The impact of teacher mentoring on student achievement in disadvantaged schools

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Abstract

The impact of teacher mentoring on student achievement has been researched extensively, but there are still gaps and disparities in the literature with regards to the size of the impact on student achievement, the generalizability of existing research, the length of mentoring needed as well as the time that it takes to achieve meaningful increases in student achievement in disadvantaged poor-performing schools.

The purpose of this research was to address these gaps in the research literature by doing a concurrent, matched but non-randomised control study to determine the impact of mentoring of teachers on student achievement in the school-university partnership between the UFS and disadvantaged poor-performing schools in its feeding area over a period of four years. The impact of mentoring teachers on the student achievement in accounting, mathematics and physical sciences were researched.

Large positive impacts were achieved in all the subjects. There was no significant time delay in the impact that mentoring had on student achievement. The impacts were achieved from the first year after mentoring started and were still present four years after mentoring started.

The practical significance of these findings is that student achievement in poor-performing disadvantaged schools can be meaningfully improved by mentoring teachers in these schools.

Keywords

Mentoring, student achievement, accounting, mathematics, physical sciences, disadvantaged schools, poor-performing schools, school-university partnership, effect sizes, teacher mentoring, learning in context, accomplished teaching, teacher.

Opsomming

Uitgebreide navorsing is gedoen oor die impak van die mentor van onderwysers op die prestasie van hulle studente. Daar bestaan egter nog steeds onduidelikhede in die literatuur ten opsigte van die grootte van die impak van mentorskap op studenteprestasie, die veralgemeenbaarheid van bestaande bevindings, die termyn nodig om ‘n onderwyser te mentor sodat betekenisvolle verbetering in studenteprestasie verkry word asook die aantal jare wat dit neem vanaf die aanvang van die mentorskap totdat betekenisvolle verbetering in studenteprestasie verkry word.

Die doel van hierdie studie was om hierdie onduidelikhede in die literatuur aan te spreek deur ‘n paralelle, vergelykende, willekeurige kontrolestudie te doen op die impak van mentorskap op onderwysers se studenteprestasie in ‘n skool-universiteitsvennootskap tussen die Universiteit van die Vrystaat en voorheen-benadeelde, swakpresterende skole in die universiteit se voedingsarea. Die impak op studenteprestasie in die vakke rekeningkunde, wiskunde en fisiese wetenskappe is nagevors.

Groot positiewe impakte is behaal in al drie die vakke. Daar was geen beduidende tydsverloop ten opsigte van die impakte nie. Die positiewe impakte is behaal vanaf die eerste jaar nadat die mentorskapsprojek begin is en het voorgekom in elke jaar daarna.

Die praktiese waarde van hierdie bevindings is dat studenteprestasie in voorheen-benadeelde, swakpresterende skole noemenswaardig verbeter kan word deur die onderwysers in hierdie skole te mentor.

Declaration

(i) I, H.S. van der Walt, declare that the Master's Degree research dissertation or publishable, interrelated articles, or coursework Master's Degree mini-dissertation that I herewith submit for the Master's Degree qualification Magister in Education at the University of the Free State is my own independent work, and that I have not previously submitted it for a qualification at another institution of higher education.

(ii) I, H.S. van der Walt, hereby declare that I am aware that the copyright is vested in the University of the Free State.

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(iv) I, H.S. van der Walt, hereby declare that I am aware that the research may only be published with the dean's approval.

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H.S. van der Walt

Date: 19 April 2016

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Chapter 1

Introduction

1.1 Background

A plethora of studies has explored the nature and effects of school-wide reforms in order to improve student learning and achievement (Elmore 2004; Fullan 2006; Hargreaves et al. 2010; Mintzberg 2005). School-wide reforms can be achieved by changing school contexts through learning in context (Fullan 2006). The changing of school contexts has the end result of accomplished teaching, which yields improved student learning and achievement (Linn et al. 2011). Learning in context can again be facilitated by teacher mentoring (Tovey 1999). Mentoring can, therefore, be used to improve student achievement.

The impact of teacher mentoring on student achievement has been researched extensively, but there are still important gaps and disparities in the literature. In fact, the magnitude of the impact on student achievement, the generalizability of existing research, the length of mentoring needed as well as the time that it takes to achieve meaningful increases in student achievement in disadvantaged, poor-performing schools are far from clear (Ingersoll & Strong 2011).

Therefore, the purpose of this study is to determine the impact of teacher mentoring on student achievement in a schools-university partnership designed to improve student achievement in disadvantaged poor-performing schools.

1.2 Rationale

By any measure of school achievement, national or international, South African schools are in a crisis (Arends et al. 2012; Clark 2014; Gilmour 2013; Ndlovu 2011). This is not for a lack of funding from the national government, for the democratic government spends more money on education in relation to GDP than any other African country, and education consistently takes the lion's share of the national budget (Jansen 2011). Neither does this underperformance of the school system stem from a lack of ideas. Radical curriculum reforms from government and specific project and programme reforms from inside and outside the state, have failed to stem the stagnation in educational achievement among the nation's 13 million learners (Jansen 2011).

Gilmour (2013) indicates that there has been a consistent and persistent low level of performance that has defied all manner of policy interventions. In the Annual National Assessment (ANA) of 2012 the most common score achieved by learners is lower than 20%. South African students' performance in internationally benchmarked science and mathematics studies has been equally embarrassing. South African students scored below the mean (512 points) in reading (492 points) and mathematics (500 points) in the Southern and East African Consortium for Monitoring Education Quality (SAQMEC III) benchmark test in 2007. Countries like Zimbabwe, Botswana, Kenya, and Swaziland outperformed South Africa in this test (Clark 2014). South African 9th graders performed among the bottom six countries at the grade 8 level and below the low-performance benchmark (400 points) for both science (332 points) and mathematics (352 points) of the 42 countries that participated in the Trends in International Mathematics and Science Studies (TIMSS) 2011 (Arends et al. 2012). The 2011 TIMSS results also showed a relationship between the poverty index of the school and achievement in science and mathematics.

South African schools are funded by the state according to a five-level poverty ranking or socio-economic status of the communities around them (Chutgar & Kanjee 2009). Schools in quintile 1 are considered the poorest, and those in quintile 5 are considered the least poor. When achievement in science and mathematics is analysed by quintile, disadvantaged schools in quintile 1–2 perform worse than better-resourced schools in quintiles 3-5 (Arends et al. 2012). Such a picture should be cause for discomfort for a country aspiring to be globally competitive in a knowledge-based economy. If student achievement in science and mathematics is to be predetermined or predestined by the type of school attended, rather than the student's innate potential, then many learners with potential will not be able to contribute optimally as citizens to the country's development – a badly missed opportunity, with dire long term socio-economic costs (Ndlovu 2011).

The question still remains: What explains the terminal character of the school's crisis, and what can be done urgently to turn around education achievement on a sustainable basis? In order to address this question, the University of the Free State (UFS) launched the UFS Schools Partnership Programme (UFS SPP) during 2011. One of the goals of the UFS SPP was to improve academic achievement of secondary school students in mathematics, physical sciences and accounting through the use of expert mentors to mentor subject teachers (Jansen 2011).

1.3 Statement of purpose and research questions

As indicated earlier there are contradictory findings and gaps on the impact of mentoring on student achievement in disadvantaged poor-performing schools. The magnitude of the impact on student achievement, the generalizability of existing research, the length of mentoring needed as well as the time that it takes to achieve meaningful increases in student achievement in disadvantaged, poor-performing schools are far from clear. The purpose of this research is to address these contradictions and gaps in the research literature by doing a concurrent, matched but non-randomised study to determine the impact of mentoring of teachers on student achievement in the school-university partnership between the UFS and disadvantaged poor-performing schools in its feeding area over a period of four years (2011 – 2014).

The *primary research question* is: What is the impact of mentoring teachers on student achievement? The *secondary research questions* are:

1. What is the impact of mentoring accounting teachers in the UFS SPP schools on student achievement in accounting?
2. What is the impact of mentoring mathematics teachers in the UFS SPP schools on student achievement in mathematics?
3. What is the impact of mentoring physical sciences teachers in the UFS SPP schools on student achievement in physical sciences?

1.4 The research context

The study sample was UFS SPP schools. They were selected non-randomly from disadvantaged poor-performing urban and rural schools in the university's feeding area that applied to be part of the program. The sample (n = 18) consisted of 1 small combined school (<500 learners), 10 medium sized ordinary secondary schools (500 – 900 learners), 6 large ordinary secondary schools (above 900 learners) and 1 large comprehensive school (above 900 learners). The quintile of the schools ranged from quintile 1 to quintile 4.

These schools were matched with one school similar to them – thus a non-mentored school – that served as a control. The matched schools (n = 18) were chosen from schools with the same quintile, type, category, geographical position (same school district), size and learner to teacher ratio (see Table 1 and Figure 6 and 7).

As indicated in the rationale, the UFS launched the UFS SPP during 2011 for Accounting and during 2012 for Mathematics, Physical Sciences and Management. The goals of the project were to:

- improve the academic achievement of senior secondary school learners especially in accounting, mathematics and physical science;
- develop these schools to have strong managerial leadership capacities that are sustainable;
- create optimal opportunities for students from targeted schools to access university, and to
- design a model that can be used beyond the project schools to facilitate school improvement in South Africa.

These goals were to be achieved through the following interventions:

- The deployment of experts in school management, mathematics, physical sciences and accounting as mentors to work alongside existing teachers in order to monitor, support, evaluate, develop and motivate the local subject teachers to enhance their subject matter, pedagogical and assessment knowledge in the classroom;
- Although clustered group sessions formed part of the teacher development, the core responsibility of the subject mentors, were to attend classes of teachers and support the teaching and learning activities in class. They ensured that quality teaching and learning took place on a regular basis – that every period and time available were utilised for effective teaching and learning. The goal was that during this project the teachers would develop the necessary subject knowledge and teaching skills and the confidence to sustain good and deep practice on their own. A ratio of 1 mentor per 5 schools was used and this resulted in one day per school per week, allowing the mentor to visit at least one class per subject teacher per week. The mentor to mentee caseloads were approximately 1:10 for physical sciences grade 12, 1:10 for mathematics grade 12 and 1:10 for accounting grade 12. The minimum contact time per grade 12 teacher was 1 hour per week for all subjects;
- The deployment of experienced expert principals as mentors who worked alongside the resident principal and his school management team to enhance their capacity to offer on-

site leadership and management that boosted classroom instruction and student learning;

- The establishment of instructional, managerial, financial and administrative routines in every school so that every teacher teaches every day in every class on her/his schedule, and every school leader manages school resources (such as time) for optimal learning effects. This task required top-level management as well as school-culture expertise, to build and sustain these routines;
- The convening of regular parental forums to both explain and obtain buy-in for this new model of school change, and to ensure that parents reinforce and support what the school try to do—such as monitoring daily homework schedules.

The UFS also had a Project Operations Centre which was responsible for mentor and project staff recruitment, shaping the programme and monitoring progress. This office also, in cooperation with the UFS finance department, managed the budgets and provided regular reports to sponsors.

Several other functions to enhance the project and to ensure successful implementation were handled by this office, including:

- supplying of learning material and aids
- arranging trips to educational events
- organizing competitions and olympiads
- encouraging and facilitating communication
- organizing training, etc.

An important aspect of the project was the support and cooperation from all stake holders. A Memorandum of Understanding was signed between the UFS and the Free State Department of Basic Education. The support of the Member of the Executive Council (MEC) for Education and the trade unions were also secured.

1.5 The significance of the proposed study

1.5.1 Intellectual significance

Researchers question the generalizability of previous research on the impact of mentoring on student achievement in disadvantaged, poor-performing schools as well as the magnitude of these impacts. This study will show that the mentoring of subject teachers has a large positive impact on student achievement in disadvantaged, poor-performing schools in all similar contexts.

The findings of this study will shed light on the contradictory findings in the research literature with regards to the time that it takes to get meaningful improvement in student achievement after teacher mentoring started as well as the length of mentoring needed to achieve meaningful improvement in student achievement in disadvantaged, poor-performing schools.

1.5.2 Practical significance

All over the world there is a quest to improve student achievement in disadvantaged poor-performing schools. This study will indicate that the mentoring of subject teachers has a large positive impact on student achievement in disadvantaged, poor-performing schools and that it can be used in all similar contexts to improve student achievement in these type of schools. The model offers practical ideas as to how to turn around the performance of teachers, students and schools in disadvantaged communities.

1.5.3 Social justice significance

Many students are not performing to their innate potential just because they have to attend disadvantaged, poor-performing schools. This socially unjust situation can be changed by mentoring teachers so that they can assist students to perform to their potential. The findings of this study should convince governments, NGO's and the corporate world to invest in the mentoring of teachers in order to rectify this injustice.

1.6 Definitions of key terms

Definitions of the following commonly used terms should assist the reader in better understanding the study:

Impact evaluation of interventions:

Impact evaluation assesses the changes that can be attributed to a particular intervention, such as a project, program or policy. Impact evaluation is structured to answer the question: how could outcomes have changed if the intervention had not been undertaken? This involves a counterfactual analysis, that is, a comparison between what actually happened and what would have happened in the absence of the intervention (White 2006). Impact evaluations seek to answer cause-and-effect questions. They, therefore, look for the changes in outcome that are directly attributable to a program (Gertler et al. 2011).

There are five key principles relating to internal validity (study design) and external validity (generalizability) which impact evaluations should address: confounding factors, selection bias, spill-over effects, contamination, and impact heterogeneity (White 2006).

The designs used for impact evaluations are usually an experimental design or a quasi-experimental design. Under experimental evaluations the treatment and control groups are selected randomly and isolated from the intervention, as well as any other interventions which may affect the outcome of interest. When randomization is implemented over a sufficiently large sample with no contagion by the intervention, the only difference between the treatment and control groups on average is that the control group does not receive the intervention (Bamberger & White 2007). The difference between the treatment group and control group can, therefore, be attributed to the impact of the intervention.

Disadvantaged schools

International context:

In the Organisation for Economic Co-operation and Development countries (OECD) disadvantaged schools are defined as schools in which the average socio-economic background of students is below the national average. On average across all OECD countries, there is a two year gap between the reading scores of students attending the most disadvantaged schools and those of students at the least disadvantaged schools. This significant gap is a source of concern because the most disadvantaged schools tend to have a higher proportion of disadvantaged students, which in turn reinforces socioeconomic inequalities and injustices surrounding these schools. Unemployment levels are higher, neighbourhoods are poorer, there are more single-parent families, more health problems, higher crime rates, and an exodus of good teachers and top-performing students. This, in turn, can contribute to lower educational achievement by students by inhibiting learning and learning outcomes (OECD 2012).

South African context:

The quintile system, which determines amounts of funding for individual schools, was implemented in post-apartheid South Africa as the government's commitment to redress and redistribution in the education sector. The National Norms and Standards for School Funding

(NNSSF), which requires the allocation of funds to schools according to their poverty score, was a key policy change implemented in 2006 to determine the funding for individual schools. The poverty score of each school assigns it to a quintile rank (Q1 to Q5) which, based on a pre-determined formula, governs the amount of funding the school receives. Schools in quintile 1 are considered the poorest, and those in quintile 5 are considered the least poor. Identifying which quintile a school falls into is a crucial step in determining school resource allocation. Thus, in 2006, the allocation per learner in Q1 schools was R703 and R117 for learners in Q5 schools. The poverty score of a school, or quintile rank, is based on the poverty level of the community in which it is located. This score is calculated using national census data: weighted household data on income dependency ratio (or unemployment rate), and the level of education of the community (or literacy rate) (Chutgar & Kanjee 2009).

Teacher

A teacher is a person who provides education for students. The role of teacher is often formal and ongoing, carried out at a school or other place of formal education. In many countries, a person who wishes to become a teacher must first obtain specified professional qualifications or credentials from a university or college. These professional qualifications may include the study of pedagogy, the science of teaching. Teachers, like other professionals, may have to continue their education after they qualify, a process known as continuing professional development. Teachers may use a lesson plan to facilitate student learning, providing a course of study which is called the curriculum.

Learning in context

The need to improve employee skills has led to an increase in the provision of employer-based training in all industries and occupations. This is a reflection of the increased commitment of employers, and a move towards the development of a culture of lifelong learning. Such moves are designed to ensure employee skill levels are sufficient to achieve organizational objectives. However, this push is not just from organizations. More and more individuals are consciously making an effort to enhance their skills, through a range of different training and education programmes that improve work-related performance and employability. Learning in context aims to contribute to individual and organizational growth and development (Mathews 2003).

The key issues with regards to learning in context are: (a) the learning context, (b) the learning reason, (c) the learning process, (d) the learning outcomes and (e) sustained development. The following definition is proposed as a working definition of learning in context (Mathews 2003):

Learning in context involves the process of reasoned learning towards desirable outcomes for the individual and the organisation. These outcomes should foster the sustained development of both the individual and the organisation, within the present and future organisational context.

The principal argument within this integrated definition is that any learning in context should produce desirable outcomes for the individual and the organization, and assist development (Mathews 2003). In this way learning in context actually changes the very context itself. Contexts do improve with learning in context (Fullan 2006). For learning in context to achieve its stated objectives, certain learning opportunities and conditions need to be evident within the workplace. Mentoring is recognized as one method of facilitating learning in context, and is designed to make use of guided learning to develop the knowledge and skills required for high performance (Tovey 1999).

Accomplished teaching:

Accomplished teaching reflects skilled practice and contributes to student learning. The hallmark of accomplished teaching is student learning. Gains in student learning must always be examined within the context of teaching practice to ensure that they are connected to what teachers are doing in the classroom (Linn et al. 2011).

Accomplished teaching meets high professional standards for instructional method and content—that is, it reflects skilled practice and places a value on how something is taught. It is important to note that value is also placed on whether something has been achieved through the act of teaching—that is, whether students learn. Accomplished teaching involves teaching practice that is grounded in an understanding of how to facilitate student learning and that leads to growth in student understanding over time (Linn et al. 2011).

The level of knowledge, skills, abilities, and commitments that accomplished teachers must demonstrate are defined by the following principles (Linn et al. 2011):

- Teachers are committed to students and their learning.

- Teachers know the subjects they teach and how to teach those subjects to students.
- Teachers are responsible for managing and monitoring student learning.
- Teachers think systematically about their practice and learn from experience.
- Teachers are members of learning communities.

Student learning and student achievement:

Student learning and student achievement are closely related concepts. But while the two terms are often used interchangeably, they convey very different ideas, particularly as they relate to teaching. Student achievement is the status of subject-matter knowledge, understandings, and skills at one point in time. The most commonly used measure of student achievement is a standardized test. Such standardized assessments measure specific areas of achievement and are best understood as one measure of a subset of a body of skills or knowledge (Linn et al. 2011).

Student learning is the growth in subject-matter knowledge, understanding, and skills over time. In essence, it is an increase in achievement that constitutes learning. Central to this notion of learning as growth is change over time. Knowing whether student learning has occurred, then, requires tracking the growth in what students know and can do. It is only by comparing student mastery at successive points in time that the nature and extent of learning can be gauged. Student learning is also reflected in a broad array of outcome measures, including attendance, participation, engagement, and motivation (Linn et al. 2011).

The causal inference that gains in student achievement are due to a teacher is not easily justified. Analysing the impact of teacher instruction on students requires a careful, sequential examination of student achievement prior to instruction, the nature and quality of instruction developed and delivered to help students learn, and student achievement after instruction (Linn et al. 2011).

Pass rates:

The proportion of students who passed a particular subject in a particular year.

Average percentages:

The average mark for a particular subject in a particular year. The average mark required to pass a subject in the South African education context is equal to 30%, but in the international education context, it is equal to 50%.

Chapter 2

Literature review

What is mentoring and does teacher mentoring improve student achievement?

2.1 Introduction

The tradition of mentoring began with *Mentor*, a character in Greek Mythology. As Odysseus, King of Ithaca, prepared to leave for the Trojan Wars he instructed his faithful companion *Mentor* to remain in Ithaca and to take charge of his son, Telemachus. He was entrusted to teach Telemachus all of the things that would help him to become a great ruler. *Mentor* served as a teacher, role model, trusted advisor, counsellor and, among many other things, a father figure to Telemachus. This was the beginning of the classic mentoring relationship (Caldwell et al. 1993).

History is full of examples of such relationships: Socrates and Plato, Freud and Jung, Lorenzo de' Medici and Michelangelo, Haydn and Beethoven and so on (Merriam 1983). The practice of mentoring is now being acknowledged and embraced by major business corporations, schools and universities, foundations, and associations as a formal component of career and human resource development (Gerstein 1985).

2.2 Mentoring and its components

2.2.1 Why mentoring?

During the past two decades mentoring became the dominant form of teacher induction and most of the research on mentoring shows very positive outcomes (Bullough 2012). In the United States being formally mentored in some way has become a common experience among beginning teachers. No doubt nearly all beginning teachers are informally mentored. Twenty three US states fund formal mentoring programs and require all new teachers to participate. Nineteen states made a similar requirement of prospective principals (Bullough 2012).

The origins of mentoring initiatives for teachers in schools can be traced back to the school reform movements in the 1980s. During these movements, policy makers and educational leaders advocated for mentoring as a strategy to retain the newly qualified teachers by allowing them access to capable senior teachers who could induce them into the new environment (Hobson et al. 2009). Between 20% and 50% of newly hired teachers leave the classroom before even reaching the third year of teaching. New teacher turnover is costly in terms of student success and educational funding. Teacher turnover rates can range from between $10,000 and $18,000 per first-year teacher (Frels et al. 2013). It is documented that new teachers are leaving at significantly higher rates than are those teachers with more than 5 years of experience (Barnes et al. 2012).

However, in a time of severe economic downturn and teacher job loss coupled with intensifying accountability pressures, concern with teacher retention has been nudged aside as the primary aim of mentoring (Bullough 2012). Increasingly mentoring is seen as a key element in developing highly effective teachers (Wang et al. 2008). These are teachers whose students meet or exceed state established grade-level standards for tested achievement. While all but six states mandate teacher evaluation, practices vary dramatically for both new and veteran teachers alike. Currently, in these assessments only 13 states require taking student achievement into account, increasingly through value-added measures. Additionally, in most states, tested student achievement is the basis for rewarding or punishing schools—this despite glaring differences in student populations and in state levels of school funding. Alaska has a gap of about $11,000 in per-pupil spending between high and low spending school systems while Utah has the lowest gap of $2,000 while also spending the least on each child of any state (Bullough 2012).

United States education initiatives, beginning with enactment of the No Child Left Behind legislation has increased interest in mentoring. Believing that competition is a key to widespread education reform, the United States Department of Education sponsored Race to the Top will, over time, award $4.3 billion to support system-wide school reform in a very few states. Forty states entered the initial competition, which emphasized five reform areas: (a) designing and implementing rigorous standards and high- quality assessment; (b) attracting and keeping great teachers and leaders in America's classrooms; (c) using data to inform decisions and improve instruction; (d) using innovation and effective approaches to turn-around struggling schools; and (e) demonstrating and sustaining education reform (US Department of Education 2009). The winners in the first round were Delaware, which received $107 million, and Tennessee which was awarded $502 million. Weakened teacher tenure, increasing numbers of teacher assessments and an expanded place for tested student academic performance in judgments of teacher quality, and accelerated movement toward differentiated pay and roles and responsibilities for teachers dominated the proposals of the

16 state finalists. Mentoring also enjoyed a prominent place in these proposals. This is the context within which teachers teach and teachers are mentored in the United States (Bullough 2012).

2.2.2 Defining mentoring

Many researchers have attempted to define mentoring but despite the plethora of mentoring literature there has not been consensus on any one definition. Mentoring will always be difficult to define as it is a social event that involves interactions between individuals, those being mentors and mentees. The participants in mentoring relationships engage in a wide variety of interactions that concern emotional, intellectual and social spheres. As such, the relationship that develops is reliant on the attributes and beliefs of those involved in the mentoring (Ambrosetti et al. 2014). Some researchers argued that a definition for mentoring is not needed, however it has been acknowledged that mentoring is influenced by the context in which it is to be used and is often described according to that context (Jones & Brown 2011).

Mentoring is often described as complex (Heirdsfield et al. 2008). It is described as a complex activity because it comprises such elements as the relationship formed between the mentor and mentee, the needs and goals to be achieved within the relationship, as well as the context the mentoring occurs in (Ambrosetti et al. 2014). In this respect, Kram's (1985) landmark research *Mentoring at Work* first identified such crucial elements of the mentoring process. She holds that a mentoring relationship is founded on connection, needs and context. Thus, mentoring is made up of three components namely relational (where connections are made between the mentor and the mentee), developmental (where needs are identified and the development of these guide the relationship), and contextual (where the context guides what occurs and how it occurs in the relationship) (Lai 2005). The difficulty in defining mentoring now becomes apparent as a definition needs to firstly describe each of the above mentoring components and secondly, match the context it is being used in (Ambrosetti et al. 2014). Definitions that do not encompass the three components of mentoring are unable to maximize the potential of mentoring (Ambrosetti et al. 2014).

Literature in education sometimes confuses mentoring with coaching. In general, both mentoring and coaching are professional development practices involving one professional helping another in a mutually enriching manner. There is, however, a difference in emphasis. Coaching is more concerned with learning for performance and takes a short- to medium term perspective. Mentoring is more concerned with learning for professional growth and takes a medium- to long-term perspective (Ng 2012). In general, mentors can coach, but coaches hardly ever mentor. A mentee usually is the one who selects a mentor, but with coaching the organization usually pairs the coach with the individual who is perceived as needing coaching (Irby 2012). The main differences between mentoring and coaching are indicated in figure 1.

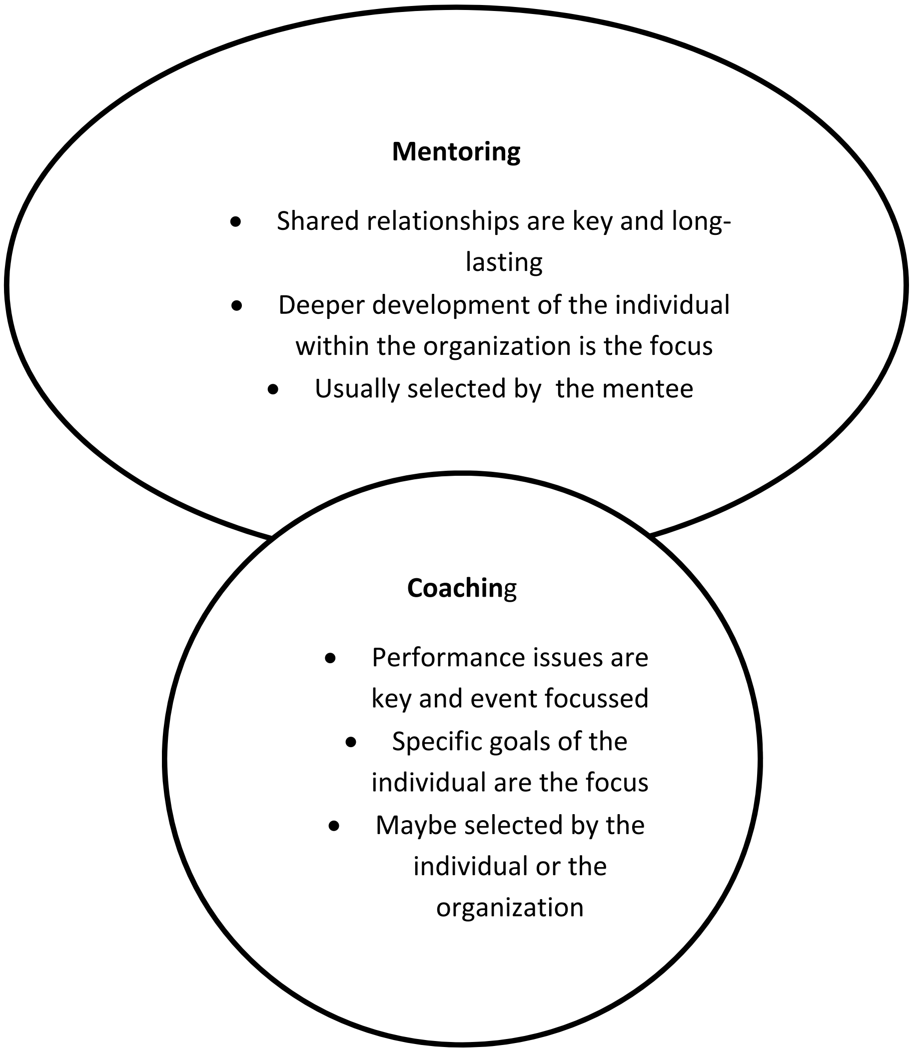

Figure 1. Diagram of the relationship between mentoring and coaching (Irby 2012).

