bandura introduced the construct of self-efficacy in 1977. Self-efficacy can be defined as “. . . a person’s confidence in their ability to organize, execute, and regulate performance in order to solve a problem or accomplish a task at a designated level of skill and ability. Academic self-efficacy refers to a person's conviction that they can successfully achieve at a designated level in a specific academic subject area” (Bandura 1994:1). People with a high sense of self-efficacy treat difficulties as challenges to be overcome and generate intrinsic interest and fascination in challenging activities. Failure for them is perceived as the result of insufficient inputs into the task or a lack of knowledge and skills and the setback is swiftly rectified. They come out stronger from hardships. On the other hand, people with a low sense of self-efficacy see

difficult activities as threats and try to avoid them. They are not ambitious and are not dedicated to reach their goals. When they have a setback, they will focus on the difficulties and their own shortcomings and are prone to stress, depression and anxiety.

The sources of self-efficacy are firstly the mastering of an activity and assessing the effect of the activity, secondly the example set by social archetypes having the desired competencies and comparing oneself with them, thirdly positive verbal social persuasion and lastly by the coping reactions to physiological states such as anxiety and stress (Bandura 1994:2-5 and Pajares 1997:21-22).

"Self-beliefs of efficacy play a key role in the self-regulation of motivation" (Bandura 1994:4). In EVT motivation is regulated by the expectation that certain outcomes and their values are the result of specific behaviours. People pursue actions if they believe they are capable to accomplish them. Specific challenging objectives boost and sustain motivation.

Personal competency beliefs determine the extent of the effort that a person put into a task, the duration of their perseverance with setbacks, their resilience in the face of difficulties and it also influences the amount of stress and anxiety that a person experiences in the execution of an activity. Beliefs of self-efficacy influence the choices that people make and factors that influence choice affect personal development, for example in career choices. Researchers have investigated the link between efficacy beliefs and career choices mainly in the science and mathematics fields. Pajares (1997:18) states that this type of investigation has implications for career counselling theory and practice. People will consider a broad range of career options if they have a high level of self-efficacy. It also leads to a higher success rate in their careers because career satisfaction depends on a person's perceived self-efficacy. Students choose major subjects and professions in fields in which they feel most competent. Teachers with a high sense of pedagogical efficacy motivate their students and that will help them to improve their intellectual development and enhance intrinsic motivation by instilling self-efficacy in their students.(Bandura 1994:7-8,12 and Pajares 1997:18,22,44-46).

4.4 The FIT-Choice Scale

Watt, Richardson, Klusmann, Kunter, Beyer, Trautwein and Baumert (2012:791) identified the need to have an instrument that is valid and reliable and grounded in motivational theory. The instrument was developed ". . . to understand how initial motivations impact teacher recruitment, retention and effectiveness, within and across different kinds of samples and settings" (Watt et al. 2012:791).

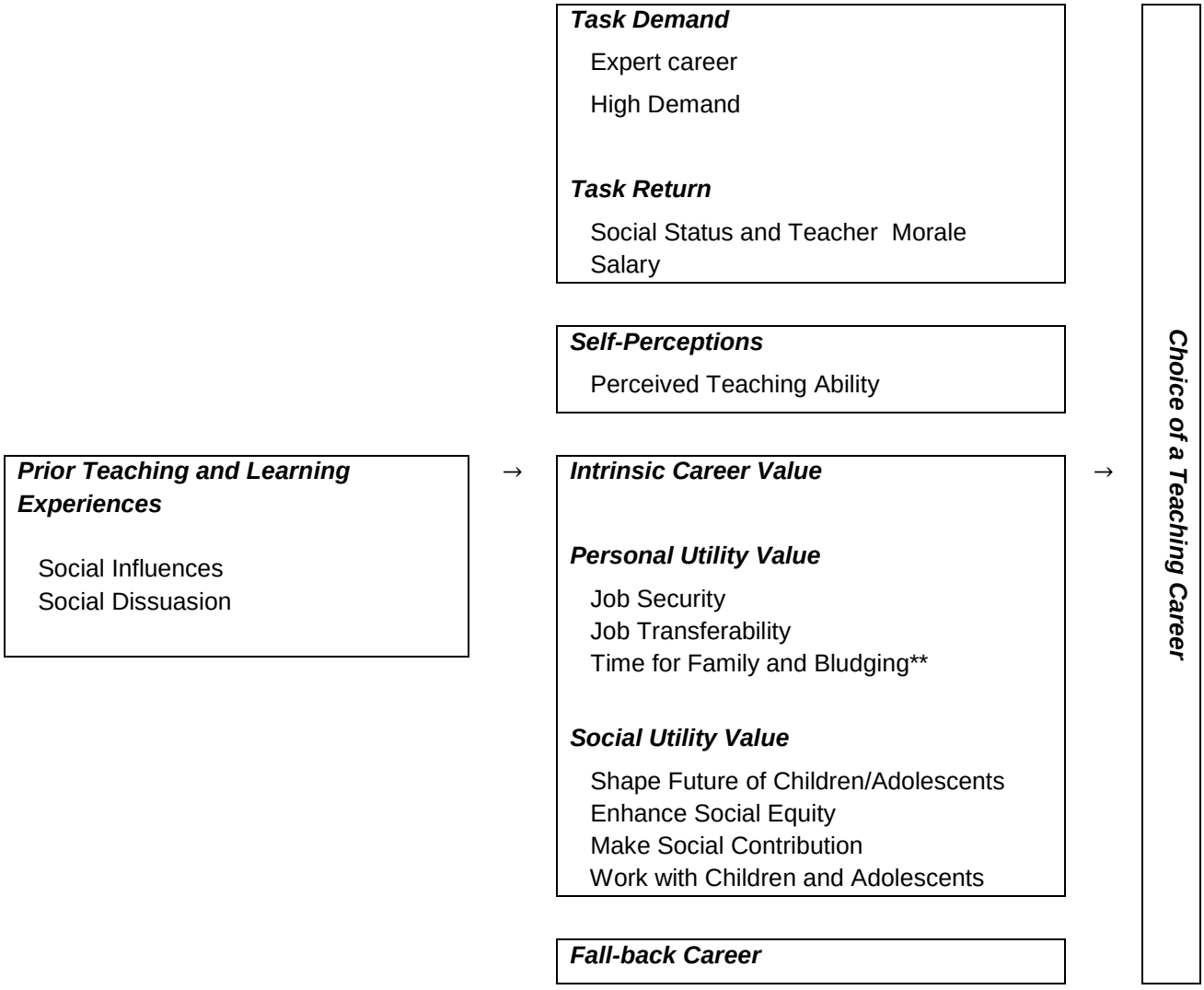
Data to determine what motivates people to choose teaching as a career were mainly based on surveys and some studies with a qualitative part. They point to inconsistency in previous research; the omission of validity and reliability information and the exclusion of the survey instruments in the reports. Different meanings were attached to intrinsic, altruistic, extrinsic and other motivations by individual researchers because of the absence of a generally accepted analytical and theoretical framework (Watt et al. 2012:792).

Watt and Richardson developed the model by grouping recurring themes from previous literature that has shown a lack of cohesion and locating these themes in a systematic approach within the Expectancy Value Framework. It was developed to " . . . provide a precise conceptualisation of components, link the various elements together, suggest causal sequences, and outline relations between individual's motivations, perceptions and their professional development. Background experiences, self-perceptions, task perceptions and values are theorised to shape individual's choice behaviours regarding whether to undertake a teaching career" Watt et al. (2014:24). The FIT-Choice scale was published in 2006 in the Asia-Pacific Journal of Teacher Education and technically validated in 2007.

Jugovic et al. (2012:271-272) affirm the theory being developed by Watt and Richardson because it ". . . provides constructs broad enough to encompass motivational categories found in previous research, simultaneously allowing the introduction of new motivational concepts within a clear model." The FIT-Choice model ". . . introduces three major value classes as well as self and task perceptions that are related to those choices" (Jugovic et al. 2012:272).

The diagram below is from Watt and Richardson (2006:32).

Figure 3: Theoretical model guiding development of FIT-choice



** Australian colloquialism that relates to people adopting the laziest approach or choosing an easy option. In the context of teaching, this could be based on their perceptions about the length of the teacher's workday as well as school holidays.

The model therefore specifies intrinsic, personal utility and social utility values that individuals consider in their choice of a teaching career. Personal utility value consists of lower order constructs such as job security, job transferability and time for family.

Social utility value refers to shaping the future of children and adolescents, enhancing social equity, making a social contribution, and working with children and adolescents.

The model also contains individuals' perceptions of their teaching abilities and task perceptions such as demands (difficulty and required expertise) and returns (social status and salary) related to certain aspects of a teaching career, and in addition, motivation to select teaching as a fall-back career, as well as more distal socialisation influences on occupational choices such as the influence of significant others and an individual's prior teaching and learning experiences. Satisfaction with the choice of a teaching career is presented in this model as an outcome variable (Watt and Richardson 2012:188).

The validation of the FIT-choice scale in 2007 was done by using a sample of 1653 Australian pre-service teachers. High initial career satisfaction of beginner teachers is predicted by the use of the FIT-scale to identify altruistic type motivations, intrinsic value motivation that they attach to teaching, and self-evaluations of their teaching skills.

Beginning teachers' "ability beliefs, intrinsic value, and social utility values" correlated significantly positively with five measures that were observed later namely "planned persistence, planned effort, professional development, leadership aspirations and career choice satisfaction." Later planned persistence (commitment) also related positively with positive prior teaching and learning motivations.

Negative correlation between teaching as a "fall-back" career and the above five measures were established, as well as a negative relationship between personal utility values and later planned persistence and career choice satisfaction. The FIT-choice scale predicts therefore positive and negative outcome variables. Watt et al. (2012:792)

Pre-service teachers from the USA, Australia, Germany and Norway were sampled in 2012 to test whether the FIT-Choice scale would function the same way among samples from different settings in order to be used in the research in a variety of sociocultural contexts. The conclusion was that the FIT-Choice scale displayed good construct validity and reliability across diverse samples. Watt et al also found that motivations appeared more similar than different across the four samples.

4.5 Application and incorporation of the conceptual framework

“Researchers have reported that the mathematics self-efficacy of college undergraduates is more predictive of their mathematics interest and choice of math-related courses and majors than either their prior math achievement or math outcome expectations” (Pajares 1997:45).

The EVT model is a motivational model used to study choice and persistence which will be applied in this study pertaining to the factors that influence students to choose mathematics teaching as a career (expectations and values) and predicting the commitment to pursue the career over a long period of time. Different categories of factors were identified to be included in the FIT-choice scale which was developed to give an understanding how initial motivations impact teacher recruitment, retention and effectiveness which is the focus of this study. The SDT gives insight in the field of motivation by making a distinction between amotivation, different levels of extrinsic motivation and intrinsic motivation. Intrinsic motivation is seen as the prototype of self-determined activity. By identifying the type of motivation and ratings of these motivations by using the FIT-choice scale in surveying PGCE mathematics students, conclusions can be made on how to recruit students that will be committed to teaching as a career and which factors may influence them to stay in the profession.