2.2.3 Components of mentoring

The relational component of mentoring refers to the relationship that is developed between the mentor and mentee. The relationship can either be of a personal or professional nature and the connection made between the participants is often reliant on the willingness to engage in the mentoring relationship (Hobson et al. 2009). It has been established through research that a relationship that is based on hierarchy and power rarely cultivates connectedness and/or productive outcomes (Ambrosetti et al. 2014). Therefore, rather than the typical hierarchical mentoring relationship that frequents descriptions in the research, the relational component promotes a more reciprocal relationship whereby the mentor and mentee each have skills, knowledge, and practices to share. Mentoring relationships are more commonly both reciprocal and asymmetrical, meaning that there are shared responsibilities between the participants, but one participant may be more experienced and take the lead within the relationship. Thus, the mutuality of the relationship offsets hierarchical factors that may emerge such as power struggles. Words such as nurture, support, mutuality, and trust describe the relational component. Likewise, the roles a mentor undertakes in this component are those of advocate, friend, colleague, and counsellor (Ambrosetti et al. 2014).

The developmental component of mentoring focuses on the purpose of the relationship and this relates directly to the specific needs of the mentor and mentee. This component targets the functions and behaviours that are used in assisting the participants in achieving their developmental goals (Lai 2005). However, the mentee is not the only one who benefits from the relationship, the mentor should also have goals and needs that can be developed through the process of mentoring. In a reciprocal relationship, collaboration would underpin the mentoring process where the mentor guides and coaches the mentee towards the development of their needs. The mentor offers critical feedback, role models skills, and facilitates opportunities for first-hand learning. Equally the mentee would engage in the opportunities provided and work alongside the mentor in order to developmentally grow (Ambrosetti et al. 2014).

The contextual aspect of mentoring is equally important to the relationship as the relational and developmental components. However, the contextual component extends beyond the setting of the mentoring relationship as it focuses on the explicit nuances of the job or profession and how these are communicated to the mentee (Kram 1985). As such the context is reliant on the relationship. Mentors would role model job/workplace behaviour and provide explicit instruction about the culture of the workplace and its operation. The mentee in return would observe the mentor and engage in discussion that confirms or clarifies the observations of the specific qualities of the job and/or workplace (Ambrosetti et al. 2014).

In the teacher context the relational component indicates the interpersonal relationship that occurs between mentor and mentee. The mentoring actions include support, inclusion, encouragement, collegiality, and advocacy. The developmental component informs the processes used to develop the personal and professional goals of the mentor and mentee. The mentoring actions in this component include reflection, sharing, guidance, role modelling, communication, provision of opportunities, assessment and feedback, and reflecting. The contextual component is informed by the setting of the mentoring in which the mentee is immersed in. The mentoring actions include the work of a teacher and the behaviours of a teacher. (Ambrosetti et al. 2014).

The research on mentoring with regards to the components of mentoring, indicates that both mentors and mentees consider the quality of interpersonal relationship between mentors and mentees as an important determinant factor (Kadji-Beltran et al. 2013). This finding provide evidence for what was already suggested by previous mentoring literature (Tedder & Lawy 2009; Lawy & Tedder 2011): the mentor/mentee relationship is central to the process and mentees hope to feel accepted and supported by their mentor. The most successful graduate school mentorships are characterised by shared assumptions and expectations (on the part of mentor and mentee) about the form and function of the relationship (Johnston 2009). All mentors acknowledged respect to be a fundamental element of the mentor-mentee relationship. Mentors working with the newly appointed teachers found it more difficult to express respect as they felt that they had to maintain a very delicate balance between respect and collegiality (to treat the mentee in an appropriate way as a colleague) on one hand and authority and professionalism (the power or right to direct the mentee as the result of being his or her senior/mentor) on the other. Even though there was no intention to differentiate the mentors' approach, in practice the mentors' comments indicated the use of collegial mentoring for the novice-in-subject experienced teachers and a hierarchical one for the newly appointed teachers (Kadji-Beltran et al. 2013). The need for mentors to establish a friendly but professional relationship with their mentees with clear boundaries was also discussed by Tedder & Lawy (2009).

2.3 Mentoring relations and functions

The mentoring relationship can either be of a personal or professional nature and the connection made between the participants is often reliant on the willingness to engage in the mentoring relationship (Hobson et al. 2009). The mentor/mentee relationship is central to the process of mentoring and mentees hope to feel accepted and supported by their mentor (Lawy & Tedder 2011; Tedder & Lawy 2009). Both mentors and mentees consider the quality of interpersonal relationship between mentors and mentees as an important determinant factor of the success of a mentoring program (Kadji-Beltran et al. 2013).

The existing definitions of mentoring tend to suggest a hierarchical relationship where the mentor is more experienced than the mentee, or that the mentor has or can provide knowledge and skills that the mentee wants or needs (Aladejana et al. 2006; Koc 2011). In this traditional description of mentoring, the mentor is presumed to be higher ranked and they assume the dominant role, thus creating an environment for possible power struggles between the mentor and mentee (Awaya et al. 2003). However, Allen & Peach (2007) determined that a more reciprocal relationship whereby mentors and mentees are involved in a two-way exchange of knowledge and skills negates difficulties that may be present in a more traditional relationship.

Within mentoring both the mentor and the mentee have specific roles in a mentoring relationship and these roles shape the outcomes of the mentoring (Cherian, 2007; Scanlon, 2008). If roles are not well defined in the mentoring context, mentoring relationships will continue to operate according to preconceived perceptions (Ambrosetti et al. 2014).

The roles/functions of the mentor are (Ambrosetti et al. 2014):

Supporter: The mentor offers encouragement and direction to the mentee. As a support person, the mentor introduces the mentee to other staff, informs them about rules and policies and also provides feedback to the mentee.

Colleague: The mentor treats the mentee as a professional by advocating for the mentee and sharing their professional knowledge and skills.

Friend: The mentor provides the mentee with companionship and camaraderie. They also act as a critical friend and encourage the mentee to try new tasks and challenges.

Protector: The mentor shields the mentee from unpleasant situations, raises the mentee’s profile and defends the mentee’s actions.

Collaborator: The mentor works alongside the mentee. They work on tasks together, plan and implement lessons together.

Facilitator: The mentor creates and provides opportunities for learning and development. The mentor allocates time for the mentee to perform tasks and creates a place for the mentees to action a task.

Assessor: The mentor assesses the mentee's performance and assigns a grade or marks criteria.

Evaluator: The mentor tracks the progress of the mentee by appraising the mentee's progress and provides feedback.

Trainer/Teacher: The mentor provides the mentee specific instruction about performing tasks and assists during the performance.

Reflector: The mentor critically thinks and reflects on all aspects of the mentoring process: the performance of the teacher as well as their own development as a mentor and practitioner.

Role model: The mentor demonstrates and models skills and behaviour for the mentee. They model tasks, actions, interactions and processes.

However, the mentor may also need to draw upon supervisory roles such as those of assessor and evaluator in the pre-service teacher education context (Crasborn et al. 2008; Fransson 2010; Tillema et al. 2011). As noted earlier, it is common practice in the pre-service teacher context for the mentor teacher to assess and assign a grade to the pre-service teacher as required by the pre-service teaching program (Walkington 2005). Assessment of the pre-service teacher by the mentor teacher leads to a more hierarchical relationship where the pre-service teacher may feel unable to take risks, try out new skills and develop their own teaching style (Maynard 2000).

The roles of the teacher as a mentee can be summarized as follows (Ambrosetti et al. 2014):

Contributor: As a contributor the mentee works alongside the mentor by assisting and performing associated roles and tasks.

Active participant: The mentee takes advantage of opportunities presented to them to develop their professional skills and knowledge. They initiate tasks, volunteer to undertake tasks and become involved in every aspect of the job. The mentee actively listens and acts on advice.

Collaborator: The mentee works alongside of the mentor in planning, implementing and reflecting on tasks.

Reflector: The mentees reflects orally and in written format on their own performance, actions and learning, and discuss these reflections with their mentor in order to clarify and develop professionally.

Observer: As an observer the mentee observes how tasks or actions are completed by their mentor and keeps observational notes. They discuss their observations in order to develop their skills and knowledge that pertains to the job and the work environment.

It has been shown in a number of studies that the roles of a mentee can include that of active participant, listener and observer (Kamvounias et al. 2007). In the mentee role context, the mentee can be responsible for their own learning through the setting of goals, engaging in professional conversations and working alongside the mentor (Kamvounias et al. 2007).

Some of the roles of the mentee are the same as those as the mentor teacher, namely collaborator and reflector. Thus, the roles of the mentor and mentee can be interconnected as shown by Ambrosetti & Dekkers (2010). From this perspective, mentoring can be deemed to be an interactive social process within the teacher education context. Therefore, it follows that the roles the participants engage in can be dependent on responses and reactions to the interactions that occur (Ambrosetti et al. 2014). The influence of time, experience, perceptions, interpretations and the relationship itself can also impact on the roles within the relationship (Lucas 2001) (see discussion section 2.8).

Two common roles span across both the mentor and mentee, namely collaborator and reflector. Collaborator is classified as both a relational and developmental role as it involves working together in a supportive manner. Reflector is classified as a developmental role as reflection is part of the learning process. As shown above these two roles, although similar in the actions that occur, are played out from different perspectives (Ambrosetti et al. 2014).

Gosh (2012) divided the mentoring functions in mentoring functions providing challenge and mentoring functions providing support. The functions of encouraging reflective thought, assessing, and teaching qualify as challenging functions performed by teacher mentors. Challenge should consist of actions that can stimulate the mentee to reflect on their values, assumptions, competencies, and vision creating a tension that is needed for change and growth in the mentees.

An interesting view of the roles of mentors is that of Clarke et al. (2014) that indicates the roles of a mentors as follows: Providers of Feedback, Gatekeepers of the Profession, Modellers of Practice, Supporters of Reflection, Gleaners of Knowledge, Purveyors of Context, Conveners of Relation, Agents of Socialization, Advocates of the Practical, Abiders of Change, and Teachers of Children.

Research on the perceived roles of mentors in three different clinical settings: the early field experience of teacher students, pre-service student teachers and entry year teachers showed that in each of the three clinical settings, the mentors perceived their roles to be different. At the student teaching level, mentors perceived their role to help student teachers develop the confidence and skills to be successful in a classroom. At the early field experience level, mentors perceived their role to encourage professionalism and to help mentees confirm education as a career choice. At the entry year level, mentors perceived their role to help first year teachers manage the myriad responsibilities associated with teaching and year-long curricular planning, to establish relationships with other professionals, and to become familiar with the school policies, practices, and procedures (Gut et al. 2014).

Roles in content mentoring:

Standards-based reforms and accountability highlights the need for content mentoring. The need for mentors to have a content role raises the question: what knowledge and practices are needed for mentors to fulfil this content role with novices (Achinstein & Davis 2014)? Some direction is provided by the knowledge and practice base for content teaching, which highlights specialized content knowledge, general pedagogical knowledge, PCK, and knowledge of assessment (Ball et al. 2008). Mentors must hold a complicated bi-level focus on both students and novices in relation to content wherein mentors must have specialized content and PCK to create student learning, as well as, knowledge and skills to tailor mentoring to meet the needs and contexts of novices (Achinstein & Athanases 2005). Research of mentor–novice conversations identified key aspects of learning to teach academic content, including: learning to represent/present academic content; learning to think about subject matter and students' perspectives; deepening novice's subject matter understanding; and learning to organize students for the teaching and learning of content (Feiman-Nemser & Parker 1990). Feiman-Nemser & Parker 1990 studied four mentor–novice pairs' conversations and identified a range of ways mentors addressed novices' subject matter. They highlighted the mentor's role in guiding novice's PCK development where mentors help novices learn to translate disciplinary understanding into explanations and tasks appropriate for students by sharing and appraising ideas that worked and guiding novices in developing representations. Also of note in the findings were how mentors supported novices in thinking about subject matter from students' perspective, including paying attention to student thinking and understanding. Athanases & Achinstein (2003) highlighted the importance of assessment in a mentor's knowledge base, particularly in focusing novices on individual learners' needs. They found mentors tap knowledge and abilities in several assessment domains, including: assessment of students, alignment of curriculum with standards, and formative assessment of novices.

Two emergent dimensions of a content mentor role are found in literature on central tasks for early career professionals: reinforcing subject-matter instruction and examining student learning in the content area. Content mentors' roles, thus, may include focusing novices on content teaching and assessment of students' disciplinary understandings. Mentors must consistently focus novices on translating content into subject-matter teaching, meaning that mentors must attend to novices' PCK and practice development. Mentors also need to guide novices in assessing individual student's content understandings in order to adjust instruction to the needs of diverse learners (Achinstein & Davis 2014).

2.4 Phases of the mentoring relationship

Kram (1985) identified four phases in mentoring, namely initiation (getting to know each other), cultivation (what things do mentors and mentee do together to promote and enhance teaching and learning?), separation (how does the role of the mentor diminish and the role of the mentee increase?) and redefinition (how does the mentor-mentee relationship evolve to a peer coaching, critical friend relationship?). The terms preparation for mentoring, pre-mentoring, mentoring and post-mentoring was proposed by Ambrosetti et al. (2014). The first phase, preparation for mentoring, occurs before the mentoring relationship begins and provides the mentors and mentees with knowledge and skills of mentoring. As such, the importance of the relational component of mentoring becomes apparent as the pre-mentoring phase that occurs before the mentoring begins sets the tone of both the relationship and the professional placement. The developmental and contextual components are embedded within the mentoring phase and shape the direction of the relationship. The preparation for mentoring and pre-mentoring phase, provide the foundation for the mentoring relationship. Preparation for mentoring imparts the participants with the theoretical underpinnings in which to build the relationship on, whereas the pre-mentoring phase explicitly targets the fundamentals of a formal relationship such as expectations, goals, roles, and communicative processes (Ambrosetti et al. 2014). Research studies which highlight relationships which have failed or had negative outcomes often pinpoint fundamentals which are part of the pre-relationship phase as the reason for the failure of the relationship (Eby & Lockwood 2004). The third phase focuses on achievement of the goals articulated by the participants whereby the development of skills and knowledge occurs. The final phase in the guidelines is an evaluative phase where the participants either redefine goals or assess their progress (Ambrosetti et al. 2014).

The preparation for mentoring phase focus on the training for mentors and mentees that centres on the nature of mentoring, the processes of mentoring, the roles of the mentor and mentee and conflict resolution. The pre-mentoring phase focus on the initial meeting before the mentoring begins. The actions in this phase are defining the expectations for the relationship, outlining of goals for each participant, defining of roles for the mentor and mentee, mapping out a timeline, setting up communication channels and setting up meeting schedules. The focus of the mentoring phase is the development of the relationship and progression towards the achievement of the set goals. Opportunities for development of competencies and capabilities (skills, knowledge and processes) through teaching and coaching, active participation and collaboration, feedback approaches, reflective opportunities and interactions that endorse reciprocity (sharing, modelling, facilitation) are the main actions in this phase. During the post-mentoring phase the focus falls on the continuation or completion of the relationship. If the mentoring continues, the main actions will be to do a progress review (formal tasks and duties) and to redefine needs/goals and mentoring roles. If the mentoring ends, the main actions in this phase will be to do an assessment on the goals achieved and an evaluation of the relationship (Ambrosetti et al. 2014).

2.5 Formal and informal mentoring

Learning new curricula, dealing with classroom management and discipline, integrating students with special needs, using technology, individualizing student programs, coordinating extracurricular activities and being accountable to the various stakeholders of education are just a few of the jobs teachers do. Many of these duties are difficult for the most experienced professional, so one wonders how beginning teachers survive, since they are expected, on their very first day of employment, to do the job of a seasoned veteran. Many school districts, seeing a need to nurture the new generation of teachers, have put in place formal mentorship programs (The Alberta Teachers' Association 2004).

Informal mentoring (buddy system) is not enough (The Alberta Teachers' Association 2004):

- New educators often do not ask for the help they need.
- Beginning teachers need to observe new effective teaching models.
- Experienced teachers do not want to intrude.
- Informal mentoring does not improve teaching over time.
- Informal mentoring programs are difficult to identify and support.
- There is a need to identify who is obtaining support and the quantity as well as the quality of that support.

Formal mentoring programs must replace informal mentoring programs (The Alberta Teachers' Association 2004).

As described in the model of informal mentoring the level of competence of the mentee usually reaches the level of the mentor. This is a result of not going farther than the initial orientation of the mentee. The mentor provides teaching materials, classroom teaching strategies, and unit and long-range plans for the benefit of the mentee. This could be referred to as an apprenticeship model. The competence level of the mentor does not increase under this model. No reflective practice is in place, and no action research is carried out by mentor or mentee. Little professional growth of the mentor takes place under this informal or buddy system. Under a formal mentoring process the mentee not only reaches the competency level of the mentor but grows beyond the established baseline along with the mentor. The mentor may share materials but also goes beyond the sharing and moves into the development of materials within a collaborative team. This requires reflective practice, collaborative planning and action research coupled with a joint action plan by the mentor and mentee. Through this process both mentor and mentee soar to new heights of professional growth and competence (The Alberta Teachers' Association 2004).

2.6 Mentoring models

Lawy & Tedder (2011) identified the fact that there is no best practice model for mentoring. They highlighted that if mentoring systems are to be effective they need to be flexible and adjustable to the mentees' circumstances and needs. Consequently mentors' training should aim at informing them about the different possible models that could be followed and simultaneously enabling them to identify and choose from each model and combine the elements required in each mentoring case (Kadji-Beltran et al. 2013).

As discussed above different models of mentoring are defined by the nature of the collaboration: mentoring could be developmental (developmental or formative model) when it serves formative purposes and focuses on personal and professional development, it is based on confidence, supportive through transitions, profession centred, suitable for all, led by the mentee and places emphasis on networks. Alternatively mentoring could be performative (performative model) if it serves summative purposes, focuses on judgement and performance, is public, is subject centred, is concerned with standards and is led by the mentor (Lawy & Tedder 2011; Tedder & Lawy 2009). Induction programmes are based on the assumption that close observation and support from an experienced teacher can be helpful to new teachers (LoCasale-Crouch & et al. 2012). They are used either for introducing newly appointed teachers to education or for introducing experienced teachers in a new subject area. Mentoring is such an important part of induction programmes that the terms are often used interchangeably throughout the literature (Long & et al. 2012).

Hudson (2004) proposed a five factor mentoring model. He argued that teachers in their roles as mentors will require mentoring strategies linked to five factors to enable effective mentoring in specific subject areas. The factors are: (i) system requirements that focus on curriculum directives and policies; (ii) personal attributes that the mentor needs to exhibit for constructive dialogue; (iii) pedagogical knowledge for articulating effective teaching practices; (iv) modelling of efficient and effective practice; and (v) feedback for the purposes of reflection for improving practice (see Figure 2).

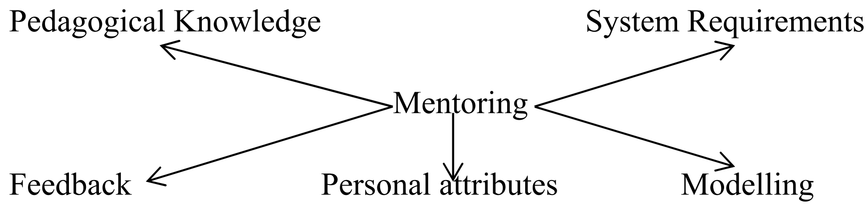

Figure 2. Five-factor model for mentoring (Hudson 2004).

The following mentoring framework is proposed by Ambrosetti et al. (2014):

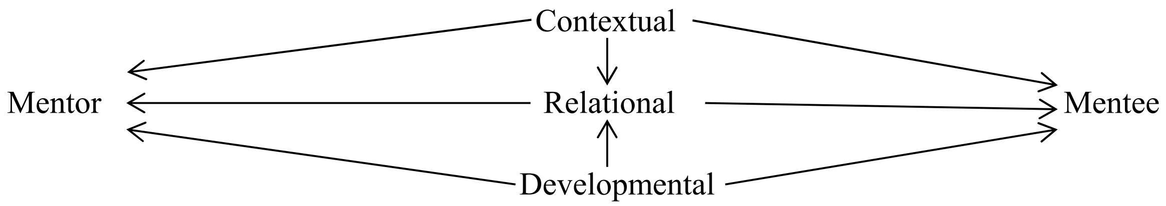

Figure 3. A holistic mentoring model (Ambrosetti et al. 2014).

The model comprises the three mentoring components identified earlier, namely relational, developmental and contextual. (Lai 2005) identified that in many cases, only one or two of the components are addressed within mentoring definitions. A similar concern has been raised by Ambrosetti (2010). Thus, it can be concluded that mentoring is not viewed as a process that is holistic. Conceptualized in Figure 3 are the three components of mentoring as a holistic process, rather than a fragmented process. Although the model places the relationship as the central component, each of the components is equal in importance. The relationship is positioned at the centre of mentoring as the developmental needs and context shape the interactions that occur between the participants. As such, the connection made between the mentor and the mentee will determine if the relationship achieves its purpose.

2.7 Mentoring programs

2.7.1 Mentoring programs for pre-service teachers

Student teaching

Mentoring is a strategy that is used in the practical training of pre-service teachers. A pre-service teacher is a person who is still enrolled in a teaching degree and is not yet a qualified teacher. In the context of pre-service teacher education, mentoring is utilized during the professional experience whereby a pre-service teacher (mentee) is placed with a classroom teacher (mentor) in order to learn how to teach. The professional placement is also considered as an opportunity for pre-service teachers to make links between theory and practice (Allen & Peach 2007; Zeichner 2010). In this respect, the mentor becomes responsible for and oversees the pre-service teacher and their practical development during the professional placement (Ambrosetti et al. 2014).

Despite the growing use of mentoring in the area of pre-service teacher education, the conceptualization of mentoring in the pre-service teacher education context needs further development (Hall et al. 2008; Koc 2011; Lai 2005). To date, mentoring has been developed in a haphazard way as clarity about the nature of mentoring varies widely and there is no particular structure of mentoring being used across the sector (Ambrosetti, 2014). This can be evidenced clearly through the use of different terminology within the literature. In particular, the term mentoring has been intertwined and interchangeably used with terms such as supervising and coaching (Koc 2011; Orly 2008; Parker et al. 2008), and few researchers describe how mentoring occurs within the specific context of pre-service teacher education. Thus, the conceptualization of mentoring in this context has been problematic with many mentors using supervisory strategies rather than mentoring strategies (Aladejana, Aladejana, et al. 2006; Hudson & Millwater 2008; Koç 2011). It has been noted however, that in the pre-service teacher education context the mentor teacher is often considered both a mentor and supervisor and they take on such roles accordingly (Crasborn et al. 2008). Nevertheless, there are distinct differences between mentoring and supervising. Supervision tends to refer to a hierarchical relationship whereby specific skills and roles of the job are taught and assessed (Fransson 2010; Tillema et al. 2011). In contrast, mentoring concerns the use of a supportive and more reciprocal relationship between mentors and mentees whereby professional and personal growth occurs through reflective processes that include developmental and contextual factors (Ambrosetti & Dekkers 2010; Lai 2005). Interestingly within the pre-service teacher education context in Australia, the mentor teacher is required to assess and assign a grade on the pre-service teacher's performance during the professional placement. In the pre-service teacher context, the mentor teacher has more professional experience in the relationship than the mentee, and takes leadership within the relationship. Therefore, this type of relationship can be classified as one that is asymmetrical. However, researchers such as Ambrosetti & Dekkers (2010), Heirdsfield et al. (2008), and Le Cornu (2010) suggested that mentoring in the pre-service teacher context should also be considered as a reciprocal relationship as both the mentor teacher and pre-service teacher bring their own expertise, skills, and knowledge to the relationship. Furthermore, the mentor and mentee participate by sharing and working together so that each participant has their needs met. Mentoring in the pre-service teacher context is a formally arranged relationship whereby pre-service teachers are placed with mentors with whom they have no prior experiences. The professional placement is often task orientated and the mentor teacher, on behalf of the tertiary institution, assesses the pre-service teacher's performance. The professional placement in this context generally occurs for a short period of time ranging from two weeks to 10 weeks. The placements may be organized as a block placement or the pre-service teachers may attend nominated day visits that then culminate in a block of time. Traditionally during the professional experience it is expected that pre-service teachers engage in activities such as observing and reflecting as well as planning and teaching. It is these activities that underpin the tasks to do required by the teacher education program. As such, pre-service teachers typically observe their mentor teacher and watch them teach, interact with students, parents and other staff, organize and manage the classroom and students; develop learning experiences for students which are implemented within the professional placement classroom; experiment with teaching strategies and approaches; interact with the students within the classroom; engage in discussions that focus on teaching strategies, the students in the class- room and feedback; and reflect on learning experience implementation.

The tasks in which the pre-service teachers engage in will be dependent on their progress within their teaching degree. Pre-service teachers at the beginning of their teaching program may engage in tasks such as observing and teaching small groups of students, where as a pre-service teacher who is nearing the end of their program will engage in planning and teaching as well as managing the classroom and the students (Ambrosetti et al. 2014). The professional experience is considered to be crucial to the development of skills and knowledge of those learning to teach (Sim 2011). It is well evidenced that the pre-service teachers themselves report that the time spent in schools and in classrooms is a highly valued component of their teaching degree (Ambrosetti 2011; Graves 2010). However, Allen & Peach (2007) reported that the experiences of pre-service teachers during the professional placement vary greatly with the range of experiences extending from positive and constructive to negative and destructive. While the tertiary institution provides guidelines for the professional placement, these outline the pre-service teacher's requirements and tasks to do rather than outlining mentoring processes, strategies, roles or functions for the participants. It is often assumed that mentoring is a natural skill, however researchers such as Hennison et al. (2011) and Wang and Odell (2002) believe that not everyone has a natural ability for mentoring, but that mentoring skills can be shaped and developed through preparation. As such, preparation for mentoring can assist in developing the mentor's knowledge of mentoring techniques and skills so that they can effectively mentor (Crasborn et al. 2008; Wang & Odell, 2002). The objective of mentoring in this context concerns the training of future teachers who in turn are teaching the future generation, therefore the emphasis on developing quality teachers needs to begin at initial teacher training (Cochran-Smith 2005; Darling-Hammond & McLaughlin 2011; White et al. 2010).

Student teaching is considered a common requirement across the globe for most teacher preparation institutions. However, the requirements vary widely across countries. (Ronfeldt & Reininger 2012). For example, the Asian countries of Japan, Korea, and Hong Kong require the shortest length of experience, ranging from a minimum of three weeks in Japan to eight weeks in Korea. In contrast, England requires a minimum of 24 weeks and the Netherlands at least 48 weeks. In the United States, student teaching is usually a semester long, varying from 12 to 15 weeks (Gut et al. 2014).

Early field experiences

Internationally, there is broad agreement on the importance of incorporating experiential learning into teacher education programs. However, approaches to achieving this aim may differ. For example, Germany and the Netherlands have developed strong commitments to school partnerships. Similarly, teachers in England must spend from 18 to 32 weeks in schools, and universities are legally bound to collaborate with school personnel, who share in the design of the teacher preparation program. In contrast, school-based learning tends to occur near the end of the program in France (Gut et al. 2014). Instead, the importance of practice is acknowledged by employing teacher educators who have extensive teaching experience in schools and who can provide teacher candidates with more practical approaches to teaching (Maandag D. W. et al. 2007). In Sweden, school officials, teacher educators, and local authorities have begun making some recent efforts to increase the amount of school-based learning that occurs earlier in the teacher education program (Gut et al. 2014).