CHAPTER 5

RESEARCH DESIGN AND METHODS

5.1 Methodology and Instruments

The mixed methods approach which originated in 1959 when Campbell and Fiske used more than one method to study the validity of psychological traits will be used in this study. This method is based on the pragmatic knowledge claim namely that the meaning of an idea or a proposition lies in its observable practical consequences. I will collect qualitative data and quantitative data sequentially in order to obtain detailed and comprehensive information about the factors that influence students to choose mathematics teaching as a career. The most prevalent factors will be identified and interpreted and also compared to the general findings from other international studies. The purpose of the open ended question (qualitative data) is to expand the quantitative data collected by means of the questionnaire. The students will complete the open ended question first to prevent them to be influenced by the questions in the questionnaire. Demographic data will also be collected as "pragmatists agree that research always occurs in social, historical, political, and other contexts" (Creswell 2003:12). The differences in geographical origin, socio-economic background, culture and gender may influence the factors being investigated and should therefore be included in the study.

The three instruments used to obtain data are as follows:

- Collection of background and demographic data: the students completed a personal details form (see appendices).
- Open-ended question: "Please state briefly your main reason/s for choosing to become a teacher." The open ended question serves to obtain additional information that is not covered by the questionnaire and the biographical data.
- Completion of the FIT-Choice questionnaire (see appendices)

Table 4: Final empirically validated "FIT-Choice" subscales and items

Part B: Influential factors

Higher-order factor	Factor	Item #	Anchors: 1 (not at all), to 7 (extremely)
			Item stem: ''I chose to become a teacher because…''
N/A	Ability	B5	I have the qualities of a good teacher
		B19	I have good teaching skills
		B43	Teaching is a career suited to my abilities
N/A	Intrinsic career value	B1	I am interested in teaching
		B7	I've always wanted to be a teacher
		B12	I like teaching
N/A	Fall-back career	B11	I was unsure of what career I wanted
		B35	I was not accepted into my first-choice career
		B48	I chose teaching as a last-resort career
Personal utility value	Job security	B14	Teaching will offer a steady career path
		B27	Teaching will provide a reliable income
		B38	Teaching will be a secure job
	Time for family	B2	Part time teaching could allow more family time
		B16	Teaching hours will fit with the responsibilities of having a family
		B29	School holidays will fit in with family commitments
		B4	As a teacher I will have lengthy holidays
		B18	As a teacher I will have a short working day
	Job transferability	B8	Teaching will be a useful job for me to have when travelling
		B22	A teaching qualification is recognised everywhere
		B45	A teaching job will allow me to choose where I wish to live
Social utility value	Shape future of children/ adolescents	B9	Teaching will allow me to shape child/adolescent values
		B23	Teaching will allow me to influence the next generation
		B53	Teaching will allow me to have an impact on children/ adolescents
	Enhance social equity	B49	Teaching will allow me to benefit the socially disadvantaged
		B54	Teaching will allow me to work against social disadvantage
		B36	Teaching will allow me to raise the ambitions of underprivileged youth
	Make social contribution	B6	Teaching allows me to provide a service to society
		B20	Teachers make a worthwhile social contribution
		B31	Teaching enables me to 'give back' to society
	Work with children/ adolescents	B10	I want to help children/ adolescents learn
		B13	I want a job that involves working with children/adolescents
		B26	I want to work in a child/adolescent-centred environment
		B37	I like working with children/adolescents
N/A	Prior teaching and learning experiences	B17	I have had inspirational teachers
		B30	I have had good teachers as role-models
		B39	I have had positive learning experiences
N/A	Social influences	B3	My friends think I should become a teacher
		B24	My family think I should become a teacher
		B40	People I've worked with think I should become a teacher

Part C: Beliefs about teaching

Higher-order factor	Factor	Item #	Anchors: 1 (not at all), to 7 (extremely)
Task demand	Expertise	C10	Do you think teaching requires high levels of expert knowledge?
		C14	Do you think teachers need high levels of technical knowledge?
		C15	Do you think teachers need highly specialised knowledge?
	Difficulty	C2	Do you think teachers have a heavy workload?
		C7	Do you think teaching is emotionally demanding?
		C11	Do you think teaching is hard work?
Task return	Social status	C4	Do you believe teachers are perceived as professionals?
		C8	Do you believe teaching is perceived as a high-status occupation?
		C12	Do you believe teaching is a well-respected career?
		C5	Do you think teachers have high morale?
		C9	Do you think teachers feel valued by society?
		C13	Do you think teachers feel their occupation has high social status?
	Salary	C1	Do you think teaching is well paid?
		C3	Do you think teachers earn a good salary?

Higher-order factor	Factor	Item #	Anchors: 1 (not at all), to 7 (extremely)
			Part D: Your decision to become a teacher
N/A	Social dissuasion	D2	Were you encouraged to pursue careers other than teaching?
		D4	Did others tell you teaching was not a good career choice?
		D6	Did others influence you to consider careers other than teaching?
N/A	Satisfaction with choice	D1	How carefully have you thought about becoming a teacher?
		D3	How satisfied are you with your choice of becoming a teacher?
		D5	How happy are you with your decision to become a teacher?

The FIT-Choice Scale was developed and validated by Helen M. G. Watt and Paul W. Richardson of the Monash University in Melbourne, Australia in 2006. The instrument has been used in a number of international studies. I have obtained permission from Professor Watt to use the questionnaire for my research.

The questionnaire is divided into three sections:

- Motivations for teaching

Each motivational factor within the FIT instrument is measured by multiple item indicators with response options with 7 possible ratings from 1(*not at all*

important) to 7 (*extremely important*) with 54 items. A preface to all the motivation items is: “I chose to become a teacher because . . . “

These motivations include intrinsic values, personal utility values (job security, time for family, job transferability), social utility values (shape future of children/adolescents, enhance social equity, make social contribution, work with children/adolescents), self-perceptions of individuals’ own teaching abilities, the extent to which teaching has been a “fall back” career choice, social influences, and prior positive teaching and learning experiences.

- Beliefs about teaching (perceptions)

The participants rated their beliefs about teaching with response options with 7 possible ratings indicating strength of agreement from 1(*not at all important*) to 7 (*extremely important*) with 15 items. They indicated whether they perceive teaching as a high in task demand (expert career, high demand) and as a high in task return (social status, salary).

- Your decision to become a teacher

Participants rated influences on their decision to become a teacher on a scale from 1 (*not at all*) to 7 (*extremely*) with 6 items. They rated the extent to which they had experienced social dissuasion from teaching as a career choice.

5.2 Sample and Sampling

The sample comprises of 40 out of a possible 45 PGCE students with mathematics as a subject for their degree who have decided to pursue teaching as a career at the three universities in the Western Cape. The participants include 16 of the 20 PGCE students from the University of Cape Town (UCT), nine of the ten PGCE students from the University of Stellenbosch (US) and all 15 PGCE students from the University of the Western Cape (UWC). These universities represent the demographics of the Western Cape and also have cohorts of students from other provinces as well as international students. All three universities offer teacher education degrees. I have decided to exclude the Cape Peninsula University of Technology (CPUT) because the admission requirements for students to enrol at the CPUT to become FET mathematics teachers differ significantly from the other three universities. A minimum of 40% for mathematics

in the NSC examination is required by the CPUT to enrol for a FET teacher qualification, compared to 70% as the minimum requirement for a degree with mathematics as a subject at the University of Stellenbosch.

5.3 Data collection

I visited the UCT, US and the UWC between March 2015 and May 2015 to collect the data personally to allow for clarification of queries from the respondents. The universities' ethics approval, consent of the faculty administrators and informed consent of all participants have been obtained. The participants completed the informed consent form, open ended question, questionnaire and personal details form at the end of their mathematics didactics class. It took the respondents about 30 minutes to complete the forms.

5.4. Data Analysis

5.4.1 Biographical data

The demographic data that were collected are gender, age, South African citizen (or not), hometown, first and second language, occupation of parents, bursary holder (or not), mathematics mark for final school examination, year matriculated, highest tertiary qualification, university mathematics level passed for degree and preference of geographical area where they want to work.

5.4.2 Open ended question

The factors influencing the students' career choice were analysed and thematically categorised. The themes identified are to make a difference in South Africa ("give back" to the community), make a difference in the lives of children, like/enjoy teaching, will have time for family, the influence/motivation of their own teachers, their love for mathematics, job security and teaching as a back-up plan.

5.4.3 Measure for consistency in the Questionnaire

The Cronbach's Alpha coefficient is a measure of internal consistency and was used to determine the reliability of the FIT-choice scale for students from South Africa.

5.4.4 Analysis of Variance (ANOVA)

One-way ANOVA's investigating the effect of gender, first language and University on the various factors were done.

5.4.5 Student's t-tests

Student's t-tests for pairwise comparisons between the four languages and three universities were performed.

CHAPTER 6

RESEARCH FINDINGS

6.1 Consistency

The Cronbach Alpha coefficient for consistency was calculated for the subscales and items in the questionnaire. The results for the tests are attached in annexure 4. The items which contribute to “Fall-back career” as a factor have a standardised coefficient of 0.575 which is below the acceptable 0.7. When item B11, “I was unsure of what career I wanted”, is removed, the value increases to 0.631 which is still below 0.7. No single question is therefore responsible for the relatively low value of the measure.

Table 5: Cronbach Alpha with Deleted Variable

Fall-back career: B11 B35 B48

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
B11	0.272963	0.630595	0.278123	0.635008
B35	0.501068	0.302826	0.496220	0.304006
B48	0.395906	0.457413	0.400161	0.457807

When the item B22, “A teaching qualification is recognised everywhere” is omitted when Cronbach’s Coefficient for the factor “job transferability” is calculated, there is a substantial increase from 0.331 to 0.503. Furthermore, B22 has practically no correlation (0.04) with the mean value of the factor. The higher order factor “personal utility value” however does not show the same effect when the question is removed before the coefficient is calculated. The value decreases slightly from 0.800 to 0.794 when B22 is left out.

Table 6: Cronbach Alpha with Deleted Variable

Job transferability: B8 B22 B45

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
B8	0.219715	0.175068	0.213216	0.175305
B22	0.043517	0.502579	0.046052	0.503517
B45	0.319161	-0.042110	0.309081	-0.042446

The Cronbach Alpha coefficient for “difficulty” (or “high demand”) as a belief of teaching is fairly low with a value of 0.332 but the higher order factor “task demand” has a value of 0.624. When question C2 “Do you think teachers have a heavy workload?” is deleted, the value changes to 0.719.

The majority of the items have shown a high level of consistency with a coefficient above 0.7. The FIT-choice scale can therefore be used in the South African context.

6.2 Biographical data

6.2.1 Gender

Twenty two (55%) of the 40 respondents are female. At UCT half of the respondents are female, 77.8% at US and at UWC the percentage is 46.7%. The percentage female mathematics student teachers is the highest in the white Afrikaans speaking group from the US and the lowest in the African home language group from UWC.

6.2.2 Age

The mean age of the students is 24.63. The mean for UCT is 24.31, for the US it is 21.89 and for UWC it is 26.6. The range of ages is the smallest in the US cohort, namely (21 – 23), and significantly larger in the in the UWC (21 – 34) and UCT (21 – 32) groups. All the students from US entered tertiary education soon after they finished their secondary education, which was not the case for the students from the other two universities.

6.2.3 Final mathematics school mark

The mean mark for students from the US is 7, for the UCT it is 6.31 and for the UWC 5.07. It must be noted that there was a school curriculum change in 2008. The marks of students who wrote their final school examination before 2008 cannot be compared with those writing the examination on the new curriculum. Before 2008 the pupils had a choice between higher grade, standard grade, functional mathematics or no mathematics. Since 2008 the compulsory subject choice was between mathematics and

mathematical literacy. The standard of the new curriculum mathematics is perceived to be somewhere between higher grade and standard grade. All the students from the US matriculated after 2007, whereas 4 of the UCT students and 10 of the UWC students matriculated before 2008. Five of the students are classified as foreign and did not write the South African final school examination.

6.2.4 Home language

Table 7: First languages of the students from three universities in the Western Cape

UNIVERSITY by FIRST LANGUAGE									
UNIV	FIRST LANGUAGE								
	AFR	CREOLE	ENG	FRENCH	ISIXHOSA	ISIZULU	SEPEDI	SETSWANA	TOTAL
UCT	1	1	8	0	3	3	0	0	16
	6.25%	6.25%	50%	0%	18.75%	18.75%	0%	0%	
US	9	0	0	0	0	0	0	0	9
	100%	0%	0%	0%	0%	0%	0%	0%	
UWC	0	0	2	2	9	0	1	1	15
	0%	0%	13.3%	13.3%	60%	0%	6.67%	6.67%	
TOTAL	10	1	10	2	12	3	1	1	40

The UWC PGCE class consists of black students (2 foreign students), while 6 of the students from UCT have an African language as first language, 8 English, 1 Afrikaans and 1 Creole. Half of the students at UCT stated English as their first language, all of the students from US are White Afrikaans speaking and 60% of the UWC students have IsiXhosa as their home language. Both the UCT and the UWC have English as their language of instruction while the US has both Afrikaans and English as their “languages of learning and teaching” (Language Policy of the University of Stellenbosch 2015:5). The UCT cohort is culturally and racially more diverse than the US and UWC cohorts.

6.2.5 Geographical origin

The location of the school where students have matriculated was used to determine their region of origin. Half of the students are from the Western Cape and the other 50% are spread throughout the country. Four students are from Africa and one from Mauritius.

"I chose to become a teacher particularly maths and science teacher (sic) because, I saw and hear that there is a huge shortage of maths and science teachers for that field especially in Eastern Cape, where I was born and raised and where I would like to teach."

22 year old IsiXhosa speaking male from UCT

Sixty per cent of the students have chosen only the Western Cape as their preferred area to work while 77.5% chose the Western Cape as an option. Seven of the nine students from Stellenbosch prefer to work in the Western Cape, one is prepared to work in any province and the student form Namibia is bound to work in her country of origin due to a bursary commitment. The other four foreigners also prefer to work in the Western Cape. Eight of the students, all from the UWC, indicated that they are prepared to work in two or more of the nine provinces in South Africa. Twenty three (57.5%) of the students chose their region of origin as a preferred place to work. More than a quarter of the students prefer to work in the province where they studied even though they come from other areas.

Table 8: Area of origin

	US	UWC	UCT	TOTAL
WESTERN CAPE	6	6	8	20
GAUTENG	1		2	3
NORTHERN CAPE	1			1
EASTERN CAPE		4	2	6
LIMPOPO		1		1
NORTH WEST		1		1
KWAZULU NATAL			3	3
MAURITIUS			1	1
DRC		1		1
BURUNDI		2		2
NAMIBIA	1			1
TOTAL	9	15	16	40

6.2.6 Teacher parent

Thirty percent (30%) of the total number of respondents indicated that one or both of their parents are teachers. The US had the highest percentage namely 44.44%, the UCT 31.25% and the UWC a percentage of 20%. Of the other 13 students from the UWC three indicated that their parents are pensioners, four left the tick box for father's occupation open, three did not complete that section of the questionnaire and three had indicated that one or both parents are unemployed.

6.2.7 Bursary holders

Of the South African students in the sample 87.5% from US, 46.7% from UCT and 46.2% of UWC have Funza Lushaka bursaries which represent 57.1% of the total number of students. The number of available bursaries has increased since the turn of the century to increase the intake of students in education.

6.2.8 Degree qualification and career switching

Table 9: Qualifications and career switching

DEGREE QUALIFICATION			CAREER SWITCHER
	Frequency	%	
B TECH	1	2.5	1
BUSINESS	4	10	
EDUCATION	1	2.5	
ENGINEER	3	7.5	3
HUMANITIES	4	10	
NDIP	1	2.5	1
SCIENCE	26	65	6
TOTAL	40		11

Eleven of the students had changed their choice of career to teaching after they obtained their degrees.

> *"The previous diploma (National Diploma: Mathematical technology) gave me problems in terms of employment. It was not recognised by employers. The course started in 2008. It was a challenge, employers did not know which department is applicable to our course. Instead of starting a new course I decided to pursue a PGCE. It was not easy, the family expected me to work."*
>
> *25 year old IsiXhosa speaking female from UWC*

> *"The reason I am doing teaching is because I needed a break from the stress of engineering because I really didn't enjoy doing my degree. I also saw teaching as an incredibly useful and much needed skill. I am still confused about the career that I'm going to pursue after university. The final contributing factor is that I am a Christian and have my heart set on missionary work overseas, and felt that teaching could be a useful skill in this field."*
>
> *23 year old English speaking male from UCT with a BSc (Hons) degree in Electromechanical Engineering*

6.3 Teaching choice motivation factors

6.3.1 Self-Perceptions

The students perceived (mean score 5.44 on a Likert scale of 1 to 7) that they have the ability to be "a good teacher with good teaching skills". This perception has also been noted in the open ended questions where students referred to their mathematical skills and the way that they are able to "share their knowledge": "I have always been good at maths", "in High School because the ability I had to have a better understanding of mathematics, chemistry and physical science, I started to lead an extra class explaining (sic) other classmates certain concept (sic) and doing preparation of our final examination" and "I believe that I can help Eastern Cape Province to improve the past rate given a chance".

6.3.2 Intrinsic career value

With a mean score of 5.22 for the intrinsic factor of the value of teaching as a career, the students showed that teaching as career was appealing to them because of the nature of the job itself. Responses such as “I like teaching because I like (sic) when you can see in someone’s eyes that they understand something they didn’t before”, “I want to inspire”, “I always wanted to be a teacher”, “I just love teaching and helping”, “I think it is a meaningful and rewarding career”, “I believe teaching is my calling”, “I prefer to fulfil a supportive role”, “I enjoy helping people” and “I’m really enjoying it” were made.

> *“I always wanted to be a teacher since my school days. I like to add positive value to the lives of people. I like working with children and see how they grow. I feel that teaching is a calling. My most important motivation is to make a difference in the community.”*
>
> *21 year old Afrikaans speaking female from US (translated from Afrikaans)*

> *“I decided to be a teacher because I like to teach and to learn. I like to share my knowledge with other especially the children (youth) in order to see them become the good professionals of their country in the future. I want to see the result of my effort, to created (sic) the good persons useful in this world and to see my children learners have knowledge more than me.”*
>
> *32 year old French speaking Burundi male from UWC*

> *“I always have an interest in teaching and assisting other people with academic work. I have been tutoring since my first year 2008 at Chris Hani Secondary School in Khayelitsha (Makhaza). I enjoy teaching and have been told to be good with nurturing young minds and communicating with my peers at Biotechnology lab at UWC.”*
>
> *25 year old IsiXhosa speaking male from UWC*

6.3.3 Fall-back career

Teaching was not the first career choice for seven (17.5%) of the students. Four (10%) of the students struggled to find employment in the field they studied and then reverted to study teaching. The average score for "fall-back career" however, was the lowest of all the factor scores (mean of 2.54). This low score corresponds with the literature on factors influencing career choice studies in other countries.

> *"I enrolled for teaching, because I never found a job in my field after 2 years of graduating."*
>
> *26 year old Sepedi speaking female from UWC*

> *"I chose to be a teacher because I didn't get a job in the field I studied for . . . . and since I didn't qualify for Honours, I applied for PGCE . . ."*
>
> *23 year old IsiXhosa speaking female from UWC*

> *"Initially teaching was a backup plan since at the time of my graduation I was not sure what I wanted to do. It is only when I went for my teaching observation that I really wanted to teach. This was due to the fact that the maths teachers I had observed were teaching some incorrect methods to the learners. This was a school in the townships."*
>
> *23 year old IsiXhosa speaking female from UCT*

> *"I was not accepted into the BSc (Hons) programme and I was struggling to get employment so I thought doing the PGCE would guarantee me a steady salary while doing BSc (Hons) via UNISA."*
>
> *28 year old IsiXhosa/English speaking male from UWC*

6.3.4 Personal utility value

The overall mean score of 4.2 is moderate compared to the other factors' scores. "Job security", "Job transferability", "Time for family" and "Bludging" all had means below 5 with "Bludging" the lowest at 3.53. The responses for the open ended question included one male respondent who believes teaching will give him ample free time. Four (10% of

the respondents) female students indicated that “more time for family” is a factor that influenced them to decide to become a teacher and seven (17.5%) of the participants mentioned the likelihood of steady employment as a reason for deciding to choose mathematics teaching as a career. It was also mentioned that mathematics is a scarce subject and that it should be easy to find employment, and that job opportunities in various different locations would be possible.

> *“Teaching is a safe option that I had to choose especially in maths and sciences in the FET phase.”*
>
> *28 year old IsiXhosa/English speaking male from UWC*

> *“This countries (sic) economy is not yet transformed for non-white qualified individuals in S.A. The job market is not that easy to enter. I need steady employment.”*
>
> *31 year old Afrikaans speaking male from UCT*

> *“I am a single mother, so it will allow me time with my young boy.”*
>
> *32 year old English speaking female from UCT*

> *“However I think teaching is a nice career for woman (sic) to have more time for your family. This is because I worked in a bank and its too straneous (sic) to work there and no school holidays. I think I will do with (sic) being a teacher because at least I am guaranteed a job and I will earn better than I did as a bank teller and a consultant.”*
>
> *26 year old Sepedi speaking female from UWC*

6.3.5 Social utility value

This higher-order factor had an overall mean score of 5.56. The factors “Shape future of children/adolescents” and “Make social contribution” scored the highest mean values of 5.96 and 5.88 respectively. “Enhance social equity” and “Work with children and adolescents” scored slightly lower at 5.31 and 5.26 each. The answers to the open

ended question also reflected the importance of these as factors influencing the students' career choice.

40% of the students indicated that they want to make a difference in South Africa contributing to improve education in the country by motivating pupils, be part of transforming the country by creating more opportunities for non-white qualified individuals, "give back" to the community, answer to a calling to serve in areas where there is a shortage of mathematics teachers and share knowledge to disadvantaged children.