Early field experiences can be defined as field experiences that occur prior to student teaching. During early field experiences, teacher candidates spend a limited number of hours in the school setting, usually observing or supporting the teacher by assisting individual students, working with small groups of children, or occasionally teaching single lessons. Extensive early field experiences permit a gradual socialization into professional norms and standards, reduce the number of teachers who leave the field in the first year, and increase the retention rate threefold in comparison to teachers from traditional preparation programs. Teachers who received extensive field preparation work longer hours are more willing to take risks, use technology better, and seem to have better problem-solving skills. Teacher candidates have also described a number of difficulties associated with early field experiences (Gut et al. 2014). For example, early field experiences can be unguided, fragmented, and lack coherence, thus creating challenges with managing students, pacing the class, and keeping up with the additional workload imposed by the field experience (Smith 1992). Teacher candidates sometimes feel used by the teacher, especially when they think the teacher is an ineffective role model or could not find time to talk with them (Lasley, T. J., Applegate 1985). Similarly, mentoring teachers have expressed frustration with mentees' lack of preparation, professionalism, commitment, enthusiasm, and a lack of involvement by the university (Applegate & Lasley 1982).

2.7.2 Mentoring programs for beginning teachers

School leaders have turned to mentoring programs as induction support for new teachers and with the goal of increased student success and increased teacher retention (Frels et al. 2013). Effective mentoring programs aim to provide teachers: (a) an induction meeting 4–5 days before the beginning of school, (b) professional development through systematic training over a period of 2 or 3 years (Wong 2004), (c) reduced teaching assignments with time for reflection being the key to teacher success (Howe 2006), (d) mentoring components, (e) study groups where new teachers have opportunities to collaborate, (f) "a structure for modelling effective teaching" (Wong 2004, p. 48), (g) opportunities to visit classrooms, and (h) "a strong sense of administrative support" (Wong 2004, p. 48).

Beginning teachers need assistance in the process of acquiring and strengthening knowledge, skills, values, and norms of both the teaching profession and the particular school culture. Moreover, they require support in overcoming feelings of stress and frustration that often accompany entry into the teaching profession. These various needs are in line with the three major domains of new teachers' development: pedagogical, emotional, and ecological. Mentoring is expected to address all three (Nasser-Abu Alhija & Fresko 2014). Mentors can provide pedagogical assistance through observing lessons, giving feedback, modelling, discussing instruction, helping with lesson plans, and aiding in the analysis of student work and achievement (Zimpher & Rieger 1988). In the emotional domain, they can help new teachers cope with difficulties and frustrations encountered in daily interactions with students, colleagues, and parents (Kilburg & Hancock 2006) and alleviate these feelings by providing encouragement, and compassion. Through the development of caring relationships with new teachers they can foster feelings of self-worth and self-confidence, boost morale, and enable putting difficult experiences in perspective (Hobson et al. 2009; Kilburg & Hancock 2006). Finally, in the ecological area, mentors can assist new teachers adjust to local school culture (Hobson et al. 2009). Mentoring can take on different emphases in different induction programs (Nasser-Abu Alhija & Fresko 2014). For example, Wechsler et al. 2010 found that the most common mentoring activities addressed the pedagogical realm, focusing on instructional issues, the needs of specific students, and instructional materials. However, in a different study (Andrews & Quinn 2005), new teachers reported receiving the greatest support with respect to school policies and procedures, followed by personal and emotional support, classroom management, assistance with resources and supplies, and least with instruction and curriculum.

Ingersoll & Strong 2011 proposed a model for the theory of teacher development that includes the improvement of performance and retention of beginning teachers with the ultimate goal of improving the growth and learning of students (see Figure 4).

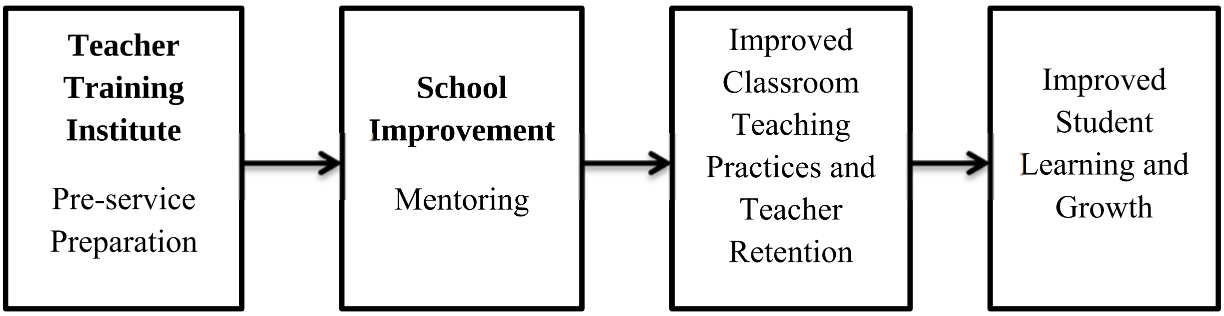

Figure 4. Theory of teacher development (Ingersoll & Strong 2011).

Reviewing the wide range of differences among mentoring programs offered in the US, Smith and Ingersoll (2004, p. 683) concluded:

Duration and intensity are important sources of variation: Mentoring programs can vary from a single orientation meeting at the beginning of a school year to a highly structured program involving multiple activities and frequent meetings over a period of several years. Programs vary according to the numbers of new teachers they serve... Programs vary *according to their purpose. Some, for instance, are primarily developmental and designed to foster growth on the part of newcomers; others are also designed to assess, and perhaps weed out, those deemed ill-suited to the job. Finally, mentoring programs themselves differ along the same dimensions. For example, they vary as to whether they include training for the mentors; how much attention they devote to the match between mentor and mentee; the degree to which mentors are compensated for their efforts, either with a salary supplement or a reduction in other duties; and whether an effort is made to provide mentors who have experience in teaching the same subjects as their mentees.*

2.8 Variables that affect the quality of mentoring programs

2.8.1 Selection of mentors

Since mentoring is a multifaceted role which requires a multitude of competencies and skills, mentor selection is of high importance to successful mentoring (Hobson et al. 2009; Ingersoll & Strong, 2011) and many have recommended that rigorous selection procedures be adopted (Hirsch et al. 2009; Yusko & Feiman-Nemser 2008). Mentor selection varies among programs, ranging from the use of very strict criteria to no requirements at all (Nasser-Abu Alhija & Fresko 2014). Among the qualities associated with effective mentoring that should be taken into account in mentor recruitment, the following can be found: teaching expertise, recognition and respect by peers, reflective and analytic capabilities, interpersonal skills, availability and flexibility, openness, a positive mentoring relationship experience in the past, and a commitment to serve as mentors (Frels et al. 2013; Hirsc et al. 2009; Hobson et al. 2009; Kilburg & Hancock 2006; Yusko & Feiman-Nemser 2008). According to Hobson et al. 2009, mentors should not be in any administrative position in order to be effective since senior school leaders generally have less time to devote to mentoring and often beginning teachers tend to be more inhibited around them.

Despite the recommended requirements for mentors, selection of mentors in practice is usually based on teaching competency rather than on personality characteristics, management style, and coaching skills (Kaiz 2002). When mentoring commences relative to the start of the school year is likely to affect the selection of an appropriate mentor. Implicit in the description of mentoring programs are the assumptions that new teachers assume their position at the start of the school year and that mentoring starts adjacent to this time. According to this scenario, experienced teachers know in advance that they will be serving as mentors to new teachers. However, it is not unreasonable to expect that some new teachers receive their teaching assignments after the start of the school year, mainly as substitute teachers. Being new in the school system, they are often entitled or required to participate in an induction program and are assigned mentors, who agree, or are coerced, to take on this assignment at short notice. The amount of time these mentors can devote to mentoring activities, their emotional commitment to mentoring, and their engagement in relevant training and professional development are likely to be negatively affected if they are recruited after the start of the school year. Thus, mentors recruited after the school year has begun and teaching schedules have been set are less likely to fulfil their role efficiently.

Another aspect of selection pertains to who chooses the mentor. Recruitment can be carried out by school principals, local education authorities, or even by the new teacher. Differences in mentors' commitment may be affected by who selects them. The existing research is unclear on this issue (Nasser-Abu Alhija & Fresko 2014). For example, Andrews & Quinn (2005) found no difference in the amount of assistance and support received by new teachers, when mentors were assigned by the school district as opposed to when they were assigned by school principals. In a different study by Hellsten et al. (2009), it was revealed that new teachers prefer to select their own mentor as opposed to being assigned a mentor by the induction program.

In New York, participating district superintendents choose mentors from a list developed by a select committee composed mostly of teachers and also are responsible for making intern assignments (Bullough 2012). A mentor is defined as a teacher who has "demonstrated their mastery of pedagogical and subject matters skills, given evidence of superior teaching abilities and interpersonal relationship qualities, and who [has] indicated their willingness to participate in such [a] program" (New York State United Teachers 2010, p. 7).

In Texas, by law, mentors must teach in the same school as those they mentor and teach the same grade level or in the same content area where possible. Finally, mentors must have at least three years of teaching experience and have a superior record of raising tested student achievement levels, and complete an approved program of mentor training (Bullough 2012).

2.8.2 Training of mentors

Being an expert teacher does not necessarily ensure successful mentoring (Clarke et al. 2014; Nasser-Abu Alhija & Fresko 2014). Hennison et al. (2011) and Wang and Odell (2002) believe that not everyone has a natural ability for mentoring, but that mentoring skills can be shaped and developed through preparation. In order to perform their role effectively, mentors require preparation beforehand and continuing professional development and support throughout (Hirsch et al. 2009; Hobson et al. 2009; Yusko & Feiman-Nemser 2008). Existing training programs for mentors vary greatly with respect to content, amount, timing, and duration (Hirsch et al. 2009). These programs often focus on administrative aspects of mentoring rather than on developing mentors' ability to support and facilitate new teachers' development, are often not compulsory, and tend to be poorly attended (Hobson et al. 2009; Wang & Fulton 2012). Empirical research findings support the value of mentor training. Giebelhaus & Bowman (2002) found that new teachers who were mentored by trained mentors demonstrated more effective lesson planning, better instruction, and better reflective practice. Findings from a study by Schelfhout et al. (2005) indicated that even a short inductive mentor training affects the reflective nature of coaching and the content and focus of mentoring. Finally, results of a study by Wechsler et al. (2010) showed that mentors who had a higher level of training provided more intensive mentoring and focused more on instruction as compared to untrained mentors.

The fact that there is no best practice model for mentoring was also identified by Lawy & Tedder 2011, highlighting that if mentoring systems are to be effective then they need to be flexible (Tedder & Lawy 2009) and adjustable to the mentees' circumstances and needs. Consequently mentors' training should aim at informing them about the different possible models that could be followed and simultaneously enabling them to identify and choose from each model and combine the elements required in each mentoring case (Kadji-Beltran et al. 2013).

Moreover, rather little research has been conducted on the problem of mentor induction—the transition from teacher to mentor and how teachers become effective mentors (Bullough 2012). This issue is complicated by realization that mentors develop their own styles of mentoring and that these often reflect set teaching commitments that elevate the values of support over inquiry and limit the kind and quality of feedback and guidance given beginning teachers (Harrison et al. 2005; Young et al. 2005). Mentors need mentoring (Gordon & Brobeck 2010). It is self-evident that mentoring calls for skills and knowledge, including of the politics of place, that go well beyond what is demanded of classroom teaching (Bullough 2012).

Preparation of mentors should focus not only on mentoring practices that tend to support novice teacher survival, but also on practices that provide long-term growth. It must embrace a dialectic perspective on adult learning, one where aspiring mentors are viewed as both experts and novices regarding matters of science teacher mentoring. Preparation for mentors should take years and include instruction that helps to untangle the practical knowledge of teaching. Mentor preparation should also include opportunities through which mentors can grapple with dilemmas of practice (Koballa et al. 2010). It should also occur within a community of learners (Kadji-Beltran et al. 2013; Koballa et al. 2010).

Studies on relationships between mentors' preparation, their knowledge of teaching and mentoring, their mentoring practice, and the quality of novices' learning to teach often rely on fragmented information, inferences and self-report (Wang & Odell 2002).

2.8.3 Matching of mentors and mentees

Matching of mentors and new teachers seems to be an important element of effective mentoring (Hirsch et al. 2009). The literature relates to matching on different traits, such as grade level, subject matter, age, gender, personality styles, and geographical proximity (Hirsc et al. 2009; Hobson et al. 2009; Kilburg & Hancock 2006; Wang & Fulton 2012). It should be noted that although matching on grade level and subject matter has been found to affect the degree to which the mentor is able to provide assistance in pedagogic-specific matters, findings have not always been consistent (Nasser-Abu Alhija & Fresko 2014). In a study done by Nasser-Abu Alhija & Fresko 2014 mentors viewed matching on subject matter as more critical than matching on grade level. These results can be attributed to the fact that teachers tend to teach the same subject to different grade levels.

Numerous challenges to successful mentoring can emerge when the personality and teaching approach of the mentor and the student teacher are not well aligned (Bradbury et al. 2008). Relational tensions can be initiated when student teaching placements are arbitrarily determined by the availability of teachers and their proximity to the university. They may be further exacerbated if the student teacher does not have an opportunity to meet with the mentor prior to the experience (Gut et al. 2014). Thus, neither student teacher nor mentor may have a chance to adjust their initial expectations (Siebert et al. 2006). Negative experiences have been attributed to difficult personal relationships with the mentor (Frels et al. 2013), inadequate feedback, and feeling inhibited in the choice of teaching methods (Rhoads et al. 2011).

Kilburg & Hancock 2006 conducted a large study in Oregon, involving 149 mentoring teams in four school districts that revealed several challenges. About one-fourth of the 149 teams reported a variety of problems, problems that tended to come in clusters. Many of the most pressing issues originated in difficulty with placements—mentors and mentees did not share the same school, subject, specialty area, or grade level, and the mentor lacked time to observe and the team had difficulty meeting. A few mentees reported their mentors lacked communication and coaching skills and failed to give adequate emotional support. A poor match was the central issue. This resulted in part from the shortage of willing mentors (Bullough 2012). When problems arise generally what beginning teachers do is seek help elsewhere by looking for an informal mentor rather than request a change in assignment (Worthy 2005). In this case the matter of choice comes to the forth again. Research on matching mentor and mentee still needs a way to go. Maintaining flexibility in placements particularly in the early stages of induction is a wise practice (Bullough 2012).

In the literature there is considerable disagreement about what is a good fit between a mentor and mentee. The following questions still have to be addressed: should a mentor and mentee share a basic set of values as well as a commitment to a particular vision of teaching and of learning? Is congruence the aim? Or, rather, since learning inevitably involves a measure of tension, is there greater value in having to struggle with and confront differences of varying kinds? How much difference is too much (Bullough 2012)?

The effects of mentoring where mentors and mentees have different beliefs and experiences of teaching and mentoring have to be researched (Wang & Odell 2002).

2.8.4 Qualities and attributes of a successful mentor

Mentor qualities such as empathy (Young & Cates 2010), confidence, sense of humour, patience and tolerance (Reid & Jones 1997), unthreatening attitude and readily availability (Bullough & Draper 2004), and social, emotional and instructional support (Nielsen et al. 2006) are among the characteristics of an effective mentorship.

Gilles & Wilson (2004) suggested that important attributes of mentors include: relearning, seeing a bigger picture, expanding their roles, gaining insights about the process of mentoring, and understanding the impact of the program on themselves.

2.8.5 Organizational support

Support by the organization/school principal is considered an important factor for successful mentoring (Ingersoll & Smith 2004; Kadji-Beltran et al. 2013). The organization plays an important role in the mentoring process and create the conditions that facilitate mentors and mentees to develop the mentoring relationship. In general, school culture and a whole-school approach to teaching and learning play a pivotal role in improving quality of teacher performance (Long & et al. 2012).

The principal is an important factor in reducing teacher attrition (Wood 2005) and is key to creating school structures that support quality induction programs and mentoring experiences. School structural support, implemented by the principal, encourages communication and the sharing of ideas (Johnson & Kardos 2002). Effective principals as leaders have the ability: (a) to ensure professional development is connected with the goals of each district and (b) to set standards and expectations and commitment to students (Kadji-Beltran et al. 2013). Principals also have the ability to instil within their teachers the importance of professional development by facilitating: (a) on-site professional development, (b) discussions and debates about professional development, and (c) the applications of these methods in the classroom (Wood 2005). Despite the noted role of principals, empirical evidence is lacking on the direct impact of principals on the success of new teacher induction programs (Frels et al. 2013). In their study of principals and superintendents as leaders of mentoring programs, Alsbury & Hackman (2006) recognized the importance of translating educational theory into practice in a broader role of helping mentees with respect to networking and socialization into the school community.

2.8.6 The availability of time/duration of mentoring

In the study of Gut et al. (2014) in which they determined the differences in mentoring across three clinical settings namely early field experiences, student teaching and entry level teaching, they found two key differences that influenced mentoring across these three clinical settings. The first was the amount of interaction time. The longer the interaction time, the greater the chance the mentor-mentee pair had of developing a positive mentoring relationship. This was best illustrated during student teaching, which allowed ample time for interaction and close collaboration. In contrast, the lack of interaction time during early field experiences often made the teacher candidate appear passive and uncommitted in the eyes of the mentor. There was also limited interaction time for mentoring during entry year teaching, due to the passive stance adopted by the mentor.

Kadji-Beltran et al. (2013) established that the duration of a mentoring program as well as the time spent and frequency of contact relate to the success of the mentoring relationship. This was also indicated by Piggot-Irvine & et al. (2009) and LoCasale-Crouch & et al. (2012).

In New York, beginning teachers are offered a year of induction support. In California they are offered two years. The difference is very important, allowing in California greater time for learning and for targeted professional development. With additional time, the widely recognized survival concerns of beginning teachers are more likely to be replaced by growth concerns and more rapidly. For mentors, this difference likely makes finding an appropriate balance between support and assessment responsibilities easier and more likely to be achieved (Bullough 2012).

Kilburg & Hancock (2006) also found in their study that one of the challenges that mentoring teams experienced was a lack of time for the mentor to observe the mentee.

2.8.7 The availability of resources to maintain and sustain mentoring programs

Funding of mentoring programs is essential for sustainability. If one looks at mentoring programs in the U.S. the following pattern emerges (Bullough 2012):

California mentoring programs: Funding is through competitive state grants. In 2008–2009, the dollar amounts were impressive: More than $6,000 per year per new teacher, including a minimum of $2,000 from the employing school district.

New York mentoring programs: Throughout the late 1980s the program was consistently funded at ever increasing levels, reaching $16.5 million in 1990–1991. Since then and until recently, funding has been spotty. For example, 84 school districts submitted applications for funding in 1994 for part of $4 million but the funds were never appropriated. This pattern continued—funding, no funding—through the 1990s and into the early 2000s. Between 2004 and 2007 funding was level at $6 million. In 2008-2009, programs were funded in 93 school districts.

Texas mentoring programs: Texas offers a final example. Supported by a Federal grant, beginning in 1999 Texas piloted the Texas Beginning Educator Support System (TxBESS). Mentoring of beginning teachers had been mandated by law but unfunded, and few systematic efforts at beginning teacher induction existed. Seeking to improve achievement results in reading and mathematics particularly for minority and economically disadvantaged children and increase teacher retention, $3 million dollars were appropriated in 2002 to support an expanded but optional program of mentoring for beginning teachers. Three years later, and with additional funding, a program was developed to certify Master Teachers in reading, science, and mathematics. A stipend of $5,000 was awarded to those teachers completing the program along with opportunities to serve as mentors. Supporting the Beginning Teacher Induction and Mentoring Program (BTIM) grant, between 2007 and 2010, an additional $30 million dollars was allocated to 50 school districts for improving their teacher mentor programs. Here it should be noted that there are some 1,030 school districts in Texas, both very large and very small. Some districts support their own induction and mentoring programs. Current legislation supporting the BTIM program provides that funds may be used for mentor stipends, training, and released time to meet with and observe beginning teachers.

In a study conducted by Smith & Ingersoll (2004) teachers that received mentoring plus extra resources—reduced instructional load, fewer preparations, a classroom aide, showed a substantially lower attrition rate than those which received mentoring without extra resources.

However, little is known about the cost-effectiveness of mentoring (Hobson et al. 2009).

2.8.8 Race and gender issues

Through a study on the effects of a long-term mentoring program for women at an Australian university, DeVries et al. (2006) found that male mentors "increased their understanding and sensitivity regarding gendered process in the workforce" (p. 573). Much debate exists concerning the outcomes for women with regard to the gender composition of the mentoring arrangement (DeVries et al. 2006). Burke et al. (2006) found that women with female mentors reported greater role modelling and scored higher on the measure of psychosocial functions. However, Tharenou (2005) found that female mentors, over males, had a stronger effect that both helped and hindered their female mentee. The findings of Tharenou's study and others (Lyness & Thompson 2000; Metz & Tharenou 2001) established that women mentors were more likely to focus on psychosocial functions rather than career functions, and that a stronger focus on psychosocial functions had negative or little impact on women's career advancement. However, regardless of this outcome, women who were mentored had higher career advancement than those who were not. The findings of other studies (Noe et al.

2002) have concluded that women with female mentors were more likely to learn strategies for dealing with gender barriers, acquire role modelling, and gain greater career support. Adding to this debate, Ragins & Cotton (1999) found that whilst women who had a history of male mentors received more promotions, they also received less compensation than their male equivalents. The gender of the mentor and the subsequent effects of this relationship on the female protégée are therefore an important aspect for consideration in mentoring programs for women (Archard 2012).

Nasser-Abu Alhija & Fresko (2014) found in their research that mentoring activities tended to vary by school level and gender. Accordingly, elementary school mentors as compared to their secondary school counterparts reported dealing more with the new teachers' capacity to cope with difficulties (emotional support). Since elementary schools tend to be small and the teaching staff predominantly female, it is more likely that seeking help from the mentor about situations of coping is more commonplace. In addition, male mentors were found to focus more on helping the new teachers adjust to school culture. Their emphasis on ecological support involving adjustment to school norms and responsibilities is in line with prior findings that show male mentors have a tendency to focus on external aspects of career development (Godshalk & Sosik 2000).

The limited number of women in senior academic positions also poses a problem for women that wants to be mentored by women (Mathews 2003).

2.8.9 Power, vulnerability and control issues

It has been established through research that a relationship that is based on hierarchy and power rarely cultivates connectedness and/or productive outcomes (Eby et al. 2000). Therefore, rather than the typical hierarchical mentoring relationship that frequents descriptions in the research, the relational component promotes a more reciprocal relationship whereby the mentor and mentee each have skills, knowledge, and practices to share (Ambrosetti et al. 2014). However, mentoring relationships are more commonly both reciprocal and asymmetrical, meaning that there are shared responsibilities between the participants, but one participant may be more experienced and take the lead within the relationship. Thus, the mutuality of the relationship offsets hierarchical factors that may emerge such as power struggles. Descriptors such as nurture, support, mutuality, and trust encompass the relational component. Likewise, the roles a mentor undertakes in this component are those of advocate, friend, colleague, and counsellor (Ambrosetti et al. 2014).

Although research presents clear benefits of mentoring for teachers, this is not always reason enough for teachers to take on a mentoring role, particularly if the complexities of their work as teachers are taken into account. Principals can put pressure on teachers to mentor or on the other hand be concerned about their absence from their classrooms. This can lead to anxiety and give an added sense of responsibility to the role as mentor. The growing demand on teacher's time in a data-driven climate of school reform can also result in teachers feeling a lack of autonomy and power in how they structure their teaching and in their access to authentic professional growth. Mentors can also experience feelings of vulnerability when they doubt their own abilities as mentors (Ponte & Twomey 2014).

Bullough 2012 argues that a community of practice is an effective tool to address power and control issues. In a community of practice the power and control shifts to the community. Tensions are better balanced within these communities because the resources of an entire community become available and because the community has a shared work that needs doing, shared standards for what counts as adequate doing, and a stake in the beginner's success. When attempting to resolve a problem or gain increased understanding of an issue or an opportunity, both mentor and mentee are given permission to reach beyond their relationship for resources and guidance.

2.8.10 Subject area, grade and school level

Given recent urgency to meet ambitious new teaching goals, common core standards, and heightened accountability, educators and policy-makers have turned to mentoring to develop novices' content teaching (Achinstein & Davis 2014). This calls for expanding mentors' roles to support novices in developing deep understanding of subject matter and connecting content to learners (Wang & Odell, 2002; Wang et al. 2004). Content knowledge was assumed to be the purview of pre-service teacher education but, given the short period of pre-service, and the complex and contextualized work of learning to teach, more teachers are entering the profession lacking this knowledge (Feiman-Nemser 2001). Even those who enter teaching with a depth of content knowledge need to develop pedagogical content knowledge (PCK), which is an amalgam of pedagogy and content, reflecting how topics are organized, represented, and adapted to particular student learners and contexts (Schulman 1987). While researchers report that matching novices with mentors in their discipline and focusing on teaching content is associated with positive outcomes for teachers and students (Boyd et al. 2012), the dominant mode of mentoring in the US remains providing socio-emotional and socialization support (Wang & Odell, 2002). Researchers have reported that US mentor–novice interactions reveal an absence of discussion of subject matter teaching and its relation to students (Wang et al. 2004). This lack of content focus during induction can lead novices to focus on generic strategies and not subject-specific pedagogy advocated in a content area, and ultimately impact novices' beliefs about their subject matter (Luft et al. 2003).

Nasser-Abu Alhija & Fresko 2014 found with respect to school level that frequency, regularity and initiation of mentoring were higher in elementary schools than in secondary schools. They ascribed it to the fact that elementary schools are significantly smaller than secondary schools and that the frequent encounters among their teaching staff are more likely to lead to more intimate relationships.

2.8.11 Communities of practice/Professional learning communities

Sharing experiences appears to be important for mentors both in the context of mentoring as well as in the context of their subject. This outcome holds important implications for mentors' training and suggests that this could integrate forms of professional learning communities (Kadji-Beltran et al. 2013). Professional learning communities are formed when a group of professionals work together and critically interrogate their practice in an on-going, reflective, collaborative, inclusive, learning-oriented and growth-promoting way, thus becoming vehicles for learning for the members within them (Simpson 2011). Their members are characterised by shared values and vision amongst collective responsibility, reflective personal inquiry and dialogue with peers, collaboration and focus on individual and group learning (DuFour 2004; Stoll & et al. 2006). Collective learning differs from traditional forms of professional development that focus on transferring knowledge and skills outside the school settings and context. Professional learning communities do not focus just on individual teachers' learning, 'but on professional learning, within the context of a cohesive group that focuses on collective knowledge and occurs within an ethic of interpersonal caring that permeates the lives of teachers, students and school leaders (Kadji-Beltran et al. 2013). For a professional learning community to be formed there has to be a specific shared 'domain of interest', the community that shares the same interest and practice (Simpson 2011, p. 702).

In the research conducted by Kadji-Beltran et al. (2013) collective learning as a supportive means for professional development was prompted by novice teachers who considered the value of acquiring teaching competencies from experiencing teaching, guidance from expert teachers and proposed collaborative development of lesson plans, teaching or watching videotaped lessons as opportunities for discussion and reflection within groups of novice teachers.

Smith & Ingersoll 2004 found in their study on teacher attrition, that the most powerful influence on teacher attrition came from having a mentor in the same subject area or collaboration with other teachers on instruction, and being part of an external network of teachers (professional learning community).

The place of mentors and mentees in professional learning communities still needs exploration. Mentoring in community contexts is very different from mentoring in an insulated dyad (Bullough 2012).