> *"I chose to become a teacher, because as I grew up in the Eastern Cape it pained me to see that some schools had no teachers at all. . . and also many (pupils) would quit because they saw no point of going to school. Other chools had teachers who were un/under-qualified hence they could not deliver and they failed the learners. I want to change the state of our education in South Africa currently especially in maths and science."*
>
> *22 year old IsiXhosa speaking male from UWC*

> *"I see it as a necessary contribution of mine to our country. It is my attempt at dealing with the privilege placed in my lap strongly related to the colonist and subsequent apartheid regimes. It is not a matter of "giving back" but rather of taking ownership of my privilege as a white heterosexual male in South Africa and making a worthy contribution to the continued struggle for the liberation of black people (all those people of colour, the oppressed). There is not much else to care about."*
>
> *23 year old Afrikaans speaking male from the US*

> *"I went to a lecture by Max du Preez where he said that there is no point being an academic if you are not giving back to society. I have grown tired of people complaining about the state that the country is in, and I strongly believe that education is the best tool for transformation that we have."*
>
> *22 year old English speaking male student from UCT*

"I am interested, yet concerned about the education situation in South Africa and want to be part in developing the system. . . . . I want to work in an environment where I can display my knowledge and experience and apply it to the context of helping others to develop themselves and live up to their potential."

22 year old English speaking male from UCT

Half of the respondents believe that they can influence and develop young minds to take the nation forward, encourage them to do their best by developing their potential and impart their own "love of mathematics".

"I thought that maybe I should be a maths teacher because this would combine my love of (and ability for) maths with my desire to help others."

22 year old female English speaking student from UCT

"I chose it because I like to make a change in people's life and I was also influenced/motivated by my high school mathematics teacher. I believe that I can help Eastern Cape Province to improve the pass rate given a chance."

22 year old IsiXhosa speaking male from UCT

"I am studying to become a math teacher because I believe in the social humanity of developing young children. I believe I have been called to serve in an area where there is much demand for maths teachers. I am extremely passionate about maths and its significance and importance in the world and I intend to share that with my students. I have always wanted to be in a 'serving' occupation and this is the path I find myself (sic)."

21 year old female English speaking student from UCT

"I choose to become a teacher because I have noticed most pupils are struggling with mathematics. I want to improve some of pupils (sic) knowledge and understanding in mathematics."

27 year old isiZulu speaking male from UCT

"Where I come from, there are (sic) lack of mathematics teachers, learners spend about the whole term without a teacher. I would like to help by becoming a teacher and help them with difficulties they encounter in maths subject (sic). I also love to interact with young mind (sic) and encourage them in their studies."

24 year old Setswana speaking female from UWC

This result corresponds with the findings in the literature – social utility values include the major factors influencing young people to choose teaching as a career overall.

6.3.6 Prior teaching and learning experiences

Although the mean score for this factor was a moderate 5.3, the candid responses of the students show the impact that their teachers had on their choice. Their love of the subject mathematics is clear from their discussions.

The impact of eleven (27.5%) students' mathematics teachers at school was a major factor in their choice of career. Three (7.5%) had bad experiences and want to improve the way mathematics is taught at school, while eight (20%) others were inspired by their teachers' passion for teaching mathematics and the confidence that the teachers helped them gain.

"I love mathematics and have a passion for the subject. This has been for my whole schooling career. I also feel that the standard of mathematics teacher (sic) in this country is very low and the jump between school and university level is very high. I want to try and make a change and give the students of South Africa a good mathematics education. I also want to pass my love for the subject on to the students and show how it can be fun."

22 year old English speaking female from UCT

"When I went to schools in the townships for my teaching observation, I realised that the math teachers were teaching some incorrect methods to the learners. That is when I decided I want to teach."

23 year old IsiXhosa speaking female from UCT

"While at school I had both bad and good experiences in terms of my maths teachers. It's my desire to write (sic) the wrongs related to school maths and perhaps change how pupils think of maths."

29 year old IsiZulu speaking male from UCT

"I am extremely passionate about maths and its significance and importance in the world and I intend to share that with my students. I was so heavily impacted by my great maths teachers at school, who showed me how to love and understand maths."

21 year old English speaking female from UCT

"I also wanted to be able to instil the confidence my maths teacher gave to me in high school in my own learners one day."

22 year old English speaking female from UCT

6.3.7 Social influences

This factor refers to the influence of others in the students' choice of teaching. The mean score of 3.45 shows that the influence of friends and family was not a major reason for their choice. It is interesting to note that 30% of the students have one or both parents in the teaching profession.

"My mom is a mathematics teacher and she is very passionate about her subject and that persuaded met to pursue teaching as a career."

23 year old Afrikaans speaking male from US

"I never intended to be a teacher at all until the day I came looking for my admission into the PGCE programme as my last resort. My parents (both teachers) told me how they would have done other fascinating careers which were also rewarding in terms of salary."

26 year old Sepedi speaking female from UWC

"My dad applied for the FUNZA bursary in my final school year." (translated)

21 year old Afrikaans speaking female from US

6.3.8 Task demand and task return

Being the factor with the highest score of 5.96, it is clear that most of the students believe that teaching is a demanding career requiring expert knowledge. On the other hand, with low scores of 3.51 for "social status", 3.8 for "teacher morale" and 2.73 for "salary" giving an overall mean score of 3.42 for task return, it can be deduced that the compensation for this demanding job is not believed to be extrinsic rewards.

> *"Many young people take teaching as a small or non-professional career since it has been a less paying professional (sic). I take it as a very important professional (sic) because it produces a lot of other professionals."*
>
> *22 year old IsiXhosa speaking male from UCT*

> *"It is to try to make teaching more fun, to make it learner centered (sic), as opposed to teacher centered (sic) where learners recieve (sic) or accept everything the teacher says and cram it and give it back to the teacher in a test and exam."*
>
> *28 year old IsiZulu/IsiXhosa speaking male from UWC*

> *"I want to be trained as a mathematics teacher to be able to obtain a thorough and in depth subject knowledge as well as to be successful in transferring the knowledge to my students." (translated)*
>
> *21 year old Afrikaans speaking female from US*

6.3.9 Social dissuasion and satisfaction with choice

With a mean score of 5.79 for "satisfaction with choice" the students are quite satisfied with their choice of teaching as a career even though it was not the first choice for some of them. They do indicate that, probably because of the perception of others that teaching does not pay well and does not have the professional status it deserves, they have been discouraged by parents and others to choose a different career. The current state of education in South Africa may contribute to the negativity towards teaching as a career, but can also motivate young pupil to pursue teaching as a career, because they want to make a difference.

“The current state of education in South Africa is very demotivating, learners drop out and in most cases do not see the essence of learning. I believe if learners are groomed by teachers that believe in them and have a clear understanding of where they come from, (sic) is a strong tool to groom brave young people who can take this country forward.”

24 year old IsiXhosa speaking female from UCT

“Also, I went to a well-resourced school, but the teachers had clear faults and did not present the material in a way that I approve of. I feel that I can try change the misconception that teaching is a low-paid job for people who couldn’t do anything else.”

22 year old English speaking male from UCT

“From a very young age, I knew I wanted to become a teacher. I was persuaded otherwise for my undergraduate degree. However, I am glad I reverted back to my goal.”

24 year old Creole speaking male from UCT

Table 10: Means of teaching motivations per university, gender and first language

Section B:Influential factors

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Ability	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.5	5.48	5.36	5.32	5.59	5.18	5.63	5.57	5.89	5.44
Intrinsic_career_value	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.33	5.3	5.04	5.12	5.33	4.51	5.23	5.87	7	5.22
Fallback_career	N	16	9	15	22	18	17	10	10	3	40
	Mean	2.33	1.96	3.11	2.68	2.37	3.43	2.07	1.9	1.22	2.54
Job_security	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.9	4.78	4.42	5.03	4.28	4.57	5	4.77	4.11	4.69
Time_for_family	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.06	4.67	3.87	4.61	3.54	4.14	4.57	3.77	3.78	4.13
Job_transferability	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.48	4.59	3.69	4.55	3.8	4.14	4.57	4.37	2.89	4.21
Bludging	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.22	4.22	3.43	3.77	3.22	3.88	4.45	2.7	1.17	3.53
Personal_utility	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.25	4.6	3.9	4.55	3.76	4.21	4.66	4.01	3.15	4.2
Shape_future	N	16	9	15	22	18	17	10	10	3	40
	Mean	6.13	5.94	5.8	5.89	6.06	5.68	5.95	6.25	6.67	5.96
Enhance_equity	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.72	5.06	5.03	5.39	5.22	5.65	5.1	5.25	4.33	5.31
Make_contribution	N	16	9	15	22	18	17	10	10	3	40
	Mean	6.17	5.41	5.84	5.79	5.98	5.84	5.47	6.17	6.44	5.88
Work_with	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.34	5.83	4.82	5.27	5.24	4.62	5.78	5.75	5.5	5.26

Social_utility	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.78	5.6	5.31	5.54	5.58	5.33	5.6	5.86	5.76	5.56
Prior_experiences	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.23	5.48	5.27	5.8	4.69	5.53	5.43	4.87	5	5.3
Social_influences	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.17	4.22	3.29	3.77	3.06	3.69	4.17	2.77	2	3.45

Section C: Beliefs about teaching

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Expert_career	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.41	6.11	6.03	5.7	5.92	5.44	6.15	5.85	6.5	5.8
High_demand	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.73	6.67	6.03	6.21	5.86	5.8	6.63	6.13	5.28	6.05
Task_demand	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.6	6.44	6.04	6.01	5.89	5.66	6.44	6.02	5.82	5.96
Social_status	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.5	3.7	3.4	3.27	3.8	3.37	3.5	3.3	5	3.51
Teacher_morale	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.73	4.11	3.69	3.61	4.04	3.78	3.83	3.4	5.11	3.8
Good_salary	N	16	9	15	22	18	17	10	10	3	40
	Mean	2.47	3.11	2.77	2.52	2.97	2.68	3.2	2.1	3.5	2.73
Task_return	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.33	3.71	3.35	3.21	3.68	3.35	3.55	3.04	4.67	3.42

Section D: Your decision to become a teacher

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Social_dissuasion	N	15	9	15	21	18	16	10	10	3	39
	Mean	4.89	5.37	4.98	4.98	5.09	5.04	5.2	4.87	5	5.03
Satisfaction	N	15	9	15	21	18	16	10	10	3	39
	Mean	5.73	6.07	5.67	5.92	5.63	5.54	5.9	5.97	6.11	5.79

6.4 Comparisons

6.4.1 Gender

From the ANOVA analysis it can be concluded at a significance level of 5% that there is a significant difference in the effect of the influential factors “time for family”, “job transferability”, “personal utility” and “prior experience” on the choice of teaching as a career between males and females. The mean scores for females were higher than that of males on all four aspects. The higher mean score for “time for family” for females reflects the females’ traditional role as the primary person to look after and nurture the family. The higher score for “job transferability” for females can be explained by the wife being able to find employment more readily in locations where her husband (the traditional breadwinner) is employed. “Personal utility value” is a higher order factor combining “job security”, ”time for family” and “job transferability”. “Prior experiences” refer to the influence of teachers as being inspirational and role models as well as positive earning experiences at school.

Table 11: Gender comparisons

	Time for family		Job transferability		Personal utility (higher-order)		Prior experiences	
Gender	Mean	Pr	Mean	Pr	Mean	Pr	Mean	Pr
Female	4.606	0.0259	4.545	0.0425	4.554	0.0148	5.803	0.0105
Male	3.537	<0.05	3.796	<0.05	3.757	<0.05	4.685	<0.05

The mean scores for beliefs about teaching and the students’ decision to become a teacher were not significantly different between the genders.