2.8.12 Mentoring (must be respected) as a legitimate method of learning in context

Learning in context can be achieved by mentoring (Mathews 2003). The role of practice in learning to teach has received increasing attention among teacher educators during the past two decades, resulting in several global trends (Gut et al. 2014). These include an increased emphasis on school-based experiences (Maandag D. W. et al. 2007), an expansion of student teaching requirements (Ronfeldt & Reininger 2012), and the recent call in the United States for clinically-based teacher education (Gut et al. 2014). These trends have been accompanied by a theoretical shift concerning how teachers learn to teach. Historically, pre-service teachers were exposed to a theoretical knowledge base and then expected to find ways to apply their learning in a classroom. More recently, a number of scholars (Ball & Forzani 2009; Cochran-Smith & Lytle 1999; Korthagen & Kessels 1999) have reversed this perspective by asserting that experiential learning establishes the basis for understanding theory. The increased emphasis on situated learning in clinical settings has led to increasing attention to the role of mentoring in teacher education. A more generalized understanding of teaching principles is reached through reflection on teaching practice (Gut et al. 2014). Korthagen (2010) described this process of reflection as occurring in three tiers: (a) the acquisition of teaching experiences, (b) the creation of schemas through reflection upon teaching experiences, and (c) the development of theoretical knowledge by aligning schemas with more formally learned concepts, typically acquired through coursework, professional development activities, or professional reading. During this process, mentors provide support for mentees as they move from a context specific, tacit experience of teaching practice to more generalized, explicitly understood concepts (Gut et al. 2014).

Most of the literature makes little of the fact that mentoring is a matter of adult learning and that helping adults learn complex tasks in difficult conditions presents unique challenges, particularly unlearning old habits and remaking established beliefs (Bullough 2012). Conceptions of teaching and learning to teach are often not used as the basis for studies of teacher mentoring and teacher' learning to teach (Wang & Odell 2002).

2.8.13 Expectations that mentor and mentee bring to the relationship

The most successful mentorships are characterised by shared assumptions and expectations (on the part of mentor and mentee) about the form and function of the relationship (Johnston 2009).

In the research of Frels et al. 2013 mentees indicated that they wanted mentors who possessed personal skills, rapport, and initiative as well as a working understanding of the school routines. Mentees hope to feel accepted and supported by their mentor (Tedder and Lawy 2009, Lawy and Tedder 2011). Mentees want mentors with good communication and coaching skills which give them adequate emotional support (Kilburg & Hancock 2006). The dominant role of mentors in the eyes of both pre-service and beginning teachers is to provide emotional and technical support; learning to teach, in their view, is to be left to their own accumulation of teaching experience and lessons based on trial and error (Wang & Odell 2002).

Mentors want only one mentee and a better understanding of how to mentor (Frels et al. 2013). Mentors expect their mentees to know their content, to provide standards-based instruction, and to prioritize their students' needs when designing and delivering instruction. Mentors also perceive mentees as more capable if they had more experience working with children. They expect a positive mentoring experience if their previous experience was positive or a negative experience if their previous experience was negative (Gut et al. 2014). Mentors are hesitant to play an active role in supporting novices' learning to teach. Instead, many mentors see their role as providers of emotional support or technical guidance for novices who are adapting to the teaching profession.

The existing studies of mentors' expectations for their role suggest that mentors' expectations are not consistent with the role that they are expected to play to help novices learn standards-based teaching. They do not expect to support novices by posing problems for them or by uncovering assumptions that underlie existing practice. They have no intention of engaging novice teachers in developing a deeper understanding of subject matter and connecting that knowledge to a diverse student population. They do not see their role as helping novice teachers to understand the relationship between theoretical knowledge as a basis for standards-based teaching and relevant teaching practice. Nor do they see their role as supporting novices in acquiring more knowledge about teaching through systematic reflection and analysis. Instead, they focus on providing emotional support and technical assistance in their collaboration with novice teachers, just as many novice teachers expect (Wang & Odell 2002).

2.8.14 Assessment

In some induction programs, mentors not only provide support and guidance to new teachers, but are also involved in the formal process of evaluating their performance (Yusko & Feiman-Nemser 2008). Since mentors can closely observe the competences and growth in the new teacher, it is assumed that they are able to provide reliable and valid evaluations. However, some programs prohibit mentors from evaluating new teachers for summative purposes (Hirsch et al. 2009) so as to prevent role conflict (Hobson et al. 2009), which could negatively affect the mentoring relationship. According to Hobson et al. (2009), the empirical evidence is inconclusive. The results of some studies suggest that if the assessment and support roles are not separated, it will be difficult to establish a mentoring relationship based on mutual trust in which risk-free learning can occur. Nonetheless, the results of other studies show that if a good relationship is established at the outset, no conflict need arise. Rippon & Martin (2003) and Yusko & Feiman-Nemser (2008) similarly concluded that mentors can successfully perform both roles provided they possess a wide range of professional and interpersonal skills. Furthermore, Yusko & Feiman-Nemser (2008) argued that separation of the two roles is impossible if mentoring is to be taken seriously by both parties. Being involved in evaluating new teachers does not necessarily prevent the development of trustworthy relationships, although it sometimes makes it more challenging (Nasser-Abu Alhija & Fresko 2014).

2.9 Impact of mentoring programs

2.9.1 On teachers' retention, teaching practices, commitment and professional values

Thompson et al. (2004) studied the California Beginning Teacher and Assessment Program (BTSA) and its accompanying California Formative Assessment and Support System (CFASST) among 1 125 third-to-fifth-grade teachers from 107 school districts during their third teaching year. The first part of the study examined the relationship between the degree of beginning teachers' engagement with district mentoring programs and their students' academic achievement. The second part of this study examined the impact on beginning teachers' teaching practices. The case study sample consisted of 34 elementary teachers, representing 26 BTSA programs and 29 districts, from across the state. These 34 teachers were as sub-sample of the 287 early career teachers who responded to the BTSA/CFASST engagement survey described above. The average effect size for the set of teaching practices researched (instructional planning, reflection on practice, questioning practices, feedback practices, depth of student understanding) was 0.32 standard deviations, which indicates that teacher mentoring had a relatively large impact on teaching practice.

Smith & Ingersoll (2004) compared teachers who had no induction mentoring with those who experienced varying degrees and intensity of support. The levels included (a) basic induction, where a beginning teacher reported having a mentor and supportive communication with school administrators; (b) basic induction plus collaboration, where the beginning teacher reported having a mentor in their own field and regular and supportive communication with administrators or department chairs, a common planning period or regularly scheduled collaboration with other teachers in their area, and participated in a beginning teacher seminar; and (c) all of the above plus participating in an external teacher network and receiving extra resources—reduced instructional load, fewer preparations, a classroom aide. Only 3% of the beginning teachers who responded reported receiving virtually no induction support at all. Most—56%—fell in the basic induction category while 26% fell into the second category, basic induction plus collaboration. Only 1% of beginning teachers said they received extra resources, and thereby fell into the third category. The practice of offering additional resources to beginning teachers appears to be growing as is suggested by New York's 10% teaching load reduction but is much more common in other nations than in the US, England, Wales, New Zealand, and Japan for example (Howe 2006). The percentage of leavers after the first year of teaching decreased with each category move—20% of those not receiving any induction support left; 18% of the beginners receiving the first, the basic package, left, as did 12% and 9% of those falling in the second and third categories, respectively. Of those beginning teachers who received extra resources, Smith & Ingersoll (2004 p. 705) wrote:

The larger package further reduced the predicted rate of turnover—the predicted probability of a departure at the end of the first year for teachers receiving this package was less than half the probability for teachers who participated in no induction activities.

Villar & Strong (2007) underscored the point in their benefit–cost analysis of a comprehensive district program of support for beginning teachers that included released time from classroom teaching for mentors, on-going mentor training, support for teacher networking and teacher cohorts, and consistent interaction with school administrators—a program in most respects fitting into Smith and Ingersoll's "extra resources" category. Not only did teacher retention increase significantly thereby generating large dollar returns on program investment but, the authors concluded, the "beginners resembled fourth-year teachers, thus yielding a substantial return when expressed in salary differences" (Villar & Strong 2007, p. 14). The more important implication is that teacher learning was accelerated. Clearly, while a mentor is crucially important to a beginner's development, mentoring, alone, is no substitute for a full program of induction. It is apparent that effective induction requires something more than what a single, thoughtful, and caring mentor alone can provide (Bullough 2012). This said, for beginners the need for support of various kinds remains, including emotional support, which mentees consistently report as the most valued outcome of being mentored (Fletcher et al. 2008).

As noted, while initially the driving concern behind developing induction programs was to increase teacher retention, aims have expanded. In addition to improved retention, induction—and mentoring, more specifically—is increasingly recognized as essential to teacher development (Bullough 2012).

In their review of studies on mentoring of beginning teachers Ingersoll & Strong (2011) concluded that all of the studies had limitations and weaknesses but that they provided empirical support for the claim that induction for beginning teachers and teacher mentoring programs in particular have a positive impact. Almost all of the studies reviewed showed that beginning teachers who participated in some kind of induction had higher satisfaction, commitment, or retention. Likewise, for teachers' classroom practices, most of the studies reviewed showed that beginning teachers who participated in some kind of induction performed better at various aspects of teaching, such as keeping students on task, developing workable lesson plans, using effective student questioning practices, adjusting classroom activities to meet students' interests, maintaining a positive classroom atmosphere, and demonstrating successful classroom management.

The major exception to this overall trend was the study conducted by Glazerman and colleagues (2010). This study was a large randomized controlled trial done in a sample of large, urban, low-income schools. The research community views the results from randomized controlled trials as more reliable and valid than findings derived from other research designs. The results of this study were more mixed than most. The study found no differences between the teachers in the treatment and control groups in their classroom practices in the 1st year and in teachers' retention over several years.

One possible explanation for the conflicting findings regarding the effects of induction on beginning teachers' instructional practices could lie in differences in the duration of induction. The Glazerman et al. (2010) study found that it took time—at least 2 years of induction—for any differences in effects to show up in students' test scores. However, to examine the impact on their classroom practices, the beginning teachers in the sample were observed only once in the spring semester during their 1st year of teaching. Notably, the five other studies on the effects of induction on classroom teaching practices all undertook multiple and lengthier classroom observations of each teacher in the study. Moreover, the largest of these five other studies observed the treatment group after they received induction for 2 years. Four of these five studies detected positive effects on teachers' practices; the fifth study had ambiguous findings. Hence, one explanation for the lack of effect on practices is that, like gains in student test scores, it could be the case that it takes more than a half year of participating in comprehensive induction before teachers' daily instructional practices visibly and consistently differ from those of teachers receiving the prevailing induction.

This is consistent with the theory and rationale behind one of the comprehensive induction programs utilized in the Glazerman et al. study—the program offered by NTC. This model holds that on-the-job development of beginners takes more than 1 year, and hence beginning teachers in its program are required to receive 2 years of support (Moir et al. 2009). Another possible explanation for the inconsistent findings regarding the effects of induction, especially on retention, lies in external validity—the issue of generalizability.

Limits to the generalizability of findings from randomized controlled trials have been a point of debate in other fields. For instance, in medical research there has long been discussion among practicing physicians concerning the limits of results from clinical trials because patients in the field may differ from those enrolled in particular trials and trials may focus on population-level effects that are, by definition, overall averages (Riehl 2006). The study by Glazerman and colleagues intentionally sampled large, urban public school districts that had a majority of students from families below the federal poverty line. Although some of the other studies reviewed similarly and solely focused on teachers in large, urban, low-income public school districts (Kapadia et al. 2007; Rockoff 2008), most of the studies we reviewed did not. It is unclear whether the absence of effects of comprehensive induction on teachers' practices and retention found in the Glazerman et al. study's sample of large, urban public school districts would hold true in other types of districts.

That the effects of induction on retention can vary by setting is borne out by Ingersoll & Smith (2004) disaggregated analysis of national data. Their initial analysis of a national sample found that induction had strong positive effects on teacher retention (Ingersoll & Smith, 2004). However, their follow-up analyses found that the impact of induction differed by school poverty level, with very strong effects in low-poverty schools and no effects in high-poverty schools (Ingersoll & Smith, 2004). This latter finding is consistent with the findings in the study by Glazerman and colleagues. The Ingersoll and Smith data suggest that context matters and that induction's efficacy may depend on the school setting. Their hypothesis is that induction is not a panacea and that it, alone, may not be sufficient to reduce the high levels of teacher turnover that normally exist in many urban, low-income public schools. In other words, one explanation for the inconsistent findings regarding teacher retention is that although induction could, after a couple of years, positively affect teachers' practices and student achievement in high-poverty, urban public schools, nevertheless, receiving comprehensive induction as opposed to the prevailing induction alone may not be able to persuade teachers to stay in such schools at significantly higher rates (Ingersoll & Strong 2011).

There is only a modest literature on the potential negative effects of mentoring on mentees. In some cases mentoring may support ineffective practice by reinforcing traditional norms and practices rather than promoting more powerful teaching (Feiman-Nemser 2001). Little is known about how to increase mentees' willingness to be mentored (Hobson et al. 2009).

2.9.2 On organization's context

Mentoring actually changes the very context of schools. This leads on to establish 'lateral capacity building' in which schools and districts learn from each other. When this happens two change forces are unleashed, namely, knowledge (best ideas flow) and motivation (people identify with larger parts of the system). For example, when principals and teachers interact across schools in this way, they become almost as concerned about the success of other schools in their network as their own school. This is an example of changing for the better the larger context within which they work. The successes achieved in a district-wide (York district) and state-wide (Ontario) reform in Canada show that the theory of change translates powerfully into specific, inter-related strategy that gets results. It is using change knowledge for school and system improvement. Both York and Ontario are getting improved student results following a previous period of flat-lined performance (Fullan 2006).

Kadji-Beltran et al. 2013 also concluded from their research that mentee–mentor collaboration raised other school teachers' interest and resulted in sharing practices. This indicates the potential of mentorship to foster the development of a climate of collaboration and support within the school. Teacher collaboration and close partnership between colleagues has been established as an important factor in enabling professional learning to occur (Harris & Jones 2010). In general, school culture/context and a whole-school approach to teaching and learning play a pivotal role in improving quality of teacher performance (Long & et al. 2012).

Organizational benefits include increased productivity and organizational stability, increased socialization and communication, the retention of valued teachers, the preservation of intellectual capital and institutional memory, the support of cultural diversity, improved leadership capacity and succession planning, and cost-effectiveness. Studies on the organizational benefits of mentoring stress that optimal effectiveness is achieved when mentoring practices are integrated within an institution's larger human resource management strategy and are linked to other personnel practices, such as professional development training programs, performance appraisals, and systems of rewards and recognition (Zellers et al. 2008).

According to the The Alberta Teachers' Association (2004) mentoring benefits the Teaching Profession by retention of the best, most creative teachers; retention of experienced teachers who find a new challenge and opportunity for growth by serving as mentors; increased continuity of traditions and positive cultural norms for behaviour; and the establishment of professional norms of openness to learning from others, new ideas and instructional practices, continual improvement, collaboration, collegiality and experimentation.

2.9.3 On mentors

In a study done by Nasser-Abu Alhija & Fresko (2014) they found that most mentors expressed a high degree of satisfaction. However, satisfaction was greater among those mentors who reported no feelings of role conflict. Satisfaction of mentors stemmed particularly from contributing to the professional development of new teachers as well as from their own professional development.

Mentors in a school-university partnership in Hawai reported that the experience had been rewarding and that they were benefitting from it in several ways. They noted that their engagement in mentoring student teachers had led to their own professional growth. They learned from observing their students in action, from the contact they had with university faculty, from new relationships with other teachers and administrators (communities of practice). They experienced a sense of fulfilment, because they felt that they were giving back and witnessed how student teachers grew in their teaching skills. Some mentors felt that they could use what they have learned in the mentoring process to influence change in their own schools (Ponte & Twomey 2014).

Mentorship is an opportunity for self-assessment, reflection upon the mentors' own pedagogies and updating. It also strengthens mentors' emotional well-being by enhancing communication and trust with colleagues and breaking out of the classroom routine. Teachers' sense of emotional well-being can affect their classroom performance positively (Kadji-Beltran et al. 2013). This support the arguments that mentorship is both regenerative, since it inspires mentors' teaching practices, and generative, as it gives back to the profession (Eby & Lockwood 2004; Margolis 2008).

The Alberta Teachers' Association (2009) summarize the benefits for the mentor as follows:

- Increased learning, renewal and teaching performance
- Recognition as an excellent teacher conferred through status as a mentor
- Refocus on instructional practices and the development of reflective skills

- Opportunity to serve the profession
- Gratitude of the mentee

As noted above there is only a modest literature on the potential negative effects of mentoring on mentors and mentees. In some cases mentoring may support ineffective practice by reinforcing traditional norms and practices rather than promoting more powerful teaching (Feiman-Nemser 2001). Little is known about how mentoring effects mentor retention and the impact on mentors of various types of training programs (Hobson et al. 2009).

Little research focus on how mentoring effects mentors and, more specifically, on the challenges mentors face when mentoring (Achinstein & Davis 2014; Bullough 2012). Only recently has attention been called to the extraordinarily complex emotional demands of mentoring (Bullough & Draper 2004).

2.9.4 On student achievement

Thompson et al. (2004) studied the California Beginning Teacher and Assessment Program (BTSA) and its accompanying California Formative Assessment and Support System (CFASST) among 1 125 third-to-fifth-grade teachers from 107 school districts during their third teaching year. This study examined the relationship between the degree of beginning teachers' engagement with district mentoring programs and their students' academic achievement.

The study used hierarchical linear modelling techniques to examine the relationship between student test scores and each teacher's degree of mentoring engagement (high, medium, or low), after controlling for a number of key factors, including school-wide academic performance, student socioeconomic status, and student English language-learner status, nested within individual teachers' classrooms. The analysis found that, across all six subtests of the standardized achievement examination, the students of teachers who had a high level of mentoring engagement outscored the students of teachers with a low level of engagement, after controlling for other factors. The authors concluded that although none of the score differences was statistically significant, the consistency of the results across all tests suggested that "BTSA/CFASST had a positive impact on student test scores" (Thompson et al., 2004, p. 13) (Ingersoll & Strong 2011).

The second part of this study examined the impact on beginning teachers' teaching practices. The case study sample consisted of 34 elementary teachers, representing 26 BTSA programs and 29 districts, from across the state. These 34 teachers were as sub-sample of the 287 early career teachers who responded to the BTSA/CFASST engagement survey described above. The researchers found generally positive but largely non-significant results for the ten measures of teaching practice. The average effect size for the set of ten teaching practices was 0.32 standard deviations. The researchers acknowledged that this impact does not translate directly into equivalent effects on student outcomes. The impact on students of a change in teacher practice depends on the nature, frequency, and centrality of the teaching practice. Therefore, the impact on student achievement might be expected to be smaller than 0.32 (Thompson et al. 2004).

A pair of studies by Fletcher and colleagues also evaluated the effects on student learning of school district mentoring programs in California and in a large, urban, East Coast district. Fletcher, Strong, and Villar (2008) focused on the effects on student reading achievement of teachers' having *different types of mentors*. This study examined data from three California school districts. The district mentoring programs varied according to how they were implemented in the teachers' 2nd year. All three districts used mentors who were released from all teaching duties, with mentor to mentee caseloads of 1:15 in the 1st year. In the 2nd year, one district shifted to an in-school "buddy" mentor with no release time, one district doubled the mentor caseload, and the third district maintained the same caseload, thereby preserving the same high intensity of mentoring support (Ingersoll & Strong 2011).

Using hierarchical linear modelling techniques, the researchers found that the third district, with a more intense mentoring model, showed higher class reading gains after 2 years for its beginning teachers than the other two districts, after controlling for differences in district size, poverty, and student race/ethnicity (Ingersoll & Strong 2011).

Another part of Fletcher et al.'s (2008) study focused on the third district, with its high-intensity mentoring model. Within each school, the analysis compared beginning teachers with veteran teachers as a whole. Veteran teachers may have had some mentoring support in the past, but they had not participated in the district's comprehensive mentoring program. The objective of the analysis was to examine the impact of participation in mentoring on student test gains over 5 years. The analysis showed that although beginning teachers were more likely to be assigned to teach low-achieving classes, their students had, on average, equal or greater achievement than those of the more experienced teachers (Ingersoll & Strong 2011).

The second study by Fletcher and Strong (2009) compared two groups of beginning fourth and fifth grade teachers in a large, urban, East Coast school district. One group had support from a full-release mentor, whereas teachers in the other group were assigned a site-based mentor. The mentors received the same training, but they differed in caseload and release time. Teachers who received the support of a full-time mentor tended to have more low-achieving and low-income students than did teachers in the other group. In spite of this, students of teachers in the full-release mentor group showed greater achievement gains after 1 year (Ingersoll & Strong 2011). The impacts were equal to 0.05 to 0.07 for English language arts and 0.4 to 0.6 standard deviations for mathematics (Fletcher & Strong 2009).

Rockoff (2008) examined the effects of mentoring on student achievement (and on teacher retention) in New York City. As in the California studies, the investigator was not able to compare participating to non-participating new teachers, since all new teachers were enrolled in the district's program. The study compared beginning teachers to other newly hired teachers who had prior teaching experience and hence were not eligible for mentoring (Ingersoll & Strong 2011).

However, within the group receiving mentoring, Rockoff (2008) compared those who received more time with a mentor to those who received less time. Overall, the study found no differences in student achievement gains between newly hired inexperienced teachers who received mentoring and newly hired experienced teachers who did not receive mentoring. However, the study did find that teachers who received more hours of mentoring had higher student achievement score gains, in both math and reading, than those who had fewer hours of mentoring (Ingersoll & Strong 2011). The magnitude of these impacts were equal to 0.05 standard deviations for mathematics and 0.04 standard deviations for reading per ten hours of mentoring (Rockoff 2008).

The largest, most ambitious, and most important study investigating the impact of mentoring was funded by the U.S. Department of Education and conducted by a research team from Mathematica Policy Research of Princeton, New Jersey. This study conducted by Glazerman et al. (2010) used a randomized controlled trial methodology. The major strength of a randomized controlled trial design is that it allows a study to isolate the impact of a treatment by ruling out other factors, such as the predispositions of participants and the character of the settings, that may affect the outcomes. This allows the researchers to make causal connections (Ingersoll & Strong 2011).

This study collected data from 1,009 beginning teachers in 418 schools in 17 large, urban, low-income public school districts. The sampled teachers were followed for 3 years, beginning in the 2005–2006 school year. Student achievement test scores were collected from district administrative records for the 2005–2006, 2006–2007, and 2007–2008 school years. This study randomly assigned the 418 schools to either the treatment or control condition, allowing for all new teachers in a school to be in the same group (Ingersoll & Strong 2011).

Beginning teachers in the treatment schools received comprehensive mentoring for either 1 or 2 years through programs offered by either the Educational Testing Service (ETS) or the New Teacher Centre, Santa Cruz (NTC). The programs included weekly meetings with a full-time mentor who received on-going training and materials, monthly professional development sessions, opportunities to observe veteran teachers, and continuing evaluation of the teachers' practices. Beginning teachers in the control schools—those not assigned to receive comprehensive mentoring services—by default received the support normally offered to novice teachers by the district or school. The research design sought to ensure that the two teacher groups were balanced by race, gender, age, training, grade level, and certification (Ingersoll & Strong 2011).

For teachers who received one year of comprehensive mentoring, there was no impact on student achievement. In each of the first three years of teachers' careers, students of treatment teachers receiving one year of comprehensive mentoring performed no better than students of the corresponding control teachers. For teachers who received two years of comprehensive mentoring, there was no impact on student achievement in the first two years. In the third year, there was a positive and significant impact on student achievement. In the third year, in districts and grades in which students' test scores from the current and prior year were available, students of treatment teachers outperformed students of the corresponding control teachers on average. These impacts were equivalent to effect sizes of 0.11 in reading and 0.20 standard deviations in mathematics (Glazerman et al. 2010).

2.10 A critical assessment of the mentoring research with regards to student achievement

The mentoring-student achievement literature was assessed by looking for contradictions between the findings of the different studies. The literature was also searched for gaps and silences with regards to mentoring and student achievement. The generalizability of the studies was also assessed.

In the study done by Thompson et al. (2004) the researchers did not have access to data on gains over time in student achievement scores as a consequence of mentoring; instead, they used data on student achievement test scores at one point in time, limiting the study's ability to make conclusions about the impact of mentoring on student achievement. Moreover, the study had a low response rate and a non-representative sample because the analysis was able to obtain achievement test data for the students of only 144 of the 287 teachers who responded to the survey, reducing the sample to 13% of the target population of all third-to-fifth-grade public school teachers in the 3rd year of their teaching careers in California (Ingersoll & Strong 2011).

The second study done by Thompson et al. (2004) also showed defects that limits the study's ability to make conclusions about the impact of mentoring on student achievement. The study used a sub-sample consisting of 34 of the 287 teachers used in the first study. This small sample size was the result of recruitment difficulties and attrition. Of the 34 teachers who ultimately participated in the study, 15 were in the high CFASST engagement group, seven were in the middle group, and 12 were in the low CFASST engagement group. The middle level teachers could not be included in the high-low comparisons, effectively reducing the sample size to 27 teachers. The teachers with high CFASST engagement taught at schools with higher Academic Performance Index (API) scores and fewer low socio-economic status (SES) students than the schools of teachers with low CFASST engagement. (Thompson et al. 2004).

The researchers had to use a quasi-experimental design instead of a randomized design because they were unable to randomly assign teachers to treatment and control groups prior to the start of the treatment. The quality of the beginning teachers (arising from their innate ability and/or extent and quality of their teacher preparation) at the point they entered into their first positions could not be accounted for. The mean effect size for teacher practices was equal to 0.32 standard deviations. This implicates a smaller impact as 0.32 on student achievement (Thompson et al. 2004).

In the study done by Fletcher et al. (2008) the authors could not infer causal relationships because the limited sample size resulted in a design that did not let them distinguish school effects from district effects. A limitation of the second part of Fletcher et al's. (2008) study was the comparison of beginning to experienced teachers to test for impacts of mentoring. The researchers did not know how much mentoring the experienced teachers had received or to what extent more effective teachers might have moved to other, more attractive teaching positions or into school administration, thereby biasing the sample (Ingersoll & Strong 2011).

The study by (Fletcher & Strong 2009) was limited by the small sample size and a design that conflates potential teacher and school effects making it difficult to draw causal conclusions (Ingersoll & Strong 2011). The study sample consisted out of 16 grade 4 teachers and 12 grade 5 teachers. Not all the students of these teachers could be included in the analysis because of the fact that some students did not have test data for both years. The impacts reported in this study ranged between 0.05 to 0.07 standard deviations for English language arts and 0.4 to 0.6 standard deviations for mathematics (Fletcher & Strong 2009).

Rockoff's study also showed defects that limit the study's ability to make conclusions about the impact of mentoring on student achievement. The study compared beginning teachers to other newly hired teachers who had prior teaching experience and hence were not eligible for mentoring. In practice some teachers who were eligible for mentoring did not receive it, and some teachers who were ineligible for mentoring did receive mentoring. The researcher could only use a sub-set of teachers because of the availability of achievement data. The composition of the study sample as well as caseloads changed dramatically over the research period. The magnitude of these impacts were equal to 0.05 standard deviations for mathematics and 0.04 standard deviations for reading per ten hours of mentoring (Rockoff 2008).

The results of the study by Glazerman and colleagues (2010) differed from the findings of the other studies with regards to student achievement. The study found that significant differences between the treatment and control groups in the achievement of their students were achieved for beginning teachers that were mentored for two years. This was, however, only achieved after the third year that mentoring started. They also found that no positive differences were achieved (even after three years) for teachers which were mentored for only one year (Ingersoll & Strong 2011). This is consistent with the theory and rationale behind one of the comprehensive mentoring programs utilized in the Glazerman et al. study—the program offered by NTC. This model holds that on-the-job development of beginners takes more than 1 year, and hence beginning teachers in its program are required to receive 2 years of mentoring (Moir et al. 2009).