6.4.2 Home Language

Home language was categorised as English, Afrikaans, Indigenous South African languages and foreign languages. At a significance level of 5% differences between the means of the home languages were identified for the factors “intrinsic career value”, “fall-back career”, “bludging”, “work with children/adolescents” and “high demand.”

The mean score for foreigners is the highest for the factor “intrinsic career value” rating the factor at the maximum value of 7. They indicated that they are very interested in teaching and were always interested in becoming a teacher. The paired differences have been identified to exist between English first language students and Indigenous African language speakers, foreign language speakers and African speakers as well as between Afrikaans and Foreign language speakers. The African speakers rated “intrinsic career value” lower than the other three language groups.

“Fall-back career” differences were between African speakers and each of the other three languages individually. Although the means of this factor for all four language groups are low, the African speaking respondents gave a higher rating to this factor than the other three groups.

“Bludging” is a concept mainly used in Australia meaning “to evade work” or “undemanding employment”. Perceiving being a teacher an easy” job as a factor differs significantly between all the languages in pairs except between Afrikaans and African as well as between English and foreign language speakers. The Afrikaans and African speaking respondents rated “bludging” significantly higher than the other two groups.

“Work with children/adolescents” have significantly different means when African speakers are compared with Afrikaans speakers and also when African speakers are compared with English speakers. The Afrikaans and English speakers had similar highest ratings for working with children, with African speakers rating this factor lowest of the four language groups.

The belief that teaching is a demanding career seen as a “difficult” job differs between African and Afrikaans speakers (who rated this factor the highest) as well as between Afrikaans and Foreign language speakers. The African and Foreign language speakers did not rate “high demand” as high as the Afrikaans speaking group.

Cultural differences, indicated by the different home languages of students in the Western Cape Province of South Africa, have an influence on how the factors that motivate students to choose mathematics teaching as a career are rated.

Table 12: Home language comparisons

	Intrinsic career value		Fall-back career		Bludging		Work with children/ adolescents		High Demand	
	Mean	Pr	Mean	Pr	Mean	Pr	Mean	Pr	Mean	Pr
African	4.510	0.0059 <0.05	3.431	0.0038 <0.05	3.882	0.0030 <0.05	4.618	0.0428 <0.05	5.804	0.0445 <0.05
Afrikaans	5.233		2.067		4.450		5.775		6.633	
English	5.867		1.900		2.700		5.750		6.133	
Non-SA	7.000		1.222		1.166		5.500		5.278	

Intrinsic career value means				
	1	2	3	4
1		0.1489	0.0089	0.0026
2	0.1489		0.2574	0.0358
3	0.0089	0.2574		0.1704
4	0.0026	0.0358	0.1704	

Fall-back Career				
	1	2	3	4
1		0.0096	0.0041	0.0078
2	0.0096		0.7677	0.3124
3	0.0041	0.7677		0.4136
4	0.0078	0.3124	0.4136	

1 = African; 2 = Afrikaans; 3 = English; 4 = Non-SA

Bludging				
	1	2	3	4
1		0.3263	0.0454	0.0045
2	0.3263		0.0096	0.0013
3	0.0454	0.0096		0.1124
4	0.0045	0.0013	0.1124	

Work with children/adolescents				
	1	2	3	4
1		0.0174	0.0197	0.2342
2	0.0174		0.9620	0.7219
3	0.0197	0.9620		0.7462
4	0.2342	0.7219	0.7462	

1 = African; 2 = Afrikaans; 3 = English; 4 = Non-SA

High demand				
	1	2	3	4
1		0.0180	0.3316	0.3238
2	0.0180		0.1915	0.0192
3	0.3316	0.1915		0.1305
4	0.3238	0.0192	0.1305	

1 = African; 2 = Afrikaans; 3 = English; 4 = Non-SA

Afrikaans and English are largely the home languages of the “white” and/or “coloured” people in South Africa, while the “black” people speak one of the African languages at home.

6.4.3 Different Universities

The three universities only differed significantly (at a significant level of 5%) with regards to the belief that teaching is a demanding career. The analyses of the comparisons by pairs indicate that UCT and US differ with regards to high demand and also with regards to the higher factor “task demand” which is the combination of “expertise” and “high demand”. The US students had the largest mean score for “high demand” and “task demand”.

Table 13: University comparisons

	High demand		Task demand (higher-order)	
	Mean	Pr	Mean	Pr
UCT	5.729	0.0397 <0.05	5.600	0.0409 <0.05
US	6.667		6.444	
UWC	6.033		6.043	

High demand			
	1	2	3
1		0.0117	0.3248
2	0.0117		0.0848
3	0.3248	0.0848	

Task demand (higher-order)			
	1	2	3
1		0.0138	0.1241
2	0.0138		0.2326
3	0.1241	0.2326	

1 = UCT; 2 = US; 3 = UWC

6.5 Conclusion

Nearly half of the PGCE students with mathematics as a subject are male, half of them are Funza Lusaka bursary holders, most of them want to teach in the Western Cape after they qualify, a quarter of them have changed their original choice of career to teaching and 30% of them have one or more parents that are teachers. The white Afrikaans speaking students from the US are on average the youngest and have the highest average Grade 12 mathematics mark while the percentage of males in this group is the lowest.

The factors that have the largest influence on students of mathematics to choose teaching as a career are intrinsically motivated. The opportunity to make a difference in the lives of children, the community and the country are highly rated. The students are satisfied with their choice of career and believe that they have the knowledge and ability

to be good teachers while they admit that mathematics teaching is a demanding career. They acknowledge the mostly positive impact of their mathematics teachers and their own experiences at school in their decision to become mathematics teachers.

The job security of teaching as a profession, the mobility in terms of where they can work and the perception that they will have more leisure time and more time for family were less important factors in their career choice. They rated the factor that teaching is a “fall back” career lowest. The students also indicated remuneration, the status of teaching and teacher morale as the least important motivations.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Limitations of this study

The research was restricted to three universities in the Western Cape, one of nine provinces in South Africa. Although the sample used is heterogeneous in its composition, the proportions of different language and race groups in the sample are not representative of the country as a whole. There are currently 23 universities and universities of technology offering teaching programmes in South Africa with the recent opening of two universities in Mpumalanga Province and the Northern Cape Province. One of the universities, UNISA, is a distance learning institution while the others are contact universities and universities of technology.

7.2 Conclusions

Intrinsic motivation factors had the biggest influence on PGCE students of mathematics to choose teaching as a career which corresponds with the trend in developed countries. Making a social contribution was rated as one of the most important reasons. This can be explained by the inequalities in the society as well as the disparate schooling of the majority of children in South Africa. The Eastern Cape, where some of the students originate from, is particularly troubled by a lack of resources and a shortage of quality teachers.

> *"In January, we were called by the Department of Education to come and work here. There are no roads, it's underdeveloped. There are so many psychological and emotional problems with the learners, so five of the [teachers] left because of the area. – Lazola, teacher, Eastern Cape, South Africa" EFA (2015:249).*

Students overwhelmingly stated that they want to make a difference in the lives of children and the community. The largest problems in education in South Africa occur in the remote rural areas where the population is mostly poor, as is the case globally. These are also the areas in South Africa where the mother tongue is an African

language. The government will have to prioritise strategies to recruit and retain competent teachers to these areas by offering incentives, improved subsidised living conditions, smaller classes, better equipped schools and competent supportive managers.

The students in the survey are mostly satisfied with their choice of career, because they believe that they can make a difference in the lives of children by providing them with a necessary scarce skill by teaching them mathematics. They have already accomplished a high level mathematics qualification that they can plough back. They realise that to be able to teach mathematics efficiently, they have to know their subject well. They believe that being a mathematics teacher is an expert career and they are prepared to work hard – they have chosen teaching in spite of the fact that it is a demanding career. The students accept that teaching is not an easy option by rating 'bludging' low. They did not choose teaching because they will have long holidays and short working days.

The low status of the teaching profession has a negative impact on the recruitment and retention of teachers. When the status of the profession rises, motivation and job satisfaction increase which positively affect student learning. Teachers' salaries when compared to other occupations contribute to the perception of teaching as a low status career. Teachers can be motivated by offering an appealing career path. Staffing remote and deprived areas with quality teachers will be easier if incentives and/or promotions are offered to those teachers. Gambia offers "hardship allowances" in the range of 30% - 40% to recruit teachers to work in remote schools (EFA 2015a:4).

A question that arises due to the difference in the ratings of task demand (high) and task return (low) is whether their intrinsic motivation would be sufficient to make up for the low social status, low salary and lack of professional advancement opportunities which they have identified in the survey. The CET, a sub-theory of SDT, which focuses on the needs for competence and autonomy specifies that "feelings of competence will not enhance intrinsic motivation unless accompanied by a sense of autonomy" (Ryan and Deci 2000a:70). Intrinsic motivation is sustained and enhanced by supportive actions. The sustainability of intrinsic motivations is thus more important than the cause thereof. It was found that "optimal challenges, effectance-promoting feedback, and

freedom from demeaning evaluations . . . facilitate intrinsic motivation". It was also confirmed that " . . . not only tangible rewards but also threats, deadlines, directives, pressured evaluations and imposed goals diminish intrinsic motivation." On the other hand intrinsic motivation is boosted by ". . . choice, acknowledgement of feelings, and opportunities for self-direction" because it gives people a bigger feeling of autonomy (Ryan and Deci 2000a:70). Teachers who support autonomy in their teaching increase their pupils' intrinsic motivations and their inquisitiveness as well as a wish for challenges. Intrinsic motivation also depends on relatedness or connectedness. (Ryan and Deci 2000a:70-71).

The "new" generation has a different view on career changing. It has been envisaged that new entrants to the job market in the 21st century will change careers more often. This may happen once they have reached their goal in their current job and need a new challenge. The large demand for STEM graduates creates opportunities for teachers in the STEM field to pursue a new career. It is therefore essential to focus on the retention of beginner teachers, as many teachers leave the profession within the first five years. The factors that influence students to choose teaching as a career should be taken into account when the challenge of teacher retention is addressed. Induction and mentorship policies must be put in place to ensure that the beginner teachers' expectations of teaching are fulfilled. If their original motivations are not met, they may decide to leave the profession. The beginner teachers of today will become the leaders in education in the future and must be nurtured and developed to fulfil the demand for those future leaders.

The mentoring of newly qualified teachers is a prominent priority in countries with the highest PISA and TIMMS scores. In New Zealand first year teachers have a 80% work load and second year teachers a 90% work load. The extra time is allocated to coaching, observation of experienced teachers, taking part in professional development programmes and getting to know the curriculum. High performing countries in East Asia apply similar models to mentor their beginner teachers. (Darling-Hammond et al. in EFA 2015:244). "Therefore, the beginning teacher should be allocated fewer teaching hours, to allow more time for lesson preparation, induction activities and meetings with

mentors, who will also need time off teaching duties to perform their role effectively" (EC staff working document 2012:35).

Although the students did not rate 'fall-back career' as an important factor in their choice, quite a number of them did mention that teaching was not their first choice. It may be that once they have made the mind shift, they have decided to commit themselves to their second choice.