The researchers appeared to focus their attention more on the randomization strategies than on the control of the treatment. While comprehensive mentoring was made available to the treatment teachers, many of them did not take advantage of it. Seven percent reported that they did not even have an assigned mentor, a fundamental component of the comprehensive mentoring treatment. At the same time, 75% of the teachers in the control group had an assigned mentor and, on average, received only 12.5 fewer hours of mentoring over the entire school year compared to the teachers in the treatment group. The treatment consisted of hybridized versions of existing programs, modified especially for the study. This resulted into two-year programs compressed into one year. Thus, the mentors in the treatment group were all new to the model. On the other hand, the mentors in the control group were working within a familiar program (Fletcher & Strong 2009). This lack of clarity surrounding the degree and consistency of differences between the treatment and control groups poses implications for the findings (Ingersoll & Strong 2011).

Another issue with the Glazerman study concerns external validity and the issue of generalizability. The study focussed on large, urban public school districts that had 50 percent or more students from families below the federal poverty line. From this group, the study included only districts for which district administrators reported low levels of existing mentoring and that were willing and able to participate, resulting in a sample of 17 districts. The sample size used to determine the impact of the comprehensive mentoring on student achievement was limited to teachers in tested grades and subjects. Only teachers of students that took both a pre-test and post-test were included in the study sample. This decreased the study sample from 217 teachers to only 47 teachers (Glazerman et al. 2010). The study sample was not representative of districts, schools, or teachers in the United States or of the subpopulation of large urban, low-income school districts in the United States. This limits the ability to generalize from the study. It is unclear whether results of comprehensive mentoring found in the study's small sample of public school districts would hold true in other settings (Ingersoll & Strong 2011).

The major advantage of a randomized controlled trial design is that it addresses threats to internal validity and allows the study to isolate the impact of a treatment and make causal connections. The advantages of a randomized design to detect impacts could have partly be undermined in this study by the factors discussed above (Ingersoll & Strong 2011).

The impacts reported in this study were equivalent to effect sizes of 0.11 standard deviations in reading and 0.20 standard deviations in mathematics (Glazerman et al. 2010).

The above studies show some consistency in results, but they also share a number of limitations, most of which the authors acknowledge. The most prominent weakness is that none of these studies involves random assignment of teachers to mentoring groups. Neither students nor teachers are randomly distributed among classes and schools; parents may select school districts, schools, and even teachers; teachers are not randomly assigned among different levels of classes within schools; district resources may be differentially distributed among schools; classroom climates and other contextual conditions vary. All these factors may influence student performance and, unless controlled, may account for any differences in student achievement gains that appear to be the result of teacher mentoring. This major limitation applies, in varying degrees, to all of the studies (Ingersoll & Strong 2011).

2.11 Scope of research

As revealed by this review of the literature, there are contradictory findings on the impact of mentoring on student achievement in disadvantaged schools. In fact, the magnitude of the impact on student achievement, the generalizability of existing research, the length of mentoring needed as well as the time that it takes to achieve meaningful increases in student achievement in disadvantaged, poor-performing schools are far from clear.

The purpose of this research is to address these contradictions in the research literature by doing a concurrent, matched but non-randomised study to determine the impact of mentoring of teachers on student achievement in the school-university partnership between the UFS and disadvantaged, poor-performing schools in its feeding area over a period of three years (2012 – 2014).

Chapter 3

Conceptual framework

The primary goal of this study is to determine the impact of mentoring teachers on student achievement in disadvantaged schools. According to the change theory of Michael Fullan, changing contexts is the cornerstone of bringing about improved student learning and achievement (Fullan 2006). Context can be changed by learning in context (Fullan 2006) and learning in context can be achieved by teacher mentoring (Tovey 1999). Teacher mentoring, learning in context and the impact of teacher mentoring on teaching practices as well as on student achievement, were discussed in the literature review (Chapter 2). The change theory of Michael Fullan will be reviewed here and then a conceptual model that will answer the main research question, will be developed. This conceptual model will inform the data collection instruments and the method of analysis used in this study.

3.1 The change theory of Michael Fullan

3.1.1 The seven core premises that underpin Fullan's change theory (Fullan 2006).

Premise 1: A focus on motivation

A theory of change must be able to motivate people to put in the effort – individually and collectively – that is necessary to get results. Without that improvement is not possible. The other six core premises are all about motivation and engagement. They are about accomplishing the first premise. Motivation cannot be achieved in the short run. In fact the beginning of all eventual successes is unavoidably bumpy. However, if the strategy does not gain on the motivation question over time it will fail. Moral purpose is a great potential motivator, but needs other conditions to act to mobilize several key aspects of motivation like moral purpose, capacity, resources, peer and leadership support and identity. The combination of this key aspects makes the motivational difference (Fullan 2006).

Premise 2: Capacity building with a focus on results

Capacity building, with a focus on results, is crucial. For large-scale reform a combination of pressure and support is needed. Capacity building, with a focus on results captures both aspects well. Capacity building is defined as any strategy that increases the collective effectiveness of a group to raise the bar and close the gap of student learning. It involves helping to develop individual and collective knowledge and competencies, resources and motivation. These capacities are specifically about getting results (raise the bar, close the gap). The theory of change says that nothing will count unless people develop new capacities. And, indeed, that new capacities are a route to motivation. Most theories of change are weak on capacity building and that is one of the key reasons why they fall short (Fullan 2006). No external accountability scheme can be successful in the absence of internal accountability (Elmore 2004). Internal accountability is nothing else than capacity building with a focus on results (Fullan 2006).

A key part of the focus on results is the evolution of positive pressure. An emphasis on accountability by itself produces negative pressure: pressure that doesn't motivate and that doesn't get to capacity building. Positive pressure is pressure that does motivate, that is fair and reasonable and does come accompanied by resources for capacity building. The more one invests in capacity building, the more one has the right to expect greater performance. The more one focuses on results fairly – comparing like schools, using data over multiple years, providing targeted support for improvement – the more that motivational leverage can be used. In the change theory, it is capacity building first and judgement second, because that is what is most motivational (Fullan 2006).

Premise 3: Learning in context

The third basic premise is that strategies for reform must build in many opportunities for learning in context. Cultures where learning in context is characteristic must be created (Fullan 2006).

According to Elmore (2004):

Improvement is more a function of learning to do the right things in the settings where you work (p 73).

He goes on to say:

The problem [is that] there is almost no opportunity for teachers to engage in continuous and sustained learning about their practice in the settings in which they actually work, observing and being observed by their colleagues in their own classrooms and classrooms of other teachers in other schools confronting similar problems.

He then puts forward the positive implication:

The theory of action behind [this process of examining practice] might be stated as follows: The development of systematic knowledge about, and related to, large-scale instructional improvement requires a change in the prevailing culture of administration and teaching in schools. Cultures do not change by mandate; they change by the specific displacement of existing norms, structures, and processes by others; the process of cultural change depends fundamentally on modelling the new values and behaviour that you expect to displace the existing ones (p 11).

In this way learning in context actually changes the very context itself. Contexts do improve (Fullan 2006).

Premise 4: Changing context

Theories of action must also have the capacity to change the larger context. We assume that the larger infrastructure must change if success is to occur. That is to say that the bigger context in which one works must incorporate the other premises, such as promoting capacity building and being motivating. This leads on to establish 'lateral capacity building' in which schools and districts learn from each other. When this happens two change forces are unleashed, namely, knowledge (best ideas flow) and motivation (people identify with larger parts of the system). For example, when principals and teachers interact across schools in this way, they become almost as concerned about the success of other schools in their network as their own school. This is an example of changing for the better the larger context within which they work (Fullan 2006).

There are many things occurring in the system that favour the status quo by diverting energy to maintenance activities, which are at the expense of devoting resources and attention to continuous improvement. Thus it is necessary to address these issues explicitly. Distractor issues include collective bargaining conflicts and strikes, unnecessary bureaucracy, and finding efficient ways to address managerial issues (Fullan 2006).

Premise 5: A bias for reflective action

For the previous four components to move forward in concert, they must be fuelled by a bias for reflective action. There are several aspects to the reflective action premise.

First, shared vision and ownership is more an outcome of a quality process than it is a precondition. This is important to know because it causes one to act differently in order to create ownership.

Second, and related, behaviour changes to a certain extent before beliefs. Thirdly there are do-and-don't change actions that derive from this knowledge which is that the size and prettiness of the planning document is inversely related to the amount and quality of action, and in turn to the impact on student learning (Reeves 2006). Pfeffer & Sutton (2000) emphasise that planning must not substitute for action.

The reflection part of the theory of action underpinning the bias for reflection is crucial. This goes back to Dewey, who offered the insight that it is not that we learn by doing but that we learn by thinking about what we are doing. It is the purposeful thinking part that counts, not the mere doing (Fullan 2006). (Mintzberg 2005) makes the same point when he says we need

*programs designed to educate practicing managers in context; [such leadership] has to be learned, not just by doing it but by being able to gain conceptual insight while doing it' (*p 200).

All the current emphasis about evidence-based and evidence-informed leadership is based on this same premise (Pfeffer & Sutton 2006). People learn best through doing, reflection, inquiry, evidence, more doing and so on (Fullan 2006).

Premise 6: Tri-level engagement

Tri-level engagement is essential for system reform. Tri-level here refers to school and community, district and state. The goal is not to align these levels, but rather to foster penetrable connectivity between them. This basically means pursuing strategies that promote mutual interaction and influence within and across the three levels. If enough leaders across the same system engage in penetrable connectivity, they change the system itself (Fullan 2005).

Premise 7: Persistence and flexibility in staying on the course

Because the above six premises are complex to manage and must be cultivated over time, determination is necessary to stay on the course. It takes resilience – persistence plus flexibility. Rigid persistence outgrows push-back in equal or greater measure. Failure to keep going in the face of inevitable barriers achieves nothing. Being flexible, in fact, is built into the action theory. Because the theory is reflective and inquiry-based, and because it is cultivated in the minds and actions of key players operating with a similar theory of change (the seven premises), there is plenty of self-correction and refinement built-in (Fullan 2006).

These seven premises constitute the theory of change. The theory of change translates in practice into specific, inter-related strategy that gets results. It is using change knowledge for school and system improvement (Fullan 2006).

3.1.2 The value of this change theory

Fullan's change theory gets to what happens in the classroom and school and are, therefore, able to change instruction. Change theories that do not get close to what happens in classrooms and school cultures are incomplete theories and most likely to fail (Fullan 2006).

After 50 years of trying to change schools, more and more policy makers, and the public, know that what is being done does not work. This makes the case for alternative strategies, if they can become clear and promising. Change knowledge and its specific strategic manifestations are indeed becoming more and more clear. How it works and why it works are more evident. And while not a quick fix, it is also not open ended. Using this knowledge should get discernible, valuable results in a relatively short period (Fullan 2006).

There are now more leaders (system thinkers in action) who are actively using and refining change knowledge. Change knowledge is not a disembodied set of facts, but rather a deeply applied phenomenon in the minds of people. For this knowledge to have an impact it must be actively shared by many people engaged in using the knowledge (Fullan 2006).

The successes achieved in a district-wide (York district) and state-wide (Ontario) reform in Canada show that the theory of change translates powerfully into specific, inter-related strategy that gets results. It is using change knowledge for school and system improvement. Both York and Ontario are getting improved student results following a previous period of flat-lined performance (Fullan 2006).

3.1.3 Limitations of this change theory

The use of change knowledge does not represent a quick fix, which is what many reformers seek (Fullan 2006).

Change knowledge is difficult to grasp and many leaders must possess it simultaneously (our guiding coalition) for its use to spread and be consistent. This is also complicated by the turnover of leaders (Fullan 2006).

Change theory represents deep cultural change which many people resist. The result of this is that de-privatisation of teaching – through observing and improving classroom teaching – is extremely difficult to achieve (Fullan 2006).

3.2 Conceptual Model

Figure 5 shows a conceptual model, adapted from Fullan's change theory, in which the improvement of student learning and achievement are ordered on a basis of sequence involving the following factors: teacher mentoring, learning in context, changing school context, accomplished teaching and improved student learning and achievement. According to Fullan's change theory, a change in school context can be achieved by learning in context. A change in school context gives rise to accomplished teaching (Fullan 2006) and accomplished teaching, in turn, gives rise to improved student learning and achievement (Linn et al. 2011). Learning in context can be facilitated by mentoring teachers (Tovey 1999).

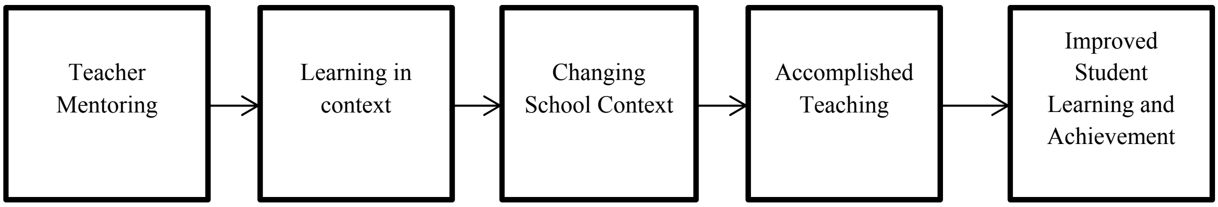

Figure 5. Conceptual model: The impact of teacher mentoring on student achievement

This model will be used to inform the collection of data and the method of analysis.

Chapter 4

Research design and methodology

4.1 Introduction

The particular research approach used was a quantitative, concurrent, matched but non-randomised control design. The study sample was UFS SPP schools. They were selected non-randomly from disadvantaged poor-performing urban and rural schools in the university's feeding area that applied to be part of the program. The sample (n = 18) consisted of 1 small combined school (<500 learners), 10 medium sized ordinary secondary schools (500 – 900 learners), 6 large ordinary secondary schools (above 900 learners) and 1 large comprehensive school (above 900 learners). The quintile of the schools ranged from quintile 1 to quintile 4.

These schools were matched with one school similar to them – thus a non-mentored school – that served as a control. The matched schools (n = 18) were chosen from schools with the same quintile, type, category, geographical position (same school district), size and learner to teacher ratio (see Appendix 1 and Figure 6 and 7). Control schools were not mentored externally for the years 2010 to 2013. During 2014 ten of the control schools were mentored externally by another organisation in the same subjects as that of the project schools. The model differed from that of the UFS SPP. Their primary focus was on physically teaching students in the named subjects (tutoring students) and their secondary focus was on mentoring subject teachers. It was assumed that informal mentoring would not be different between the project and control sample, because of the size of the sample and the fact that both samples were in the same school district.

It was also assumed that components like leadership style, leadership experience, leadership competency level, leadership attitude, teacher qualification, teacher experience, subject specialism, staff attitude and class size ratio would not be different between the project and control sample as the result of the sample size and the fact that the schools were in the same school district. A high turnover of principals and subject teachers also complicated a comparison based on these components. If a control study is implemented over a sufficiently large sample with no contagion by the intervention, the only difference between the treatment and control groups on average is that the control group does not receive the intervention (Bamberger & White 2007). The difference between the treatment group and control group can, therefore, be attributed to the impact of the intervention. Because of the abovenamed reasons, the assumption was that the only difference between the project and control schools was the mentoring of accounting, mathematics and physical sciences teachers by UFS SPP subject mentors. Differences between the project and control schools' results would, therefore, be the result of accomplished teaching as the result of the mentoring of project school teachers.

The research design, statistical analysis and the description of statistical methods used, was done by Professor Robert Schall from the Statistical Consultation Service, Department of Mathematical Statistics and Actuarial Science, Faculty of Natural and Agricultural Sciences, University of the Free State.

The following problems were encountered with the matching of the schools: Due to the availability of control schools with more or less the same properties as the project schools in the same district, pairs 1, 3 and 5 quintile 2 control schools had to be matched with quintile 1 project schools and in pair 15 a quintile 4 control school had to be matched with a quintile 3 project school. In pair 18 an Agricultural Secondary school (also ex-model C) had to be matched with an Ordinary Secondary school (not ex-model C). Quintile 4 schools can actually not be seen as disadvantaged schools, but were included in the study, because two quintile 4 schools formed part of the project schools.

The study sample represents 68 percent of all the quintile 1 to quintile 4 schools in the school district studied. It can, therefore, be seen as a very representative sample.

Figure 6 represents the statistics of the students in the project and control schools. From this figure it can be seen that the mean number of students in the project schools was 851 and that of the control schools was 923. The maximum size of the project schools was 1312 students and that of the control schools was 1360 students. The smallest project school had 367 students and the smallest control school had 354 students. The total number of students in the study sample was 31 935, with 15 316 students in the project schools and 16619 students in the control schools.

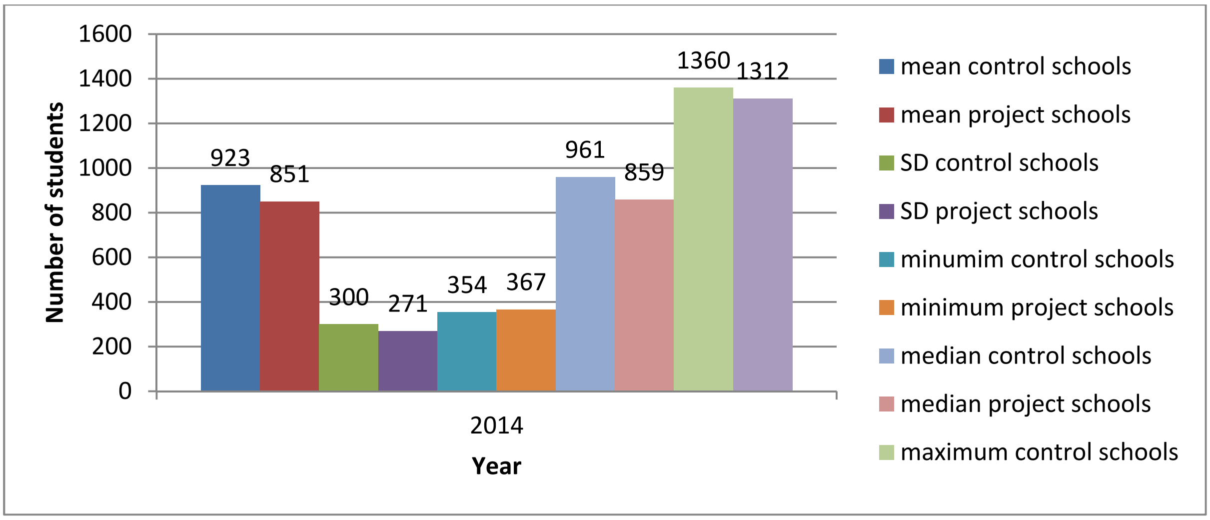

Figure 6. Summary of analysis students in project and control schools

From figure 7 it can be seen that the mean number of teachers in the project schools was equal to 32 and that in the control school equal to 35. The largest project school had 47 teachers and the largest control school had 50 teachers. The smallest project school had 15 teachers and the smallest control school had 12 teachers. The total number of teachers in the study sample was equal to 1201, with 580 teachers in the project schools and 621 teachers in the control schools. The student to teacher ratio in the project schools was equal to 26.4:1 and 26.8:1 in the control schools.

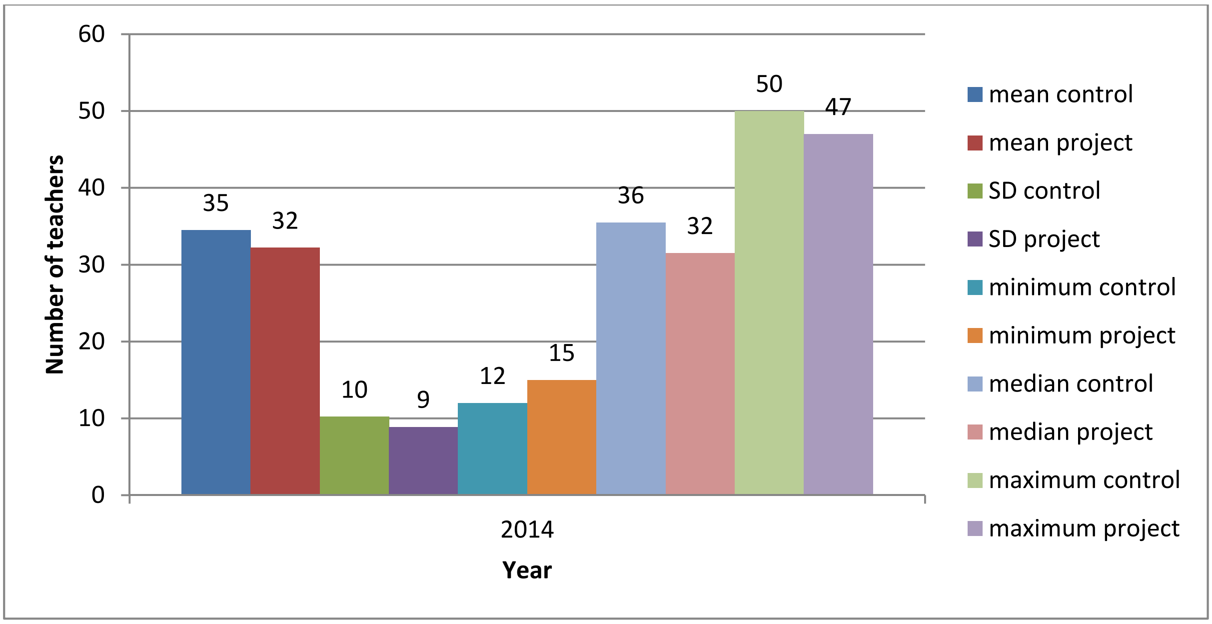

Figure 7. Summary of analysis teachers in project and control schools

4.2 Data collection and documentation

The data collection was informed by the conceptual framework, which assume that teacher mentoring will have improved student achievement as a result. The key instruments for the data collection on student achievement, were the pass rates (the proportion of students who passed a particular subject in a particular year) and average percentages (average mark for a particular subject in a particular year) of the project and control schools for the final examinations of grade 12. The grade 12 final examination results were used because it is a reliable instrument to use for comparison of achievement. Examination papers are set centrally and marking of the scripts are done centrally with good controls for quality built into the process. The grade 12 final examination results are also used as a norm to measure school achievement and school change in the country.

4.2.1 Data level questions

1. What are the grade 12 accounting final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?

2. What are the grade 12 mathematics final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?

3. What are the grade 12 physical science final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?

4. What are grade 12 accounting final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?

5. What are grade 12 mathematics final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?

6. What are grade 12 physical science final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?

7. How do the mentored and non-mentored data compare for the same years?

4.2.2 Data collected for the research

1. Grade 12 accounting final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014.

2. Grade 12 mathematics final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014.
3. Grade 12 physical science final examination pass rates and average percentages in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014.
4. Grade 12 accounting final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014.
5. Grade 12 mathematics final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014.
6. Grade 12 physical science final examination pass rates and average percentages in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014.

4.2.3 Location of data

The data were available on the database of the Free State Department of Education (FSDOE) (see Appendix II). This is a complete database with no missing data.

4.2.4 Documentation of data

The data were documented in a rolling file in Excel (see Appendix III).

4.3 Data analysis

4.3.1 Descriptive analysis

4.3.1.1 Descriptive statistics

Descriptive statistics are used to organize and describe the characteristics of a collection of data. The collection is sometimes called a data set or just data (see Appendix IV).

4.3.1.2 Descriptive methods used in study

Descriptive statistics for the variables pass rate [%], average mark [%], number of learners who wrote a particular subject, total number of learners in a school, and number of teachers in a school were calculated for each group (intervention and control) and year (see tables 1, 4 and 7).

Skewness of the pass rates and average percentages data were determined by using the following formula (Salkind 2014):

$$Sk = \frac{3(\overline{X} - M)}{s}$$

- Sk is Pearson's measure of skewness
- X is the mean
- M is the median
- s is the standard deviation

4.3.2 Inferential analysis

4.3.2.1 Inferential statistics

Inferential statistics are used to infer something about the population based on the sample's characteristics (see Appendix V).

4.3.2.2 Inferential methods used in the study

The proportion of students who passed a particular subject in a particular year (post-intervention) was analysed using logistic regression with intervention (project versus control) and matched pair as fixed effects and the pre-intervention pass rate as covariate. Residual over-dispersion (extra-binomial variation) was allowed for in the model. Based on the logistic regression model the mean pass rate per year in the intervention and control groups was estimated. Similarly, in order to compare the intervention with the control group, odds ratios, that is, ratios of the odds of passing in the intervention relative to the control group were estimated, together with 95% confidence intervals (Cis) for the odds ratios and associated P-values (statistical significance) (see tables 2, 5 and 8). The analysis was carried out using SAS procedure LOGISTIC (SAS 2013).

The average mark for each subject and year (post intervention) was analysed using Analysis of Covariance (ANCOVA) with intervention (project versus control) and matched pair as fixed effects and the corresponding pre-intervention average mark as covariate. The data for each school were weighted with the number of learners who wrote the particular subject in the particular year. Based on the ANCOVA model the mean average mark per year in the intervention and control groups was estimated. Similarly, in order to compare the intervention with the control group, the mean differences in average mark between the intervention and control group were estimated, together with 95% CIs for the mean differences and associated P-values (see tables 3, 6, and 9). The analysis was carried out using SAS procedure GLM (SAS 2013).

Effect size: The effect size for each subject for mean pass rates and mean average percentages for each period was determined by dividing the difference between the change in mean scores from baseline of the project schools and that of the control schools by the pooled standard deviation of the means of the baseline year (2010 in the case of accounting and 2011 in the case of mathematics and physical sciences).

Although statistical significance is one way to measure the size of a difference between two group means, effect size is becoming a more prevalent way to express this relationship in educational program evaluation. Indeed effect size is seen as much more important than statistical significance (Cohen et al. 2007). Effect size provides an estimate of the program's impact (Thompson et al. 2004). It is a measurement of the magnitude of the treatment (Salkind 2014). A common way to express effect size is Cohen's d statistic, in which the difference of the means of the treated and control groups are standardized, by dividing that difference by the pooled standard deviation of the two groups (Cohen et al. 2007):

$$\mathrm{d} = \frac{mean\ of\ the\ experimental\ group - mean\ of\ control\ group}{pooled\ standard\ deviation}$$

By expressing the difference of group means in terms of standard deviation units, Cohen's d statistic provides a simple metric that allows researchers to compare treatment effects from different studies even if results are reported using different units of measurement. This makes it possible to compare a range of programs and thus supports evidence-based decision-making on the part of policymakers (Thompson et al. 2004). The following guidelines can be used to determine the size of the effect (Salkind 2014):

A small effect size ranges from 0.00 to 0.20.

A medium effect size ranges from 0.20 to 0.50.

A large effect size is any value above 0.50.

It is, however, important not to interpret effect sizes with the same rigidity as statistical significance with regards to cut-off points (as indicated above), but relate the effect sizes found to those of prior studies (Cohen et al. 2007). In educational program evaluation, effect sizes of common interventions on student learning vary from below 0.10 standard deviations to 0.70 standard deviations or more (Thompson et al. 2004). Hattie (1992) found that spending a year in school has an effect size of around 0.40 on student learning. Among the national samples used to norm the Stanford Achievement Test-9th Edition (SAT-9), fifth graders scored 0.5 of a standard deviation higher than fourth graders in math and 0.3 of a standard deviation higher in reading (Granger & Kane 2004).

4.3.3 Validity, reliability and quality of the data

4.3.3.1 Internal validity

A concurrent, matched but non-randomised control design is used which improves validity if compared to a simple correlational design, but that is not as valid as a randomised control design.

4.3.3.2 External validity

Generalizability is limited due to the type of sample studied. The results should, however, be useful to all similar populations.

4.3.3.3 Reliability

Descriptive and inferential statistical instruments will give the same result every time it is used with the same data.

4.3.3.4 Quality of data

The database is complete with no missing information. Pass rates, average percentages and other data used are exact information.

Chapter 5

Findings on the impact of mentoring accounting teachers on student achievement in accounting

This chapter focuses on the data used for the accounting analysis and on the presentation, discussion and interpretation of the results of the analysis. The impact of mentoring accounting teachers on the student achievement (as informed by the conceptual framework) in accounting, are also discussed.

5.1 Data accounting

Data level questions:

- What are the gr 12 accounting final examination pass rates and average percentages (average marks) in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?
- What are gr 12 accounting final examination pass rates and average percentages (average marks) in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?
- How do the mentored and non-mentored data compare for the same years?