Uncertainty on initial career choice surfaced during the research. Inadequate career counselling is an important indicator of a field where more focus is needed. As intrinsic motivation was rated as the most important factor, career counsellors should utilise that when advising prospective students in their career choices. Students enrolling for a B Ed programme have to make the decision at the onset of their studies. However, PGCE students who had to graduate with two school subjects first, did not necessarily decide when they started their studies that they want to pursue teaching as a career. It is therefore important to also recruit students to become teachers at the university level. Recruiters of students should establish whether they are motivated by intrinsic factors in their choice of career in an attempt to enrol students in ITE that will be committed to teaching in the long run. Students who are intrinsically motivated to become teachers tend to be more committed to their career, more interested in professional development and have more leadership aspirations. They see teaching as a long term career. Providing more opportunities for promotion and advancement in the teaching profession will lead to higher retention figures among these teachers. An attempt to introduce the Occupation Specific Dispensation for Educators (Collective Agreement 1 of 2008 of the ELRC) initiated by the then minister of education, Ms Naledi Pandor, as a policy to create master teachers posts based on years of experience and qualification, was not successful due to the opposition of the teachers unions.

Introducing the Funza Lushaka bursary scheme has increased the numbers of students enrolling at teacher training institutions. Balancing the demand for certain types of teachers and subject specialisation with the allocation of the bursaries must be done carefully to ensure that the supply fits the demand. Just increasing the number of

teacher students without focusing on the quality of their training will not solve the problem of poor mathematics competency of pupils.

The PGCE students taking part in this study had to fulfil entry requirements before they could enrol to study mathematics as a subject at university. A university mathematics qualification presumes a certain level of mathematical competency which in turn provides the necessary confidence that a teacher of mathematics need to be able to be successful. Self-efficacy is therefore an essential requirement to be a quality mathematics teacher. Allowing pupils that have not shown adequate competency in mathematics at school level to enrol in a teacher training programme will lead to poor teaching and learning of the subject. It must be noted that the correlation between school mathematics marks and mathematics results at university is low (Wolmarans et al. 2010:283). Wolmarans et al. suggest that increasing the entry requirements is not the only way to ensure that students are prepared for university mathematics. “Teaching to the test”, examination “coaching” and teachers with poor pedagogical skills are factors that influence the preparedness of pupils with acceptable mathematics NSC marks for further studies in mathematics. Teaching that does not focus on the deep understanding of mathematical concepts, creativity, innovation and contextualising the material, but rather focus on procedural skills, will not provide pupils with the problem solving skills that are required. HEI’s and schools should collaborate on the skills needed to ensure success at HEI’s. The teacher training institutions should therefore ensure that they produce teachers with sufficient subject and pedagogical knowledge. Professional development of teachers and trainers is a necessity to continuously improve teaching and to adapt to changes in education. Teachers and trainers of teachers need to be lifelong learners.

The first group of pupils following the OBE curriculum wrote their NSC examinations in 2008 and performed poorly in their mathematics examinations. Wolmarans et al. suggest that the OBE curriculum was not the only cause for the poor results. “. . . any discussion that simply focuses on scepticism regarding the 2008 NSC mathematics results, is likely to be a red herring: it distracts from the potentially much more serious issues of mathematics teaching and learning at school level, as well as the assumptions

made by higher education institutions about the mathematical skills of incoming students" (Wolmarans et al. 2010:284).

"Effective teaching start with teachers who know their subject matter" (EFA 2015a:6). Ideally pupils should obtain the necessary competency at school before they enrol in a teaching course, but that is often not the case. HEI's often lack the resources to improve students' subject knowledge. Some Universities in South Africa offer a bridging year for students to improve inter alia their mathematical skills. In Ghana teacher trainees have to pass an examination on academic subjects at the end of their first year before they start focusing on pedagogical skills. Initial teacher education is not always sufficient to prepare students for their profession. They have to be competent to be self-efficient in order to be satisfied with their career choice. (EFA 2015a:7) When students have mastered their knowledge and understanding of a subject, they are intrinsically motivated and prepared to challenge themselves. They recover swiftly from failures and are more prone to be successful in their careers. Competency is therefore a prerequisite for success and satisfaction as a teacher. Competence without autonomy will however not enhance intrinsic motivation.

> *"I absolutely loved maths in high school, to the point where I enjoyed it so much; I understood it well and could link concepts across sections. I also had really good maths teachers who inspired me. I would like to do for young learners what they did for me. I was always encouraged, always pushed to do my best. My mindset towards maths was that it was fun, not work, which is why I enjoyed it, and then why I did well in it."*
>
> *22 year old English speaking female from UCT*

Teachers wanting to study further than their initial degree in South Africa find it difficult due to the lack of funding, time and support from the department of education. One of the students taking part in the research stated that she was not permitted to enrol for an honours degree because she had a Funza Lushaka bursary commitment. There is a trend in the member countries of the EU towards requiring a Master's degree before entering the teaching profession. They also provide attractive possibilities for professional development including to study up to the PhD level to be able to ". . . place

teaching on a par with other high status professions" (EC staff working document 2012:31). There is a need for more research on education done by current teachers in South Africa. Reinstating "long leave" or a sabbatical for teaching staff should be considered for those who want to further their studies.

The EFA global monitoring report team recommends in the background paper for the Oslo Summit on Education for Development on 6 – 7 July 2015 that firstly, all role players at the system level should develop a shared insight of what is required to provide good teachers and effective teaching to all learners, secondly, ITE and continuous professional development should be revisited and adapted whilst encompassing increasing classroom challenges and thirdly "the need for effective participatory school leadership" focused on effective teaching and learning must be realised as well as the demand for necessary resources (including well paid teachers) must be met. They agree that an investment in teachers will have the greatest influence on improving learning. "It is a prerequisite to allow the transformative power of education to occur" (EFA 2015b:14).

> "*The quality of an education system cannot exceed the quality of its teachers and principals, since student learning is ultimately the product of what goes on in classrooms" (OECD 2010:4).*

The 2010 OECD report on the PISA 2009 results concurs that governments, professional and other partnerships realise that they have to take note of their recruitment methods and pool from which they recruit, pre-service training, the mentoring and induction of new employees, continued professional training and development, remuneration, incentive and reward systems, how to assist those who struggle and also ensure that top performers are granted promotion opportunities.

> *"Last but not least, the most impressive outcome of world-class education systems is perhaps that they deliver high quality learning consistently across the entire education system, such that every student benefits from excellent learning opportunities" (OECD 2010:4).*

How do successful education systems provide effective teaching? " . . .they invest educational resources where they can make the greatest difference, they attract the most talented teachers into the most challenging classrooms, and they establish effective spending choices that prioritise the quality of teachers" (OECD 2010:4-5). However, if coherence in the development and implementation of policies over all the aspects of the education system over time is not present, the system will not be successful.

In South Africa, the transformation of education has been burdened by political, social and practical issues. If a country does not have competent teachers and well-resourced schools, professional autonomy opposed to administrative and bureaucratic control will not be feasible. All role players should have consensus on the required subject knowledge and skills of teachers and learners necessary for the 21st century before authority and autonomy can be devolved to the classroom teacher level. It is therefore vital to reform education so that recruited high-quality teachers are not frustrated by a perceived inefficient ITE, poor conditions at schools, overcrowded classrooms, the absence of professional development opportunities and promotion, and a lack of support. They may then decide to switch to a different profession (OECD 2010:5).

> *These are daunting challenges and thus devising effective education policies will become ever more difficult as schools need to prepare students to deal with more rapid change than ever before, for jobs that have not yet been created, to use technologies that have not yet been invented and to solve economic and social challenges that we do not yet know will arise. But those school systems that do well today, as well as those that have shown rapid improvement, demonstrate that it can be done" (OECD 2010:5).*

The implication of the findings is that prospective teachers are mainly motivated intrinsically. Their initial decision to choose teaching as a career is less dependent on extrinsic factors such as salary, lengthy vacations and job security. Recruitment strategies and interventions to ensure the retention of teachers should therefore focus on creating environments where they can fulfil their calling as a teacher. Overcrowded classrooms, excessive administrative

duties, lack of support, inadequate training and poor subject knowledge should be addressed to boost self-efficacy and contentment.

7.3 Suggestions for future research

Future research may focus on the recruitment of primary school teachers as the shortage of quality mathematics teachers in Grades 4 to 7 was identified as a problem that needs to be addressed. It may also be necessary to investigate the specialisation of mathematics teaching in Grades 4 to 7 to give the pupils the best possible opportunity to become competent in mathematics from an early age. The mathematics entry requirements at teacher training institutions for junior school teachers can be explored.

The study can be extended to the other 8 provinces in South Africa to investigate why students with mathematics as a major subject choose teaching as a career.

More in depth, qualitative interviews with these student teachers will add to the knowledge base for making the right decisions when recruiting and selecting students that will be committed to teaching as a career.

Other questions that emerge are: How does the quality of mathematics teachers graduating from universities of technology compare to those from other traditional universities? How does the subject and pedagogical knowledge of B Ed students compare to those who qualify with a PGCE?

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NOTES

1. The CESifo Group, consisting of the Center for Economic Studies (CES), the Ifo Institute and the CESifo GmbH (Munich Society for the Promotion of Economic Research) is a research group unique in Europe in the area of economic research.

2. The Centre for Development and Enterprise (CDE) is an independent policy research and advocacy organisation. It is one of South Africa's leading development think tanks, focusing on critical national development issues and their relationship to inclusive economic growth and democratic consolidation. By examining South African and international experience, CDE formulates practical policy proposals outlining ways in which South Africa can tackle major social and economic challenges. CDE has a special focus on the role of business and markets in development.

3. The International Association for the Evaluation of Educational Achievement (IEA) is an independent, international cooperative of national research institutions and governmental research agencies. It conducts large-scale comparative studies of educational achievement and other aspects of education. The IEA Teacher Education and Development Study in Mathematics (TEDS-M) is a comparative study of primary and secondary mathematics teacher education including the preparation of those teachers. It examined how different countries have prepared their teachers to teach mathematics in primary and lower-secondary school. TEDS-M paid particular attention to links between teacher education policies, practices, and outcomes. By participating in the study, countries were provided with an opportunity to conduct research on their own teacher education system and to learn from the approaches used in other countries. TEDS-M asked several key research questions:
   - What is the national policy context for mathematics teacher education?

- What are the main characteristics of mathematics teacher education programs, and how do they vary across countries?
- What is the level of mathematics and related teaching knowledge acquired by prospective primary and secondary mathematics teachers?

Developmental work on TEDS-M began in 2005. The main data collection was carried out during the period October 2007–August 2008. The report on teachers' salaries was published in 2009. The international report, international database, and accompanying user guide were released in April 2012. The policy report was released in June 2013.

4. The European Commission is the EU's executive body. It represents the interests of the European Union as a whole (not the interests of individual countries). The term 'Commission' refers to both the College of Commissioners and to the institution itself. The Commission is divided into several departments and services. The departments are known as Directorate-Generals (DGs). The DG's education and training activities focus primarily on policy cooperation; helping countries learn from one another and work together to improve education across Europe.