See appendix III for the documentation of the data used.

5.2 Presentation of results accounting

Mentoring started during 2011. The mentoring time up till the end of 2014 is, therefore, equal to 4 years. 2010 data were taken as baseline data.

Table 1 represent the properties of the data distribution for accounting for the years 2010 to 2014. The means, standard deviations, minimum and maximum values and medians for pass rates, average percentages, number of students that wrote accounting, size of schools and the number of teachers in the sample schools are represented in the table.

Accounting		Year									
		2010		2011		2012		2013		2014	
		Intervention		Intervention		Intervention		Intervention		Intervention	
		Control	Project	Control	Project	Control	Project	Control	Project	Control	Project
Pass rates project and control schools	N	18	18	18	18	18	18	18	18	18	18
	Mean	54.1	38.2	45.7	50	57.3	58.8	64.8	67.7	70.3	69.1
	Std	22	22.1	20.5	17.5	19	26	19.6	20.8	20.5	24.3
	Min	14.3	3.7	10	23.1	27.7	17.7	16.7	33.3	25	18.9
	Median	51.6	31.5	40	54.7	56.7	56.9	64.6	70.7	65.7	76
	Max	97.1	91.7	92.3	80.8	92.3	100	94.4	100	96.7	100
Average percentage (average marks)	N	18	18	18	18	18	18	18	18	18	18
	Mean	32.6	28.6	31	31.4	34.5	37.2	37	39.4	37.9	37.8
	Std	5.4	5.1	6.5	4.7	5.6	10	6	7.4	7.2	8.9
	Min	25	19.9	22.2	24.9	25.4	23.3	24.5	27.1	24.7	22.7
	Median	32	27.7	29.2	31.6	34.5	35.2	37.8	40.9	37	38.1
	Max	47.5	41.7	48.3	39.7	43.2	60.5	46.3	54.1	50.6	57.5
Students that wrote accounting	N	18	18	18	18	18	18	18	18	18	18
	Mean	36.9	45.3	36.7	29.3	37.2	27.7	34.4	28.2	28.6	33.6
	Std	22.5	24.5	21.6	14.9	31.9	17.4	26.9	22.7	23.3	26.1
	Min	12	12	10	8	12	6	6	4	8	3
	Median	28.5	36	34	26.5	26.5	25	25	22	24	27.5
	Max	94	91	93	54	150	63	111	76	112	79

Table 1. Descriptive statistics for accounting 2010 to 2014.

5.2.1 Presentation of descriptive analysis pass rates accounting

See section 4.3 in previous chapter for statistical methods used.

Figure 8 represents the standard deviation and range of the pass rates accounting.

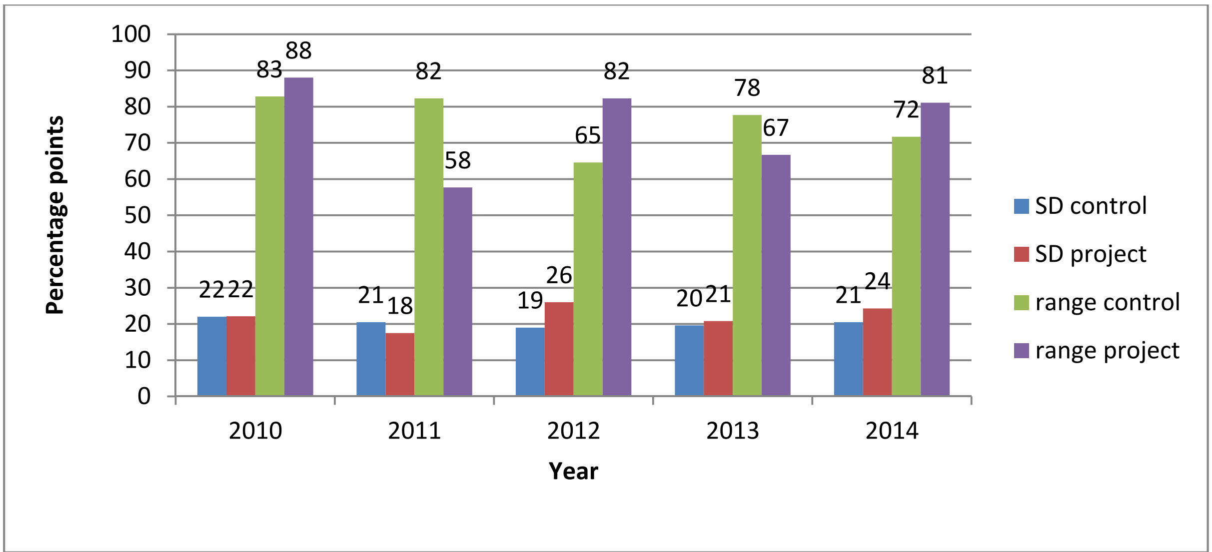

Figure 8. Distribution of pass rates accounting 2010 to 2014

Figure 9 represents the skewness of the accounting pass rates.

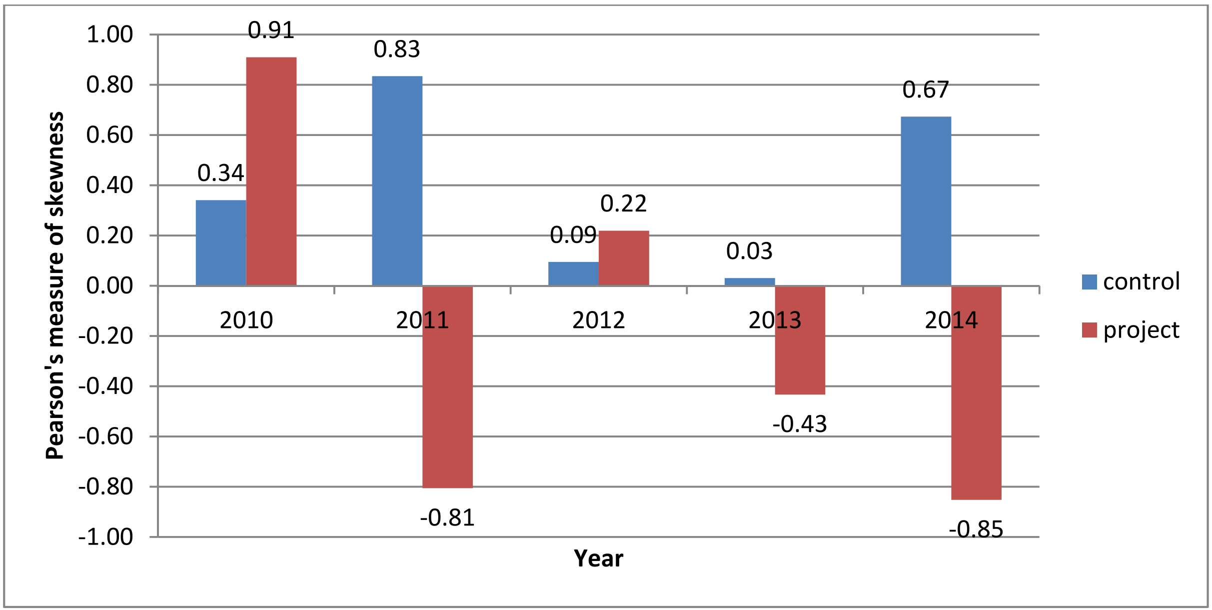

Figure 9. Skewness of pass rates accounting 2010 to 2014

Figure 10 represents the accounting mean pass rates of the control and project schools.

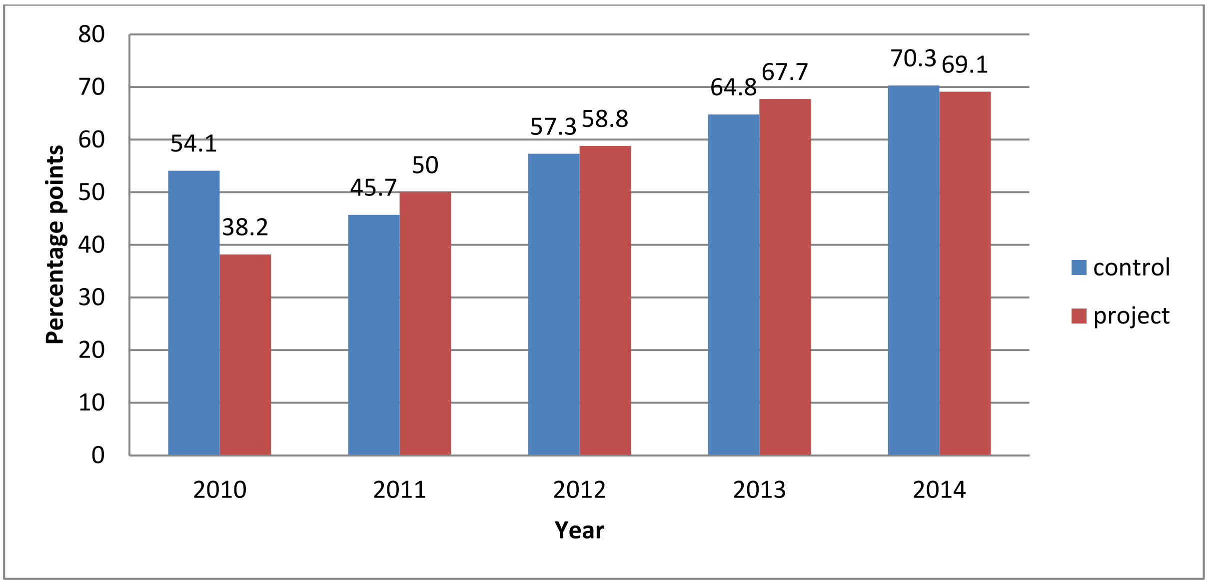

Figure 10. Mean pass rates accounting 2010 to 2014

In figure 11 the changes in accounting mean pass rates of the project and control schools with 2010 as baseline are indicated. The scores were obtained by subtracting the score obtained in 2010 from the score obtained in the specific year.

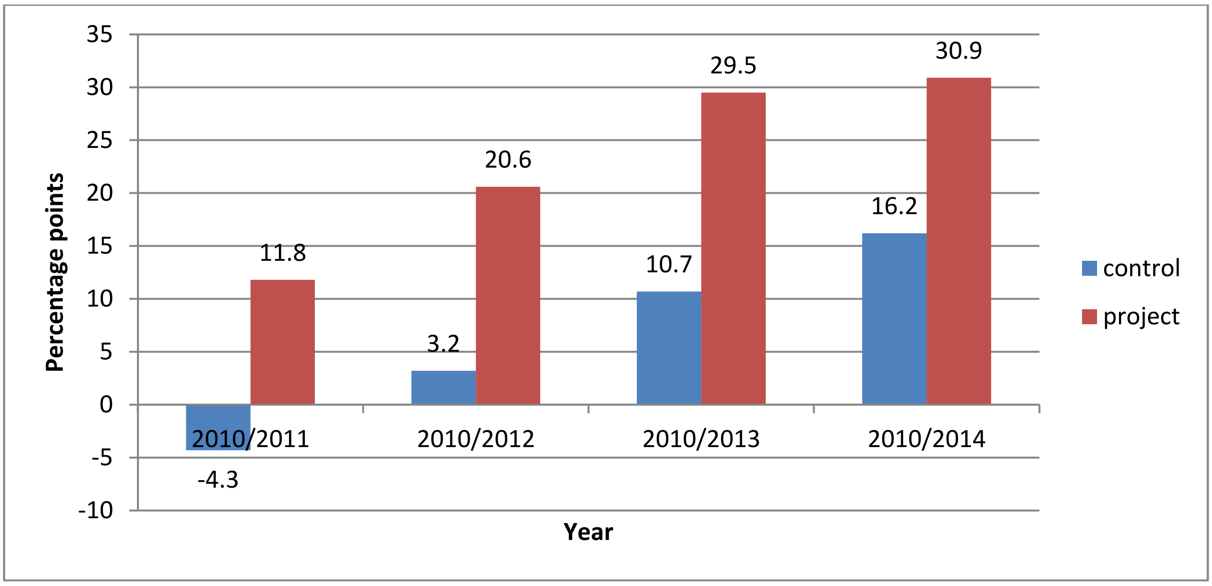

Figure 11. Change in mean pass rates with 2010 as baseline accounting 2011 to 2014

Figure 12 represents the differences in the change in accounting mean pass rates between the project schools and control schools for the periods 2010 - 2011, 2010 – 2012, 2010 – 2013 and 2010 – 2014.

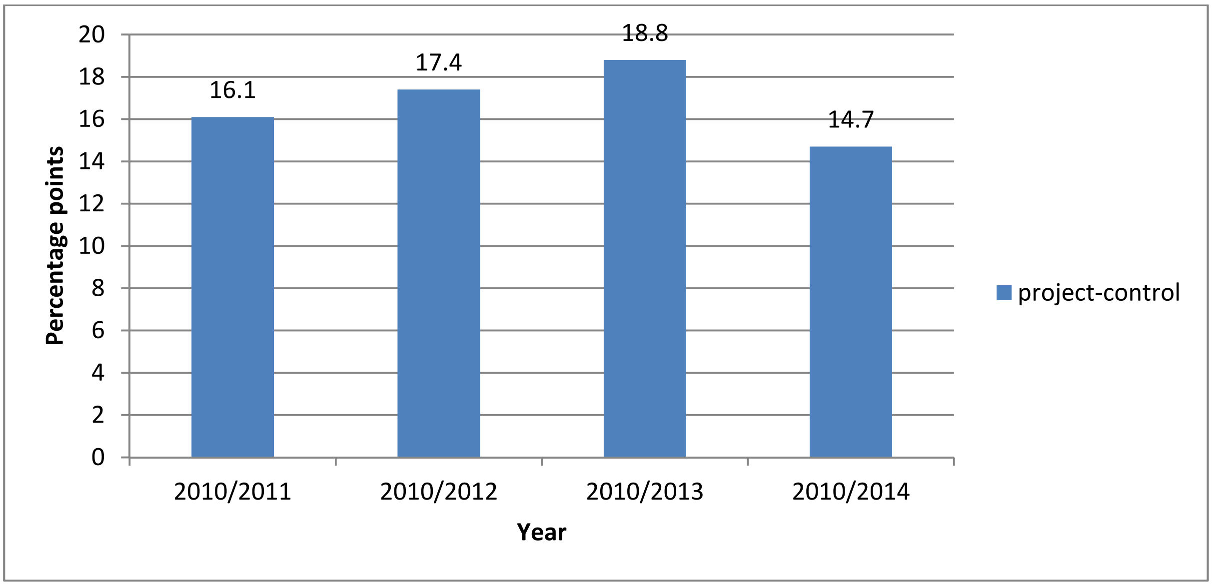

Figure 12. Difference in change in mean pass rates accounting 2011 to 2014

Figure 13 represents the accounting median pass rates of the project and control schools for the years 2010 to 2014.

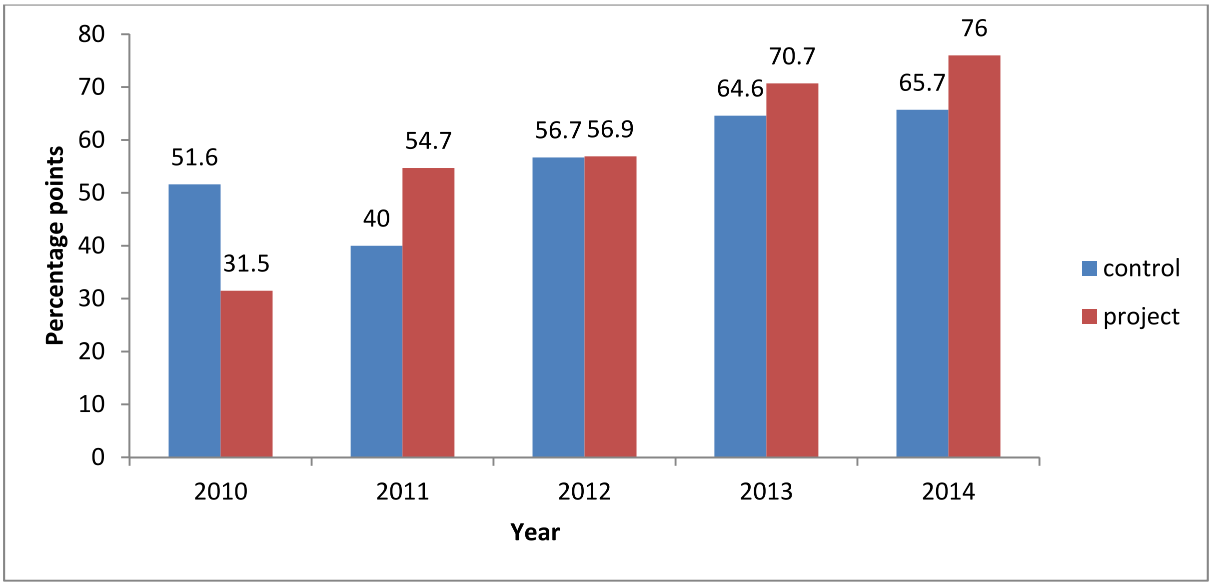

Figure 13. Median pass rates accounting 2010 to 2014

Figure 14 represents the changes in accounting median pass rates of the project and control schools with 2010 as baseline. The scores were obtained by subtracting the score obtained in 2010 from the score obtained in the specific year.

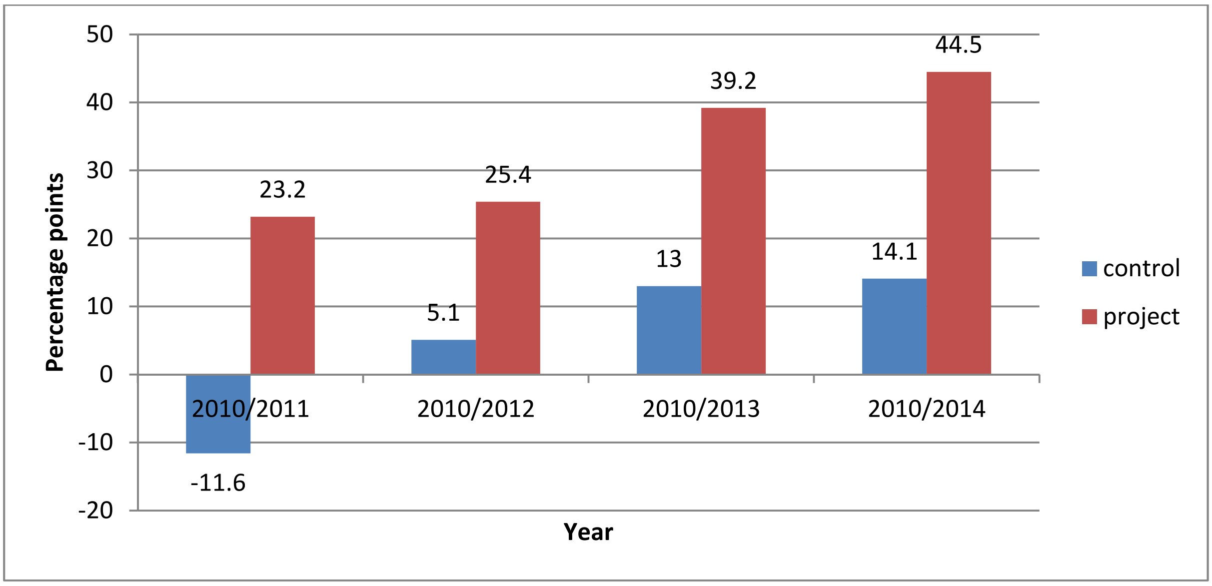

Figure 14. Change in median pass rates with 2010 as baseline accounting 2011 to 2014

Figure 15 represents the differences in the change in accounting median pass rates between the project schools and control schools for the periods 2010 - 2011, 2010 – 2012, 2010 – 2013 and 2010 – 2014.

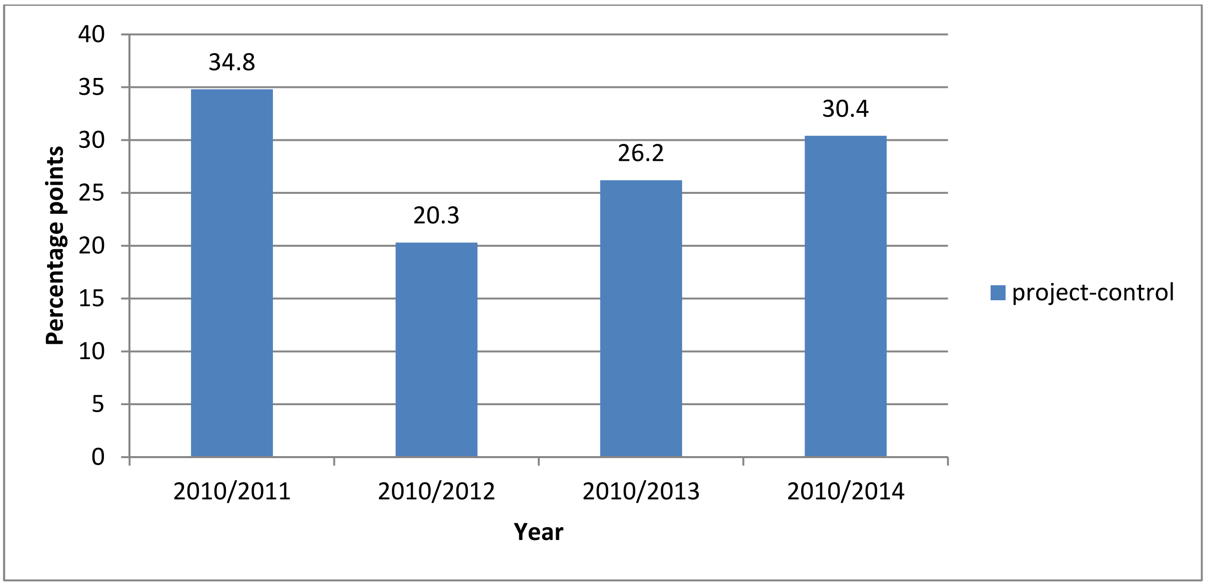

Figure 15. Differences in change in median pass rates accounting 2011 to 2014

Figure 16 represents the accounting minimum and maximum pass rates of the project and control school for the years 2010 to 2014.

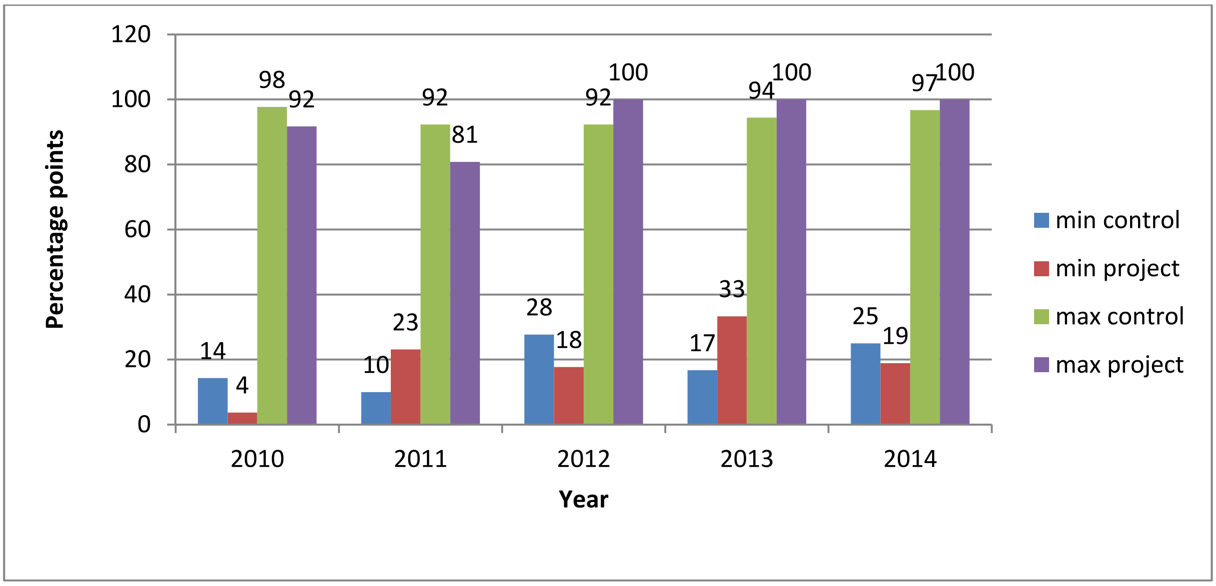

Figure 16. Minimum and maximum pass rates accounting 2010 to 2014

Figure 17 represents a summary of the descriptive statistics of the mean average pass rates accounting for the period 2010 to 2014.

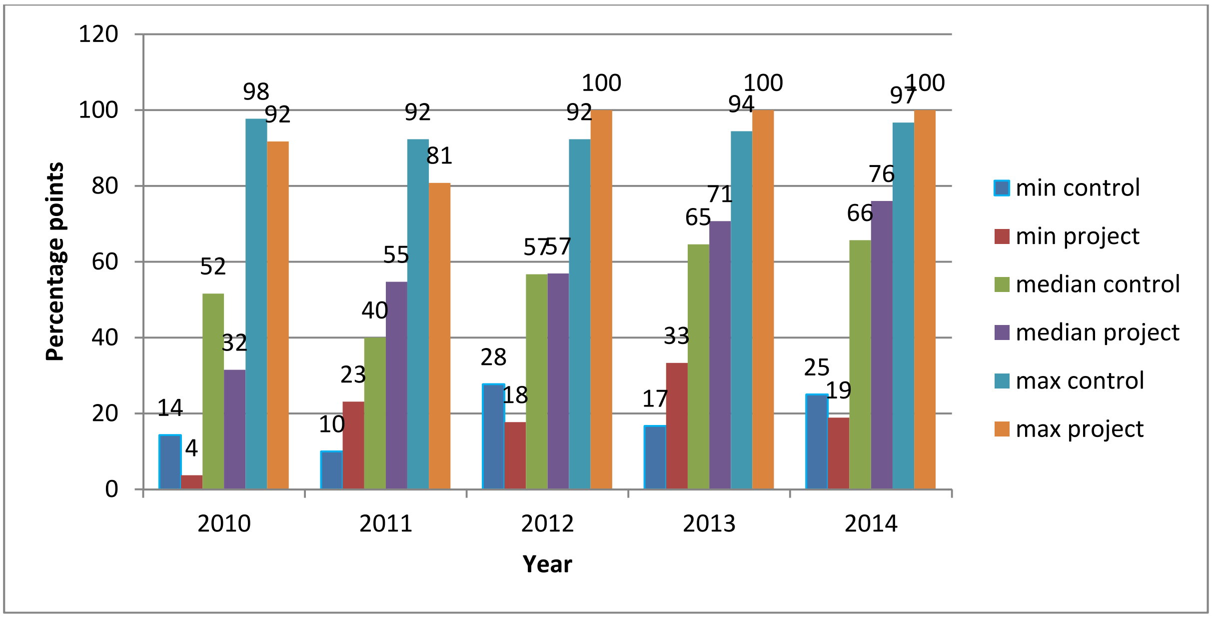

Figure 17. Summary descriptive statistics pass rates accounting 2010 to 2014

5.2.2 Presentation of inferential analysis pass rates accounting

Table 2 represents the results of a logistic regression analysis done on the accounting pass rates data with project versus control and matched pair as fixed effects and pre-project pass rates (2010) as covariate. Based on the logistic regression the mean pass rates per year in the project and control groups were estimated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratios and associated p-values.

Subject	Year	Project Pass Rates (%)	Control Pass Rates (%)	Comparison		
				Odds ratio	95% Confidence interval for odd ratio	p-value (statistical significance)
Accounting	2011	52.0	41.1	1.5	0.8 to 2.9	0.1670
Accounting	2012	60.4	57.7	1.1	0.5 to 2.3	0.7747
Accounting	2013	70.9	66.6	1.2	0.6 to 2.4	0.5751
Accounting	2014	73.4	70.8	1.1	0.4 to 3.0	0.7075

Table 2. Comparison of model estimated (logistic regression) pass rates and odds ratios accounting for the years 2011 – 2014.

Figure 18 represents the differences in the logistic regression estimated mean pass rates between the project and control schools for the period 2011 to 2014.

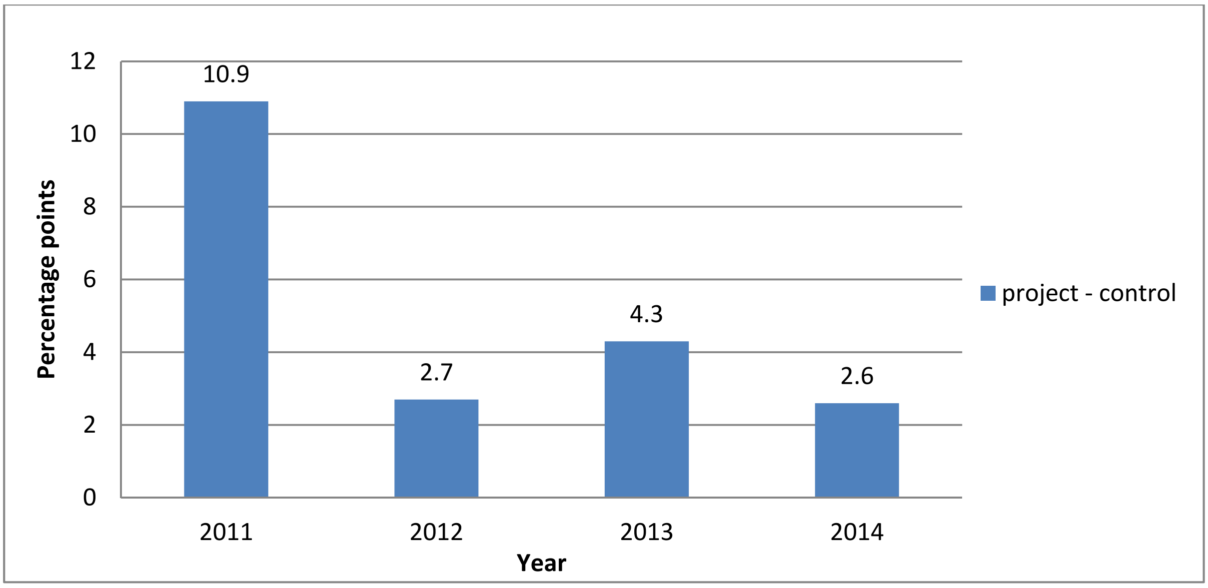

Figure 18. Differences in model estimated (logistic regression) mean pass rates accounting 2011 to 2014

Figure 19 represents the logistic regression estimated odds ratios for the mean pass rates and the 95% confidence interval for the odds ratios for the period 2011 to 2014.

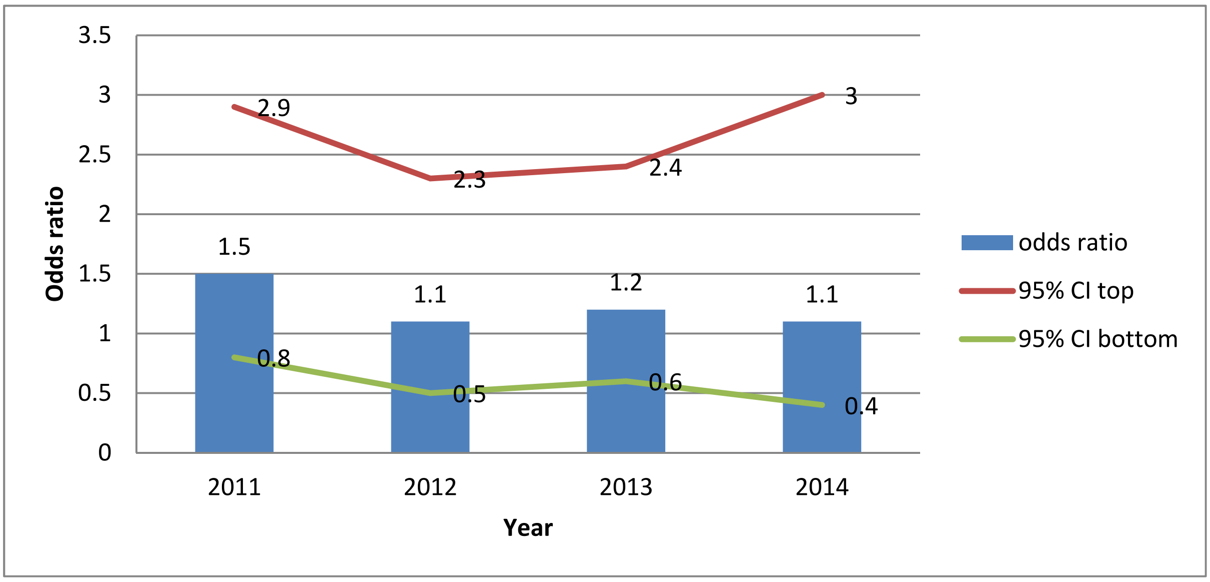

Figure 19. Model estimated (logistic regression) odds ratios mean pass rates accounting 2011 to 2014

Figure 20 represents the impacts on mean pass rates of accounting for the periods 2010 to 2011, 2010 to 2012, 2010 to 2013 and 2010 to 2014. The effect size (Cohen's d) of each period was determined by dividing the difference between the change in mean average percentages of the project schools and that of the control schools by the pooled standard deviation of the means of 2010.

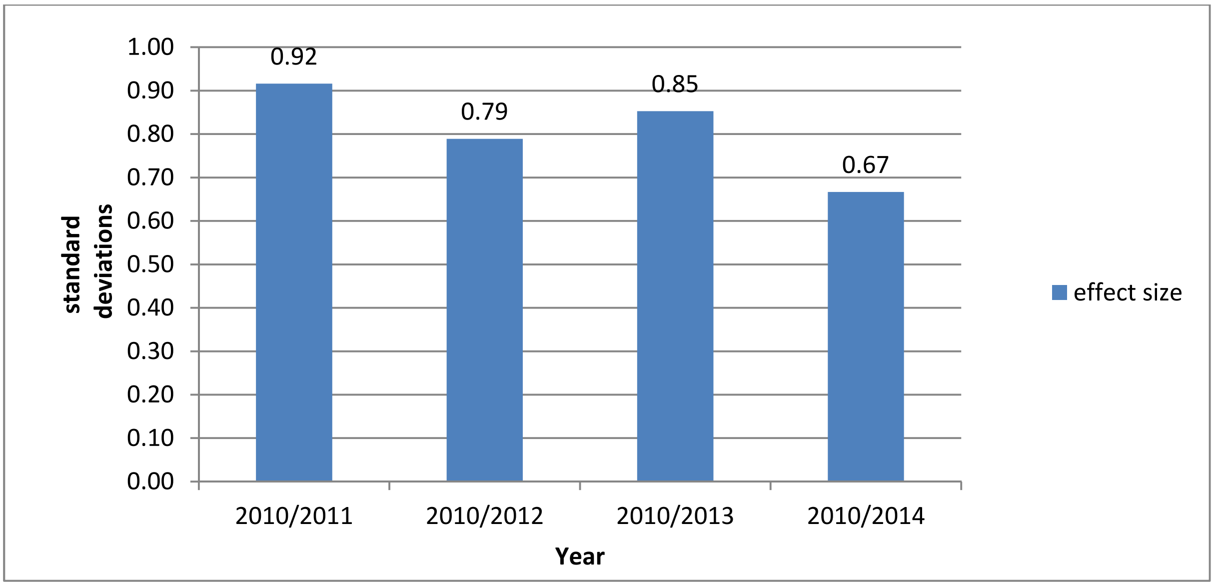

Figure 20. Impacts on pass rates accounting 2011 to 2014

5.2.3 Presentation of descriptive analysis average percentages accounting

Figure 21 represents the standard deviation and range of the accounting average percentages.

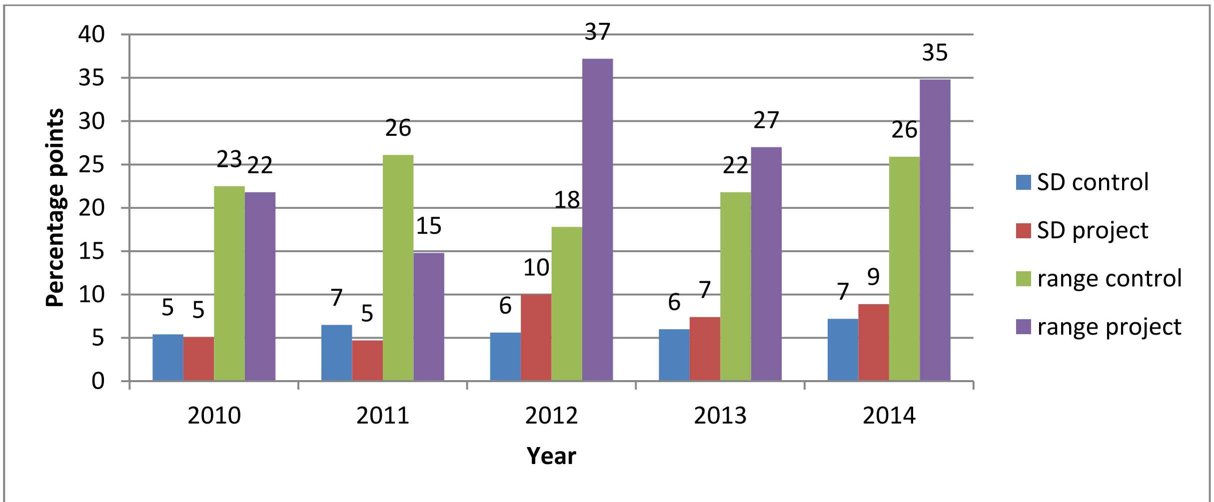

Figure 21. Distribution of average percentages accounting 2010 to 2014

Figure 22 represents the skewness of the accounting average percentages. Pearson's measure of skewness was used to determine the skewness.

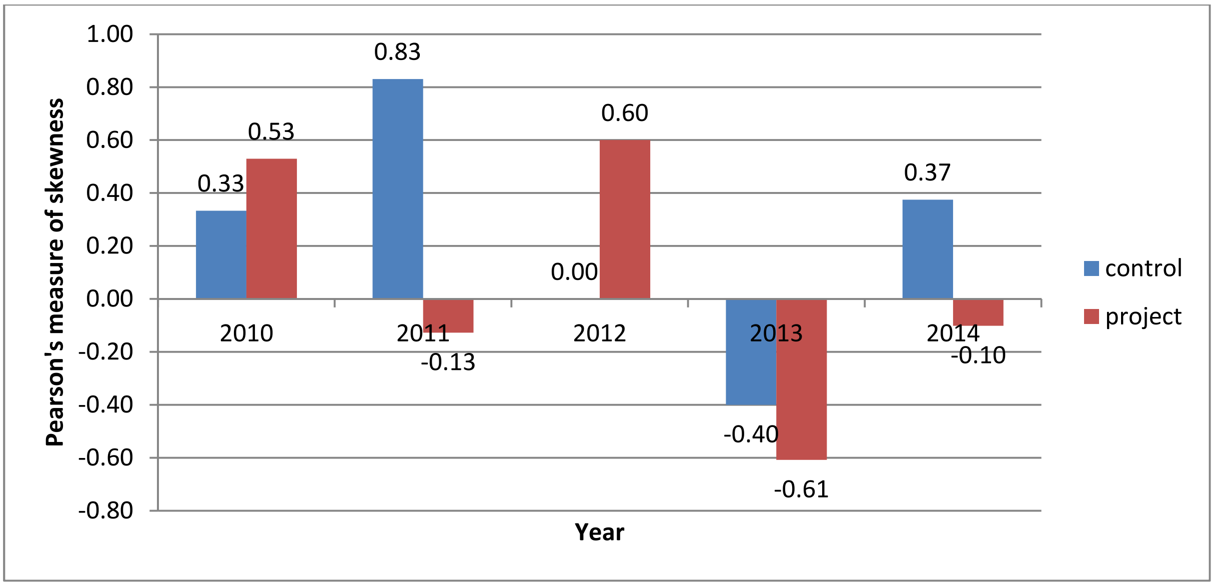

Figure 22. Skewness of average percentages accounting 2010 to 2014

Figure 23 represents the accounting mean average percentages of the project and control schools for the years 2010 to 2014.

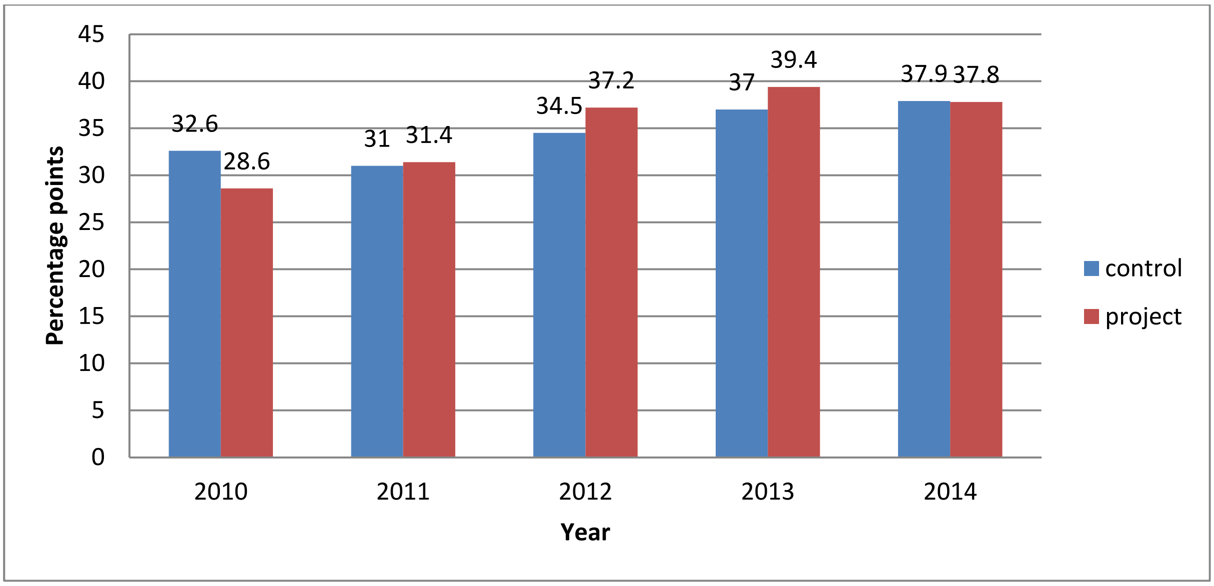

Figure 23. Mean average percentage accounting 2010 to 2014

Figure 24 represents the changes in accounting mean average percentages with 2010 as baseline. The changes were calculated by subtracting the mean average percentages of 2010 from the mean average percentages of the specific year.

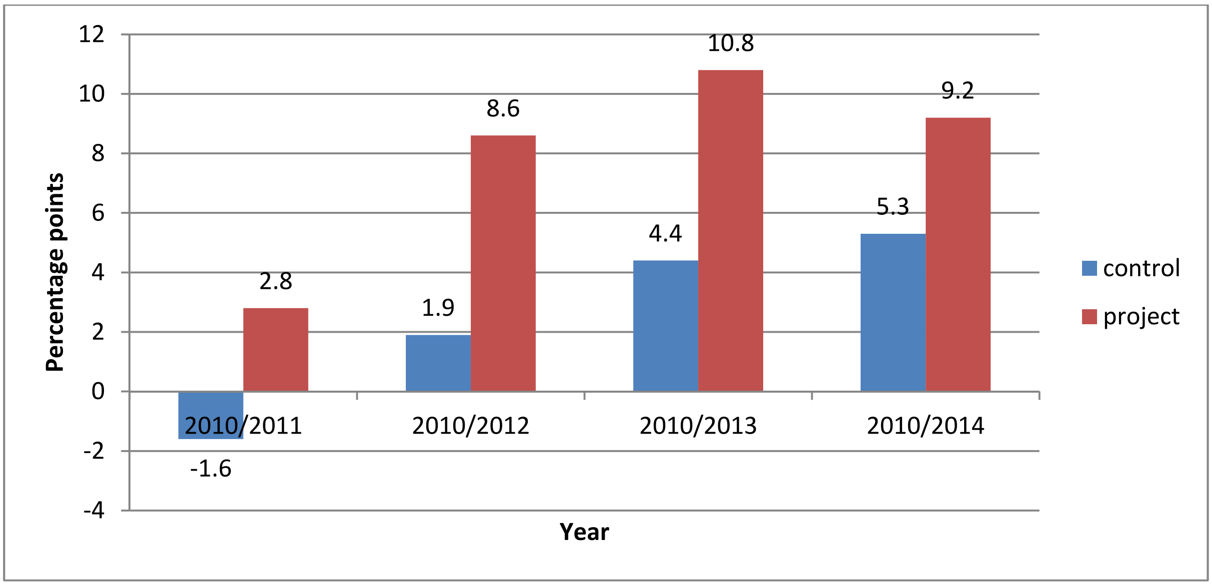

Figure 24. Change in mean average percentages with 2010 as baseline accounting 2010 to 2014

Figure 25 represents the differences in the change in accounting mean average percentages between the project schools and control schools for the periods 2010 - 2011, 2010 – 2012, 2010 – 2013 and 2010 – 2014.

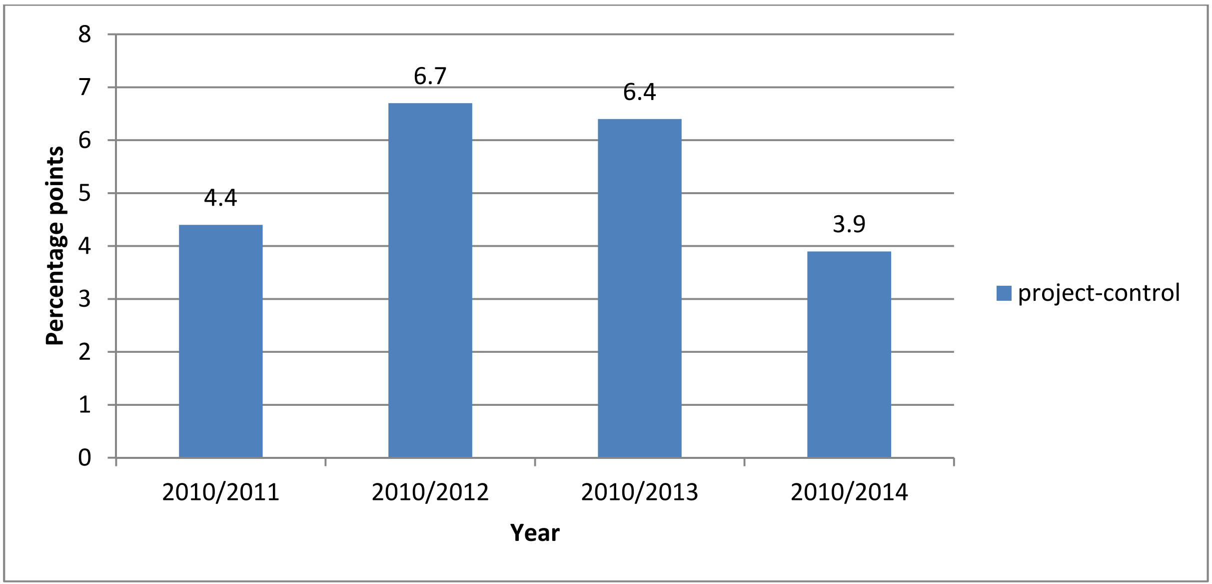

Figure 25. Differences in change in mean average percentages accounting 2011 to 2014

Figure 26 represents the accounting median average percentages of the project and control schools for the years 2010 to 2014.

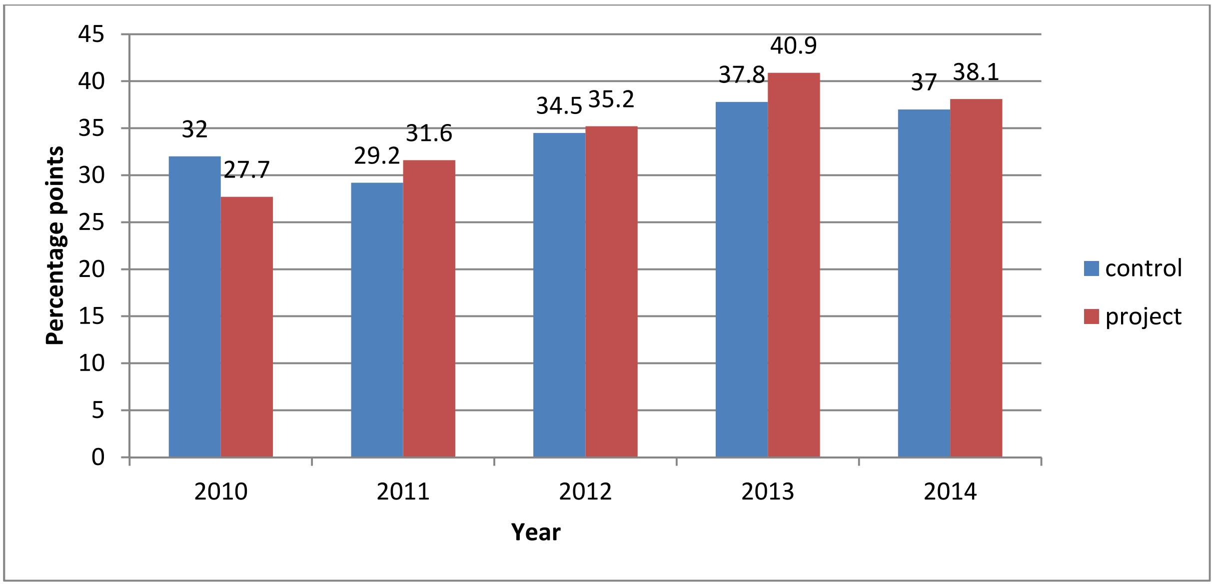

Figure 26. Median average percentage accounting 2010 to 2014

Figure 27 represents the changes in accounting median average percentages with 2010 as baseline. The changes were calculated by subtracting the median average percentages of 2010 from the median average percentages of the specific year.

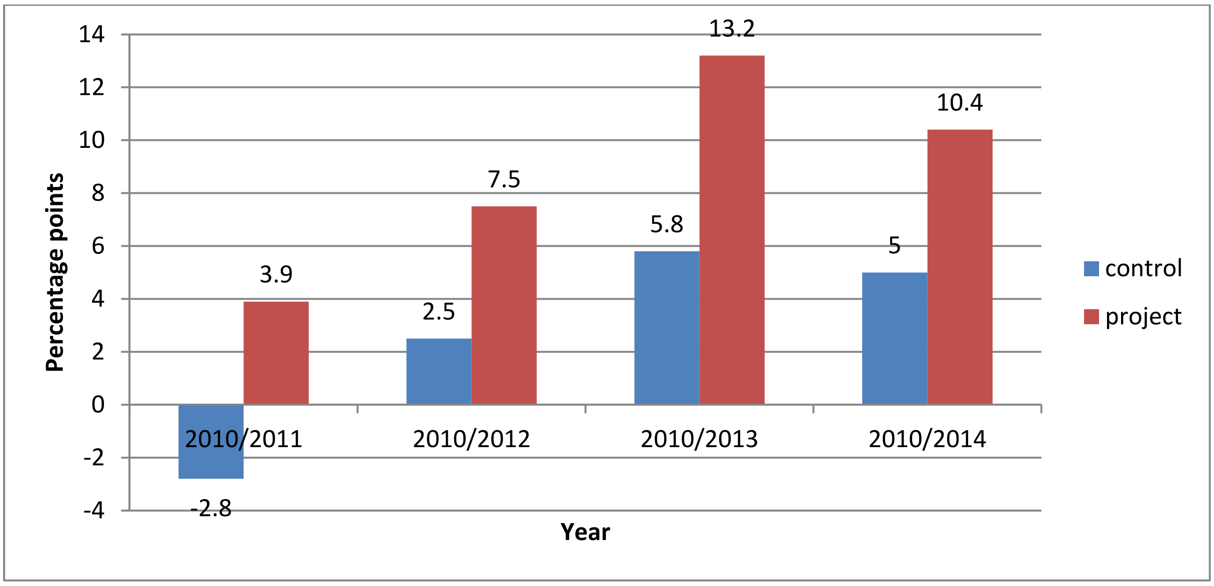

Figure 27. Change in median average percentages with 2010 as baseline accounting 2011 to 2014

Figure 28 represents the differences in the change in accounting median average percentages between the project schools and control schools for the periods 2010 - 2011, 2010 – 2012, 2010 – 2013 and 2010 – 2014.

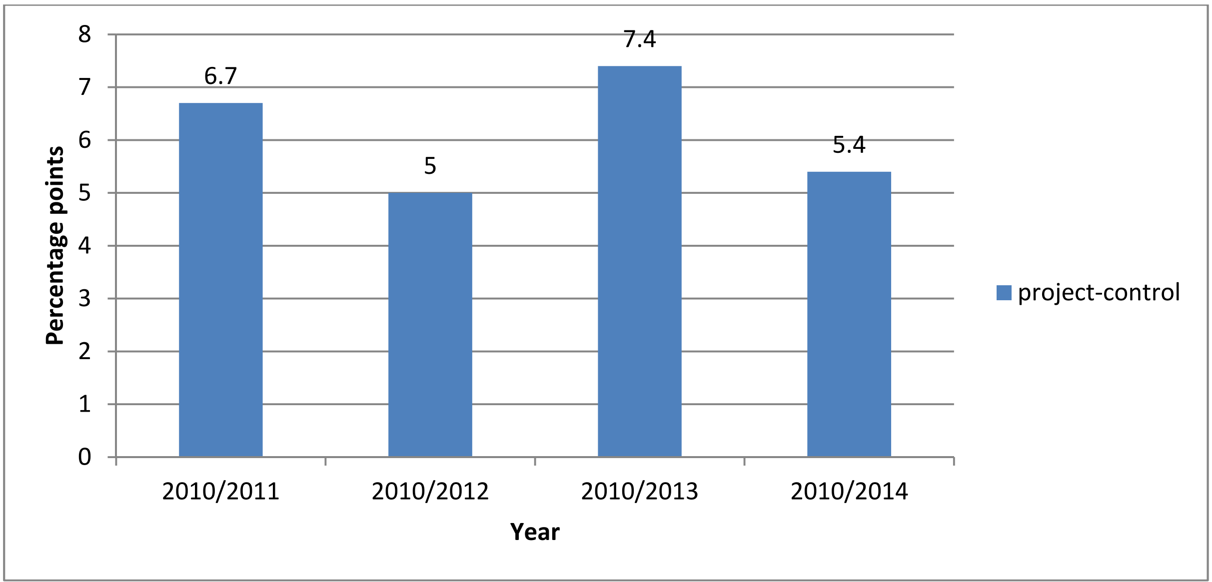

Figure 28. Differences in change in median average percentages for accounting 2011 to 2014

Figure 29 represents the accounting minimum and maximum average percentages of the project and control school for the years 2010 to 2014.