5. The Annual National Assessments (ANA's) are standardised national assessments for languages and mathematics in the senior phase (grades 7 - 9), intermediate phase (grades 4 – 6) and in literacy and numeracy for the Foundation Phase (grades 1 – 3). The question papers and marking memoranda (exemplars) are supplied by the national Department of Basic Education and the schools manage the conduct of the tests as well as the marking and internal moderation. These assessments are conducted during September of each year.

6. The Human Sciences Research Council (HSRC) was established in 1968 as South Africa's statutory research agency and has grown to become the largest dedicated research institute in the social sciences and humanities on the African

continent, doing cutting-edge public research in areas that are crucial to development.

7. The Funza Lushaka Bursary Programme is a multi-year programme to promote teaching as a profession. Bursaries are available to enable eligible students to complete a teaching qualification in an area of national priority. Recipients of these bursaries will be required to teach at a public school for the same number of years that they received the bursary.

8. The Council on Higher Education (CHE) is an independent statutory body established by the Higher Education Act, no. 101 of 1997 (amended). The CHE is the Quality Council for Higher Education, advises the Minister of Higher Education and Training on all higher education issues and is responsible for quality assurance and promotion through the Higher Education Quality Committee.

9. The Business-Higher Education Forum is the U.S.'s oldest organisation of senior business and higher education executives dedicated to advancing solutions to U.S. education and workforce challenges. Through the member-led National Higher Education and Workforce Initiative, BHEF is committed to developing new undergraduate pathways needed to keep regions, states, and the nation economically competitive.

APPENDICES

PERSONAL DETAILS

Form no . . . . . .

Please complete the following by using "X" or writing in the space provided:

University of Stellenbosch		University of Cape Town		University of the Western Cape	

Male		Female		Age in years	

South African Citizen:	Yes		If no, give country of origin	

Hometown	

Home language		Second language	

Occupation(s) of Parent(s):	Mother		Father	

Bursary holder:	No	If yes, please specify name of bursary	

Name of High School attended		Town/City	

Matric mathematics mark (symbol or code)		Year matriculated	

Highest tertiary qualification (if applicable)

University mathematics courses/modules passed	

Geographical area where you will prefer to teach: (tick one box)			
Western Cape		North West Province	
Northern Province		Gauteng	
Limpopo Province		Kwazulu Natal	
Mpumalanga		Any Province in South Africa	
Eastern Province		Other (Please specify)	
Free State			

QUESTIONNAIRE

PART A

Please briefly state your main reason(s) for choosing to become a teacher:

PART B – INFLUENTIAL FACTORS

For each statement below, please rate how important it as in **YOUR** decision to become a teacher, from **1** (not al all important in your decision) to **7** (extremely important in your decision).
Please type an **X** in the block of the number that best describes the importance of each.

" I chose to become a teacher because . . ."

		not at all important						extremely important
		1	2	3	4	5	6	7
B1	I am interested in teaching							
B2	Part –time teaching could allow me more family time							
B3	My friends think I should become a teacher							
B4	As a teacher I will have lengthy holidays							
B5	I have the qualities of a good teacher							
B6	Teaching allows me to provide a service to society							
B7	I have always wanted to be a teacher							
B8	Teaching will be a useful job for me when travelling							
B9	Teaching will allow me to shape child/adolescent values							
B10	I want to help children/adolescents learn							
B11	I was unsure of what career I wanted							
B12	I like teaching							
B13	I want a job that involves working with children/adolescents							
B14	Teaching will offer a steady career path							
B16	Teaching hours will fit with the responsibilities of having a family							
B17	I have had inspirational teachers							
B18	As a teacher I will have a short working day							
B19	I have good teaching skills							
B20	Teachers make a worthwhile social contribution							
B22	A teaching qualification recognised everywhere							
B23	Teaching will allow me to influence the next generation							
B24	My family think I should become a teacher							
B26	I want to work in a child/adolescent-centred environment							
B27	Teaching will provide a reliable income							
B29	School holidays will fit in with family commitments							
B30	I have had good teachers as role-models							

B31	Teaching enables me to 'give back' to society							
B35	I was not accepted into my first-choice career							
B36	Teaching will allow me to raise the ambitions of underprivileged youth							
B37	I like working with children/adolescents							
B38	Teaching will be a secure job							
B39	I have had positive learning experiences							
B40	People I've worked with think I should become a teacher							
B43	Teaching is a career suited to my abilities							
B45	A teaching job will allow me to choose where I wish to live							
B48	I chose teaching as a last-resort career							
B49	Teaching will allow me to benefit the socially disadvantaged							
*B52	Teaching is a fulfilling career							
*B53	Teaching will allow me to have an impact on children/adolescents							
*B54	Teaching will allow me to work against social disavantage							

PART C – BELIEFS ABOUT TEACHING

For each question below, please rate the extent to which **YOU** agree it is true about teaching, from **1** (not at all) to **7** (extremely).

Please type an **X** in the block of the number that best describes your agreement for each.

		not at all						extremely
		1	2	3	4	5	6	7
C1	Do you believe teaching is well paid?							
C2	Do you think teachers have a heavy workload?							
C3	Do you think teachers earn a good salary?							
C4	Do you believe teachers are perceived as professionals?							
C5	Do you think teachers have high morale?							
C6	Do you think teaching is a highly skilled occupation?							
C7	Do you think teaching is emotionally demanding?							
C8	Do you believe teaching is perceived as a high-status occupation?							
C9	Do you think teachers feel valued by society?							
C10	Do you think teaching requires high levels of expert knowledge?							
C11	Do you think teaching is hard work?							
C12	Do you believe teaching is a well-respected career?							
C13	Do you think teachers feel their occupations has high social status?							
C14	Do you think teachers need high levels of technical knowledge?							
C15	Do you think teachers need highly specialised knowledge?							

PART D – YOUR DECISION TO BECOME A TEACHER

For each question below, please rate the extent to which it is true for **YOU**, from **1** (not al all) to **7** (extremely).

Please type an **X** in the block of the number that best describes your agreement for each.

		not at all						extremely
		1	2	3	4	5	6	7
D1	How carefully have you thought about becoming a teacher?							
D2	Were you encouraged to pursue careers other than teaching?							
D3	How satisfied are you with your choice of becoming a teacher?							
D4	Did others tell you teaching was not a good career choice?							
D5	How happy are you with your decision to become a teacher?							
D6	Did others influence you to consider careers other than teaching?							

Helen Watt, School of Education, University of Michigan, 610 East University #4204D, Ann Arbor MI 48109-1259 USA. Tel: (+1 734) 647-1082, Fax: (+1 734) 936-1606, Email: hwatt@umich.edu. Paul Richardson, Faculty of Education, Monash University, Clayton Campus, Melbourne VIC 3800, Australia. Tel: (+61 3) 9905-2771, Fax: (+61 3) 9905-5400, Email: paul.richardson@education.monash.edu.au

INFORMED CONSENT LETTER

Researcher:
Michelle du Preez

1 Duke Alley
Somerset Country Estate
Somerset West
7130
T: +27(0)21 8525474

F: +27(0)21 8525005

Research Supervisor:
Prof Jonathan Jansen

Office of the Rector
The University of the Free State
Bloemfontein

Date: 24 March 2015

INFORMED CONSENT:

Dear Participant

I would like to invite you to take part in this research project:

The factors influencing mathematics students to choose teaching as a career

This study is about determining the motivations of students of mathematics to decide to pursue teaching as a career.

We would like you to participate with us in this research because you are a final year student with mathematics as a subject who has indicated that you are considering to become a mathematics teacher.

The reason we are doing this study is to be able to assist in the planning of the recruitment and retention of mathematics teachers in the future.

I am sure you will benefit from this study as it will help you to identify reasons why you have chosen teaching as career and will help to ensure that there are sufficient qualified mathematics teachers in the future.

While I greatly appreciate your participation in this important study and the valuable contribution you can make, your participation is entirely voluntary and you are under no obligation to take part in this study. If you do choose to take part, and an issue arises which makes you uncomfortable, you may at any time stop your participation with no further repercussions.

If you experience any discomfort or unhappiness with the way the research is being conducted, please feel free to contact me directly to discuss it, and also note that you are free to contact my study supervisor (indicated above).

Should any difficult personal issues arise during the course of this research, I will endeavour to see that a qualified expert is contacted and able to assist you.

Yours sincerely,

_____
Michelle du Preez

Please fill in and return this page. Keep the letter above for future reference

---

Study: The factors influencing mathematics students to choose teaching as a career

Researcher: Michelle du Preez

Name and Surname: _____

Age: _____

Major subjects: _____

Contact number: _____

- I hereby give free and informed consent to participate in the abovementioned research study.
- I understand what the study is about, why I am participating and what the risks and benefits are.
- I give the researcher permission to make use of the data gathered from my participation, subject to the stipulations he/she has indicated in the above letter.

Signature: _____ Date: _____

STATISTICAL DATA

Summary of Demographic Data

Categorical variables

The FREQ Procedure

UNIVERSITY	Frequency	%
UCT	16	40%
US	9	22.5%
UWC	15	37.5%

GENDER	Frequency	%
F	22	55%
M	18	45%

UNIVERSITY by GENDER			
UNIV	GENDER		
	F	M	TOTAL
UCT	8 50%	8 50%	16
US	7 77.78%	2 22.22%	9
UWC	7 46.67%	8 53.33%	15
TOTAL	22	18	40

Frequency
Row %

		FIRST LANGUAGE								ALL
		AFRIKAANS	CREOLE	ENGLISH	FRENCH	ISIXHOSA	ISIZULU	SEPEDI	SETSWANA	
AGE	N	10	1	10	2	12	3	1	1	40
	Mean	22.8	24	24.7	33	24.25	26.33	26	24	24.63
	Min	21	24	21	32	21	23	26	24	21
	Median	22	24	22	33	23.5	27	26	24	23
	Max	31	24	33	34	31	29	26	24	34
MATH CODE	N	10	1	10	1	12	3	1	1	39
	Mean	6.8	7	6.5	5	5.25	6	4	5	6.03
	Min	5	7	4	5	3	5	4	5	3
	Median	7	7	7	5	5	6	4	5	6
	Max	7	7	7	5	6	7	4	5	7

		UNIVERSITY			GENDER	
		UCT	US	UWC	F	M
AGE	N	16	9	15	22	18
	Mean	24.31	21.89	26.6	23.36	26.17
	Min	21	21	21	21	22
	Median	23	22	25	22.5	24.5
	Max	32	23	34	32	34
MATH CODE	N	16	9	14	22	17
	Mean	6.31	7	5.07	6.18	5.82
	Min	4	7	3	4	3
	Median	7	7	5	7	6
	Max	7	7	6	7	7

FIRST LANGUAGE		
	Frequency	%
AFRIKAANS	10	25
CREOLE	1	2.5
ENGLISH	10	25
FRENCH	2	5
ISIXHOSA	12	30
ISIZULU	3	7.5
SEPEDI	1	2.5
SETSWANA	1	2.5

UNIVERSITY by FIRST LANGUAGE									
UNIV	FIRST LANGUAGE								
	AFRIKAANS	CREOLE	ENGLISH	FRENCH	ISIXHOSA	ISIZULU	SEPEDI	SETSWANA	TOTAL
UCT	1	1	8	0	3	3	0	0	16
	6.25%	6.25%	50%	0%	18.75%	18.75%	0%	0%	
US	9	0	0	0	0	0	0	0	9
	100%	0%	0%	0%	0%	0%	0%	0%	
UWC	0	0	2	2	9	0	1	1	15
	0%	0%	13.33%	13.33%	60%	0%	6.67%	6.67%	
Total	10	1	10	2	12	3	1	1	40
	Frequency Row %								

TEACHER PARENT		
	Frequency	%
NO	28	70
YES	12	30

UNIVERSITY BY TEACHER PARENT			
UNIV			
	NO	YES	TOTAL
UCT	11	5	16
	68.75%	31.25%	
US	5	4	9
	55.56%	44.44%	
UWC	12	3	15
	80%	20%	
TOTAL	28	12	40

Frequency
Row %

DEGREE QUALIFICATION		
	Frequency	%
B TECH	1	2.5
BUSINESS	4	10
EDUCATION	1	2.5
ENGINEER	3	7.5
HUMANITIES	4	10
NDIP	1	2.5
SCIENCE	26	65

UNIVERSITY BY DEGREE QUALIFICATION								
UNIVERSITY	DEGREE QUALIFICATION							
	B TECH	BUSINESS	EDUCATION	ENGINEER	HUMANITIES	NDIP	SCIENCE	TOTAL
UCT	0	1	0	1	3	0	11	16
	0%	6.25%	0%	6.25%	18.75%	0%	68.75%	
US	0	2	0	1	1	0	5	9
	0%	22.22%	0%	11.11%	11.11%	0%	55.56%	
UWC	1	1	1%	1	0	1	10	15
	6.67%	6.67%	6.67%	6.67%	0%	6.67%	66.67%	
TOTAL	1	4	1	3	4	1	26	40

Descriptive Statistics
Section B

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Ability	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.5	5.48	5.36	5.32	5.59	5.18	5.63	5.57	5.89	5.44
	Min	2.67	4.33	3	2.67	2.67	2.67	4.33	2.67	4.67	2.67
	Median	5.33	5.33	5.33	5.17	5.67	5.33	5.67	5.83	6	5.33
	Max	7	6.67	7	7	7	7	7	7	7	7
Intrinsic_career_value	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.33	5.3	5.04	5.12	5.33	4.51	5.23	5.87	7	5.22
	Min	1.67	3.67	2.33	2.33	1.67	1.67	3.67	3.67	7	1.67
	Median	5.33	5.67	5	5.33	5.33	5	5.17	5.83	7	5.33
	Max	7	7	7	7	7	6.33	7	7	7	7
Fallback_career	N	16	9	15	22	18	17	10	10	3	40
	Mean	2.33	1.96	3.11	2.68	2.37	3.43	2.07	1.9	1.22	2.54
	Min	1	1	1	1	1	1	1	1	1	1
	Median	2	2	3	2.17	2.33	3	2.17	1.83	1	2.33
	Max	7	3	5.67	7	5	7	3	4	1.67	7
Job_security	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.9	4.78	4.42	5.03	4.28	4.57	5	4.77	4.11	4.69
	Min	2.33	4.33	1.33	2.67	1.33	1.33	4.33	2.33	3	1.33
	Median	5	4.67	4.67	5	4.5	4.33	4.67	5	4.67	4.67
	Max	7	5.67	7	7	7	7	7	7	4.67	7
Time_for_family	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.06	4.67	3.87	4.61	3.54	4.14	4.57	3.77	3.78	4.13
	Min	1.33	1	1.33	2.33	1	1.33	1	1.33	1.67	1
	Median	4.33	5.67	4	4.33	3.67	4.33	4.83	4.33	3.33	4.33
	Max	6.33	7	7	7	6.33	7	7	4.67	6.33	7
Job_transferability	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.48	4.59	3.69	4.55	3.8	4.14	4.57	4.37	2.89	4.21
	Min	3	3.33	1.67	3.33	1.67	1.67	3.33	3	2.33	1.67
	Median	4.17	4.33	3.67	4.33	3.67	4.33	4.33	4	2.67	4
	Max	6.33	7	5.33	7	6	5.67	7	6.33	3.67	7
Bludging	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.22	4.22	3.43	3.77	3.22	3.88	4.45	2.7	1.17	3.53
	Min	1	3.5	1	1	1	1	3.5	1	1	1
	Median	2.75	4	4	4	3.5	4.5	4	2.5	1	3.5
	Max	6.5	6.5	7	7	6.5	7	6.5	4.5	1.5	7

Personal_utility	N	16	9	15	22	18	17	10	10	3	40
	Mean	4.25	4.6	3.9	4.55	3.76	4.21	4.66	4.01	3.15	4.2
	Min	2.18	3.55	1.36	3	1.36	1.36	3.55	2.18	2.55	1.36
	Median	4.36	4.45	4.09	4.36	4	4.27	4.64	4.18	3	4.23
	Max	5.82	5.64	6.27	6.27	5.27	6.27	5.64	5.09	3.91	6.27
Shape_future	N	16	9	15	22	18	17	10	10	3	40
	Mean	6.13	5.94	5.8	5.89	6.06	5.68	5.95	6.25	6.67	5.96
	Min	5	4.5	1.5	1.5	3	1.5	4.5	5	6.5	1.5
	Median	6	6	6.5	6.25	6.25	6	6	6.25	6.5	6.25
	Max	7	7	7	7	7	7	7	7	7	7
Enhance_equity	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.72	5.06	5.03	5.39	5.22	5.65	5.1	5.25	4.33	5.31
	Min	2.5	3.5	2.5	2.5	2.5	2.5	3.5	2.5	3	2.5
	Median	5.75	4.5	5	5	5.25	6	4.75	5	4	5
	Max	7	7	7	7	7	7	7	7	6	7
Make_contribution	N	16	9	15	22	18	17	10	10	3	40
	Mean	6.17	5.41	5.84	5.79	5.98	5.84	5.47	6.17	6.44	5.88
	Min	3.67	4	2.33	2.33	3.67	2.33	4	3.67	5.67	2.33
	Median	6.5	5.67	6.67	6.17	6.17	6.67	5.67	6.67	6.67	6.17
	Max	7	6.67	7	7	7	7	6.67	7	7	7
Work_with	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.34	5.83	4.82	5.27	5.24	4.62	5.78	5.75	5.5	5.26
	Min	3.5	4.25	1.25	1.25	3.5	1.25	4.25	4	4.75	1.25
	Median	5.25	6	4.75	5.63	5.25	4.75	5.88	5.75	5	5.25
	Max	7	7	6.75	7	6.75	7	7	7	6.75	7
Social_utility	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.78	5.6	5.31	5.54	5.58	5.33	5.6	5.86	5.76	5.56
	Min	4	4.45	1.82	1.82	3.8	1.82	4.45	4	5.27	1.82
	Median	5.73	5.36	5.64	5.73	5.64	5.64	5.5	6.18	5.64	5.64
	Max	7	6.73	6.73	7	6.73	7	6.73	7	6.36	7
Prior_experiences	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.23	5.48	5.27	5.8	4.69	5.53	5.43	4.87	5	5.3
	Min	1.33	3.67	2.33	3	1.33	3.33	3.67	1.33	4.33	1.33
	Median	5.33	5.33	5.33	6.17	5	5.33	5.33	5.67	5.33	5.33
	Max	7	7	7	7	6.67	7	7	7	5.33	7
Social_influences	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.17	4.22	3.29	3.77	3.06	3.69	4.17	2.77	2	3.45
	Min	1	3	1	1	1	1	3	1.33	1	1
	Median	2.67	4	3	3.67	3	3	4	2.33	1.33	3.17
	Max	7	6.33	6.33	7	5.33	7	6.33	5.67	3.67	7

Descriptive Statistics
Section C

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Expert_career	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.41	6.11	6.03	5.7	5.92	5.44	6.15	5.85	6.5	5.8
	Min	1	5.5	4	1	4	1	5.5	4	6	1
	Median	6	6	6.5	6	6	6	6	6	6.5	6
	Max	7	7	7	7	7	7	7	7	7	7
High_demand	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.73	6.67	6.03	6.21	5.86	5.8	6.63	6.13	5.28	6.05
	Min	4.33	6	3.67	3.67	4.33	3.67	6	5	4.33	3.67
	Median	5.5	6.67	6	6.67	6	5.67	6.67	6.33	5.5	6.33
	Max	7	7	7	7	7	7	7	7	6	7
Task_demand	N	16	9	15	22	18	17	10	10	3	40
	Mean	5.6	6.44	6.04	6.01	5.89	5.66	6.44	6.02	5.82	5.96
	Min	3.4	6	4.6	3.4	4.6	3.4	6	4.6	5	3.4
	Median	5.8	6.6	6.2	6.2	6.1	5.8	6.5	6.2	6.2	6.1
	Max	6.8	7	7	7	7	7	7	7	6.25	7
Social_status	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.5	3.7	3.4	3.27	3.8	3.37	3.5	3.3	5	3.51
	Min	1.67	2	1	1	1	1	1.67	1.67	4.33	1
	Median	3.5	3.67	3	3.33	3.83	3.67	3.67	3	5.33	3.67
	Max	6.33	5	5.67	5	6.33	6.33	5	5.67	5.33	6.33
Teacher_morale	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.73	4.11	3.69	3.61	4.04	3.78	3.83	3.4	5.11	3.8
	Min	1.33	3	2	1.67	1.33	2	1.33	1.67	4	1.33
	Median	4	4.33	4	3.67	4.17	4	4	3.17	5.67	4
	Max	6	5	5.67	5	6	6	5	5	5.67	6
Good_salary	N	16	9	15	22	18	17	10	10	3	40
	Mean	2.47	3.11	2.77	2.52	2.97	2.68	3.2	2.1	3.5	2.73
	Min	1	1	1	1	1	1	1	1	2.5	1
	Median	2	3.5	3	2	3.25	2	3.75	1.75	3.5	2.5
	Max	5	5	6	6	5	6	5	4.5	4.5	6
Task_return	N	16	9	15	22	18	17	10	10	3	40
	Mean	3.33	3.71	3.35	3.21	3.68	3.35	3.55	3.04	4.67	3.42
	Min	1.88	2.63	1.38	1.63	1.38	1.38	2.13	1.88	3.75	1.38
	Median	3.38	4	3.13	3	3.75	3.63	3.88	2.56	5	3.69
	Max	5.88	4.5	5.25	5	5.88	5.88	4.5	4.75	5.25	5.88

Descriptive Statistics
Section D

		UNIVERSITY			GENDER		FIRST LANGUAGE				All
		UCT	US	UWC	F	M	AFRICAN	AFRIKAANS	ENGLISH	NON-SA	
Social_dissuasion	N	15	9	15	21	18	16	10	10	3	39
	Mean	4.89	5.37	4.98	4.98	5.09	5.04	5.2	4.87	5	5.03
	Max	7	6.33	7	7	7	7	6.33	6.33	7	7
	Min	3.67	2.67	2	2	3	2	2.67	3	4	2
Satisfaction	N	15	9	15	21	18	16	10	10	3	39
	Mean	5.73	6.07	5.67	5.92	5.63	5.54	5.9	5.97	6.11	5.79
	Max	7	7	7	7	7	7	7	7	7	7
	Min	3	4.33	3	3	3	3	4.33	4.33	5.33	3