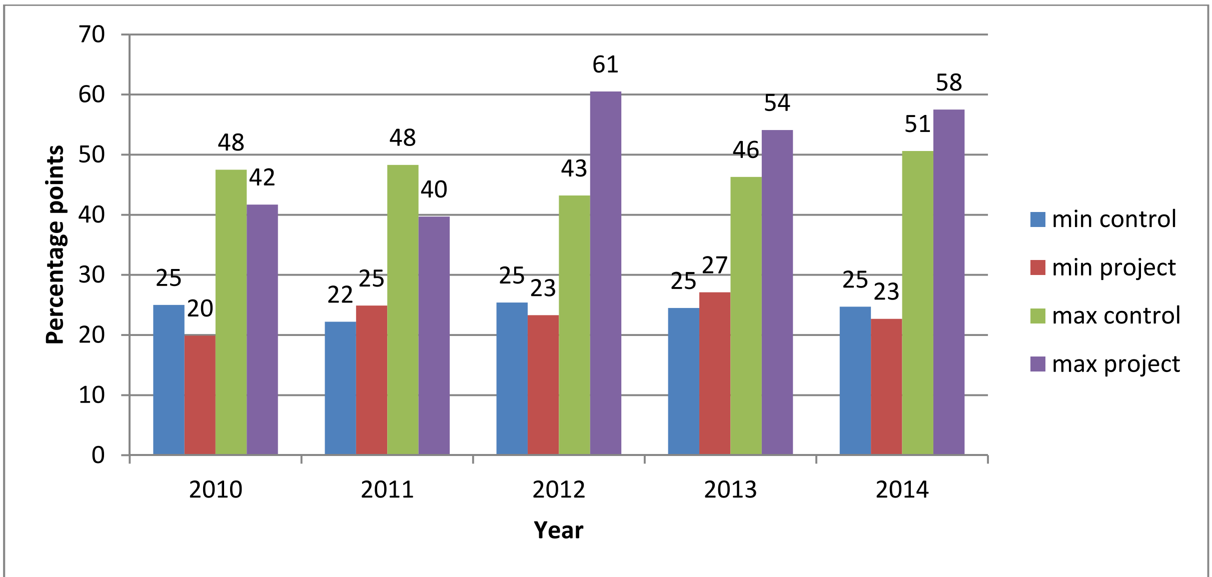

Figure 29. Minimum and maximum average percentages accounting 2010 to 2014

Figure 30 provides a summary of the descriptive statistics of accounting average percentages 2010 to 2014.

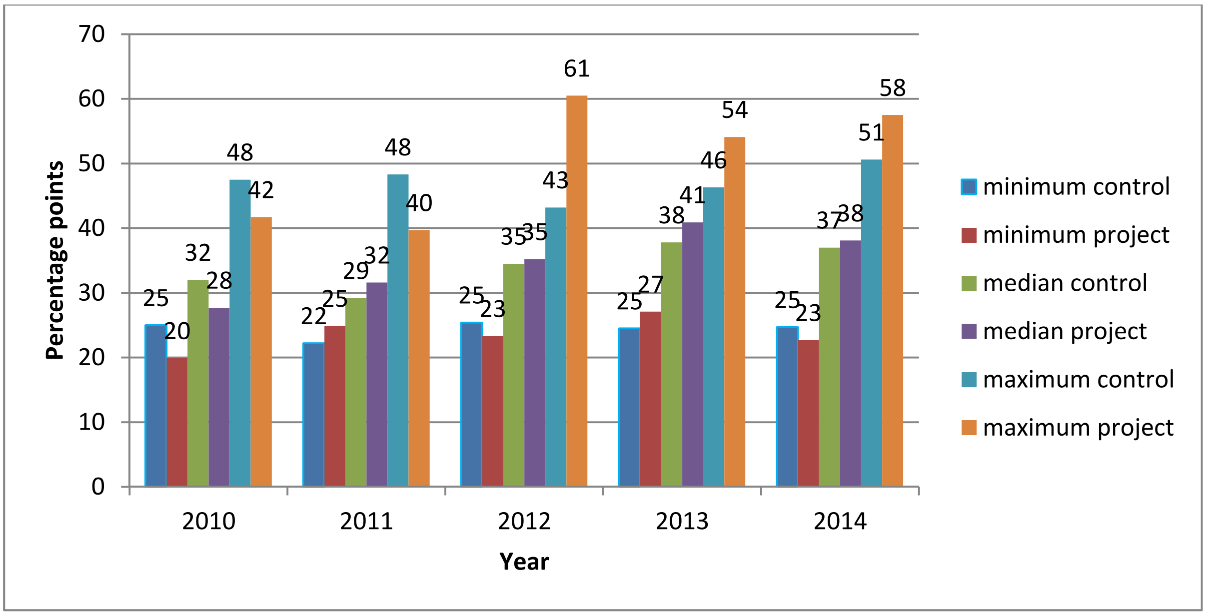

Figure 30. Summary descriptive statistics average percentages accounting 2010 to 2014

5.2.4 Presentation of inferential analysis average percentages accounting

Subject	Year	Project mean average mark (%)	Control mean average mark (%)	Comparison		
				Difference "Project – Control"	95% Confidence interval for difference	p-value (statistical significance)
Accounting	2011	31.8	30.0	1.8	-2.3 to 5.9	0.3606
Accounting	2012	36.8	34.1	2.7	-3.2 to 8.6	0.3507
Accounting	2013	40.4	35.2	5.2*	0.1 to 10.3	0.0452
Accounting	2014	39.6	35.3	4.3	-2.3 to 10.9	0.1879

Table 3. Comparison of model estimated (ANCOVA) mean average percentages for accounting for the years 2011 – 2014. * Treatment-control difference is significantly different from zero at the 0.05 level.

Figure 31 represents the ANCOVA estimated accounting mean average percentages of the project and control schools for the period 2011 to 2014.

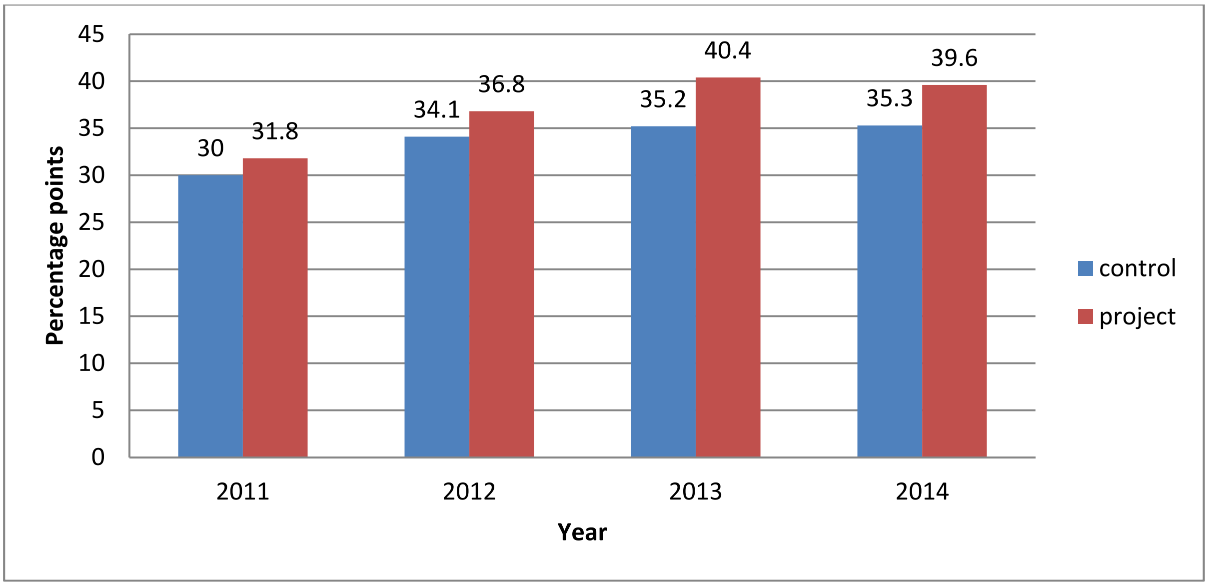

Figure 31. Model estimated (ANCOVA) mean average percentages accounting 2011 to 2014

Figure 32 shows the differences in the ANCOVA estimated mean average percentages between the project and control schools for the period 2011 to 2014.

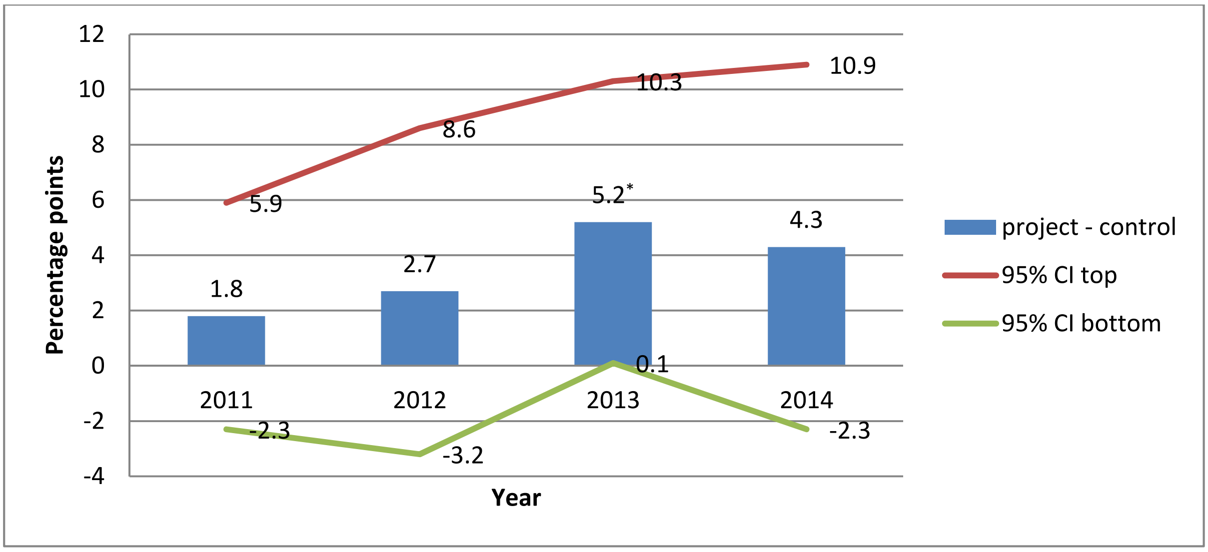

Figure 32. Model estimated (ANCOVA) differences in mean average percentages accounting 2011 to 2014. * Treatment-control difference is significantly different from zero at the 0.05 level.

Figure 33 represents the impacts on average percentages of accounting for the periods 2010 to 2011, 2010 to 2012, 2010 to 2013 and 2010 to 2014. The effect size (Cohen's d) of each period was determined by dividing the difference between the change in mean average percentages of the project schools and that of the control schools by the pooled standard deviation of the means of 2010.

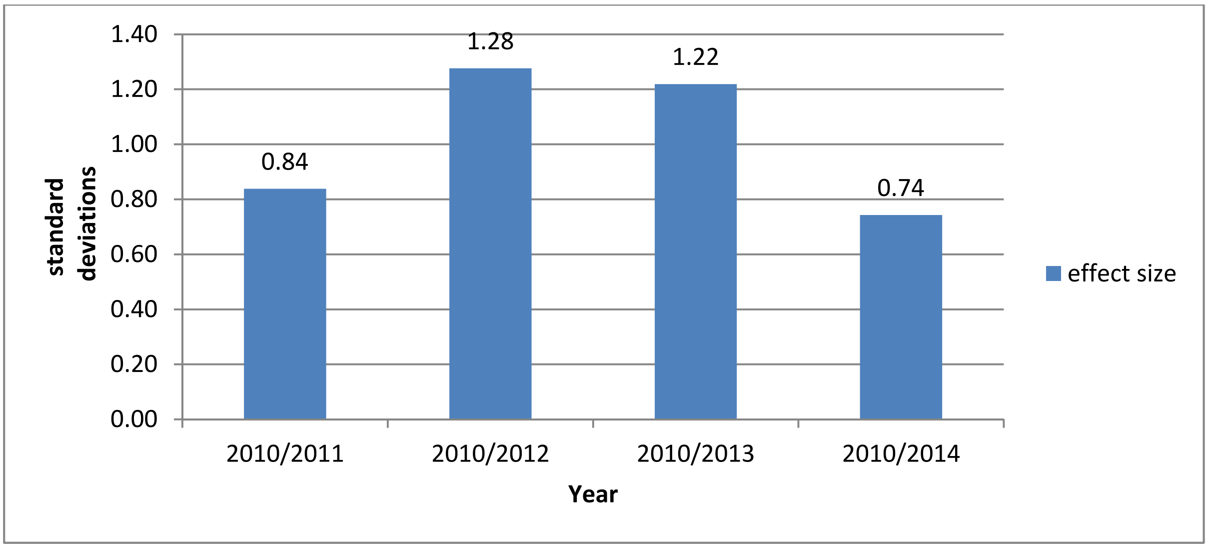

Figure 33. Impacts on average percentages accounting 2011 to 2014

5.2.5 Presentation of descriptive analysis students that wrote accounting

Figure 34 provides a summary of the analysis of the students that wrote accounting for the period 2010 to 2014.

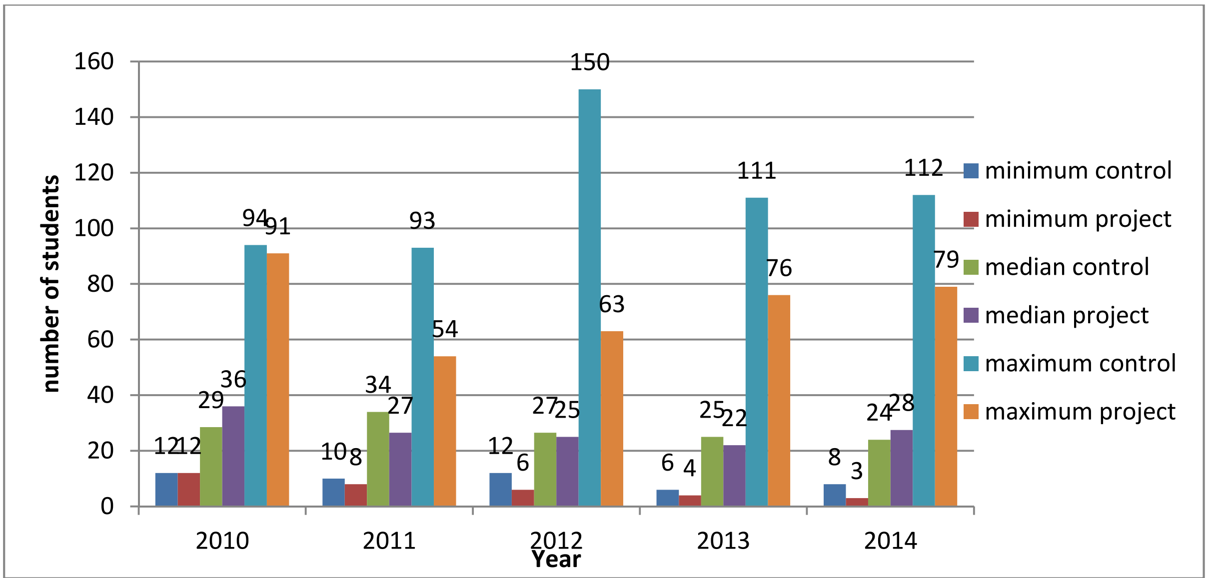

Figure 34. Summary of analysis of students that wrote accounting 2010 to 2014

5.3 Discussion of results by research question

5.3.1 Secondary research question #1

What is the impact of mentoring accounting teachers in the UFS SPP on student achievement in accounting?

5.3.2 Discussion of results of descriptive analysis pass rates accounting by research question #1

The pass rates were highly variable. That can be derived from figure 8. The standard deviation ranged from 19.0 to 26.0 percentage points and the range from 57.7 to 88.0 percentage points. The skewness of the pass rates was determined by using Pearson's measure of skewness. As can be seen from figure 9 the mean pass rates data were skewed ranging from -0.85 to 0.91.

The project schools started off at a lower mean pass rates base (38.2 percentage points for 2010) than the control schools (54.1 percentage points for 2010), but achieved higher mean pass rates for all the years except 2014 (see figure 10). The change in mean pass rates between the different years and that of 2010 were larger than that of the control schools for all the periods (see figure 11). The differences in the change in mean pass rates (project – control) ranged between 14.7 and 18.8 percentage points (see figure 12). This figures for the accounting mean pass rates indicate that the mentoring of accounting teachers had a large positive effect on accounting mean pass rates and, therefore, on student achievement in accounting in the mentored schools.

From figure 13 it can be seen that the project schools achieved higher median pass rates than the control schools for all the years although they started from a much lower base in 2010 (-20.1 percentage points). The change in median pass rates between the different years and that of 2010 were larger for the project schools than that of the control schools for all the periods (see figure 14). From figure 15 it can be derived that the difference in change in median pass rates between the project schools and the control schools for the period 2011 to 2014 ranged between 20.3 and 34.8 percentage points. This figures for the accounting median pass rates indicate that the mentoring of accounting teachers had a large positive effect on accounting median pass rates and, therefore, on student achievement in accounting in the mentored schools.

From figure 16 it can be concluded that the maximum pass rates of the project schools increased from 91.7 and 80.8 percentage points in 2010 and 2011 to 100 percentage points in 2012 to 2014. Some of the project schools achieved a 100 percent pass rate in 2012 to 2014. None of the control schools managed to achieve a 100 percent pass percentage in the period 2010 to 2014. The differences in change in the maximum pass rates between the project schools and the control schools with 2010 as baseline were -5.5 for 2011, 13.7 for 2012, 11.6 for 2013 and 9.3 percentage points for 2014. The differences in change in the minimum pass rates between the project schools and the control schools with 2010 as baseline were 23.7 for 2011, 0.6 for 2012, 27.2 for 2013 and 4.5 percentage points for 2014. From this differences it can be concluded that the mentoring of accounting teachers had a positive impact on the minimum and maximum pass rates of the project schools and, thus, on the student achievement in accounting.

5.3.3 Discussion of results of inferential analysis pass rates accounting by research question #1

Figure 18 represents the logistic regression estimated differences in mean pass rates between the project and control schools. These differences ranged between 2.6 and 10.9 percentage points. By using this differences the odds ratios for the mean pass rates were calculated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratio and associated p-values. The odds ratios ranged between 1.1 and 1.5. The 95% confidence interval's lower values ranged between 0.4 and 0.8 and the top values between 2.3 and 3 (see figure 19).

The effect sizes with 2010 as baseline were 0.92 for the period 2010 to 2011, 0.79 for 2010 to 2012, 0.85 for 2010 to 2013 and 0.67 standard deviations for 2010 to 2014 (see figure 20). The effect sizes of the different periods were all positive and large, indicating that the mentoring of accounting teachers had a large positive impact on accounting mean pass rates and, therefore, on student achievement in accounting.

5.3.4 Discussion of results of descriptive analysis average percentages accounting by research question #1

The average percentages are highly variable. That can be derived from figure 21. The standard deviation ranges from 4.7 to 10.0 percentage points and the range from 14.8 to 37.2

percentage points. The skewness of the average percentages was determined by using Pearson's measure of skewness. As can be seen from figure 22, the mean average percentages data are skewed ranging from -0.61 to 0.83.

The project schools started off at a lower mean average percentage base (28.6 percentage points for 2010) than the control schools (32.6 percentage points for 2010), but achieved higher mean average percentages for all the years except 2014 (see figure 23). The changes in mean average percentages of the project schools between the different years and that of 2010 were larger than that of the control schools for all the periods (see figure 24). From figure 25 it can be derived that the difference in mean average percentages between the project schools and the control schools ranged between 3.9 and 6.7 percentage points. This figures for the accounting mean average percentages indicate that the mentoring of accounting teachers had a large positive effect on accounting mean average percentages and, therefore, on student achievement in accounting in the mentored schools.

From figure 26 it can be seen that the project schools achieved higher median average percentages than the control schools for all the years although they started from a much lower base in 2010 (-4.7 percentage points). The change in median averages of the project schools between the different years and that of 2010 were larger than that of the control schools for all the periods (see figure 27). From figure 28 it can be derived that the differences in median average percentages between the project schools and the control schools ranged between 5.0 and 7.4 percentage points. This figures for the accounting median average percentages indicate that the mentoring of accounting teachers had a large positive effect on accounting median average percentages and, therefore, on student achievement in accounting in the mentored schools.

From figure 29 it can be concluded that the differences in change in the maximum average percentages between the project schools and the control schools, with 2010 as baseline, were –2.8 for 2010 - 2011, 23.1 for 2010 - 2012, 13.6 for 2010 - 2013 and 12.7 percentage points for 2010 - 2014. The differences in change in the minimum average percentages between the project schools and the control schools, with 2010 as baseline, were 7.8 for 2010 - 2011, 3.0 for 2010 - 2012, 7.7 for 2010 - 2013 and 3.1 percentage points for 2010 - 2014. From this differences it can be concluded that the mentoring of accounting teachers had a positive impact on the minimum and maximum average percentages of the project schools and, thus, on the student achievement in accounting.

5.3.5 Discussion of results of inferential analysis average percentages accounting by research question #1

Figure 31 represents the ANCOVA estimated differences in mean average percentages between the project and control schools. In order to compare the project with the control group, differences between the estimated mean average percentages were calculated, together with 95% confidence intervals for the differences and associated p-values (see figure 32). The differences were equal to 1.8 percentage points for 2011, 2.7 percentage points for 2012, 5.2 percentage points for 2013 and 4.3 percentage points for 2014. The 95% confidence interval's lower values range between -3.2 and 0.1 and the top values between 5.9 and 10.9. The treatment-control difference in 2013 is significantly different from zero at the 0.05 level.

The effect sizes with 2010 as baseline were 0.83 for 2010 to 2011, 1.28 for 2010 to 2012, 1.22 for 2010 to 2013 and 0.74 standard deviations for 2010 to 2014 (see figure 33). The effect sizes of the different periods were all positive and large, indicating that the mentoring of accounting teachers had a large positive impact on accounting mean average percentages and, therefore, on student achievement in accounting.

5.3.6 Discussion of results of descriptive analysis students that wrote accounting

From figure 34 it can be concluded that the median number of students that wrote accounting in the project schools decreased from 45 in 2010 to 34 in 2014. This is equal to a decrease of 24%. In the control schools the number of students decreased from 37 in 2010 to 29 in 2014. This is equal to a decrease of 22%. The trend in the project schools was more or less the same than that in the control schools. It can be concluded that the mentoring of accounting teachers did not have a positive impact on the number of students that wrote accounting from 2010 to 2014.

5.4 Concluding interpretations accounting

5.4.1 Pass rates

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median pass rates were also used in the comparison of pass rates results.

Large differences in change in mean pass rates from baseline (2010) between the project schools and the control schools for the period 2010 to 2014 were achieved. The differences ranged between 14.7 and 18.8 percentage points. The differences in change in median pass rates from baseline (2010) between the project schools and the control schools for the period 2010 to 2014 ranged between 20.3 and 34.8 percentage points. The largest gains (18.8 and 34.8 percentage points) were achieved in the period 2010 to 2011, thus, 1 year after mentoring started. These differences indicate a large positive impact of mentoring accounting teachers on student achievement in accounting.

The odds ratios ranged between 1.1 and 1.5, indicating that the odds of passing accounting in a project school was 1.1 to 1.5 times better than the odds of passing in a control school for the period 2011 to 2014. The odds ratio of 2011 was equal to 1.5. This was achieved 1 year after mentoring started. The 95% confidence interval's lower values ranged between 0.4 and 0.8 and the top values between 2.3 and 3. 95% CI values lower than 1 are not desirable. None of the odds ratios were statistically significant at the 0.05 level. This could be due to the high variability of the pass rates.

The effect sizes with 2010 as baseline were 0.92 for 2010 to 2011, 0.79 for 2010 to 2012, 0.85 for 2010 to 2013 and 0.67 standard deviations for 2010 to 2014. The largest effect size (0.92 standard deviations) was achieved in 2011, thus, 1 year after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2010 to 2011, 2010 to 2012, 2010 to 2013 and 2010 to 2014 were all large.

It is, however, important not to interpret effect sizes with the same rigidity as statistical significance with regards to cut-off points (as indicated above), but relate the effect sizes found to those of prior studies (Cohen et al. 2007). In educational program evaluation, effect sizes of common interventions on student learning vary from below 0.10 standard deviations to 0.70 standard deviations or more (Thompson et al. 2004). Hattie (1992) found that spending a year in school has an effect size of around 0.40 on student learning. Among the national samples used to norm the Stanford Achievement Test-9th Edition (SAT-9), fifth graders scored 0.5 of a standard deviation higher than fourth graders in math and 0.3 of a standard deviation higher in reading (Granger & Kane 2004).

Fletcher & Strong (2009) reported effect sizes of 0.05 – 0.6 standard deviations in their study and Rockoff (2008) reported effect sizes of 0.04 - 0.05 standard deviations per ten hours of mentoring. In the study of Thompson et al. (2004) an effect size of 0.32 standard deviations on teaching practice was found. This effect size relates to an effect size of less than 0.32 standard deviations on student achievement because teaching practice does not relate strictly into equivalent effects on student outcomes. Lorence et al. (2002) reported effect sizes of

0.14 to 0.78 standard deviations as positive to strong differences in test score performances. The impacts found by Glazerman et al. (2010) were equivalent to 0.11 standard deviations in reading and 0.20 standard deviations in mathematics. They reported this effect sizes as significant differences between the treatment and control groups. Most of their results were, however, not statistically significant at the 0.05 level.

If the above norms are taken into account, the change in effect sizes from 2010 as baseline, relate to large positive impacts. According to Hattie (1992) and Granger & Kane (2004) the effect size of the period 2010 - 2011 relates to a growth of 2.3 years in school, the effect sizes of 2010 - 2012 to a growth of 2 years, that of 2010 - 2013 to a growth of 2 years and that of 2010 - 2014 to a growth of 1.7 years in school. This growths indicate a large positive impact of mentoring accounting teachers on student achievement in accounting.

5.4.2 Average percentages

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median average percentages were also used in the comparison of results.

The differences in change in mean average percentages from baseline (2010) between the project schools and the control schools for the period 2010 to 2014 ranged between 3.9 and 6.7 percentage points. The differences in the change in median average percentages from baseline (2010) between the project schools and the control schools for the period 2010 to 2014 ranged between 5.0 and 7.4 percentage points. The largest gain in mean average percentages (6.7) was achieved in the period 2010 to 2012, thus, 2 year after mentoring started and that in median average percentages (7.4) was achieved in the period 2010 – 2013, thus, 3 years after mentoring started. These differences indicate a large positive impact of mentoring accounting teachers on student achievement in accounting.

The differences between the ANCOVA estimated mean average percentages ranged between 1.8 and 5.2 percentage points. The largest difference (5.2 percentage points) was achieved in 2013, 3 years after mentoring started. The 95% confidence interval’s lower values range between -3.2 and 0.1 and the top values between 5.9 and 10.9. 95% CI values lower than zero are not desirable. The treatment-control difference in 2013 was significantly different from zero at the 0.05 level. The differences for the other years were not statistically significant at the 0.05 level. This can be due to the high variability of the average percentages.

The effect sizes with 2010 as baseline were 0.84 for 2010 to 2011, 1.28 for 2010 to 2012, 1.22 for 2010 to 2013 and 0.74 standard deviations for 2010 to 2014. The effect size of the period 2010 to 2013 was statistically significant at the 0.05 level. The largest effect size (1.28 standard deviations) was achieved in the period 2010 - 2012, thus, 2 years after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2010 to 2011, 2010 to 2012, 2010 to 2013 and 2010 to 2014 were all large. These effect sizes compare very well to the effect sizes found in other studies discussed above (see pass rates). According to Hattie (1992) these effect sizes relates to growths in school of 2 years for the period 2010 – 2011 and 2010 – 2014 and 3 years for the periods 2010 – 2012 and 2010 - 2013.

5.5 Conclusion

From the interpretation of the results it can be concluded that the mentoring of accounting teachers had a large positive impact on student achievement in accounting. The large positive impacts were achieved from the first year after mentoring started, and were still present 4 years after mentoring started.

Chapter 6

Findings on the impact of mentoring mathematics teachers on the student achievement in mathematics

This chapter focuses on the data used for the mathematics analysis and the presentation, discussion and interpretation of the results of the data analysis. The impact of mentoring mathematics teachers on student achievement (as informed by the conceptual framework) in mathematics, are also discussed.

6.1 Data mathematics

Data level questions:

What are the gr 12 mathematics final examination pass rates and average percentages (average marks) in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?

What are gr 12 mathematics final examination pass rates and average percentages (average marks) in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?

How do the mentored and non-mentored data compare for the same years?

See appendix III for the documentation of the data used.

6.2 Presentation of results mathematics

Mentoring started during 2012. The mentoring time up till the end of 2014 is, therefore, equal to 3 years. 2011 data were taken as baseline data.

Table 4 represent the properties of the data distribution for mathematics for the years 2010 to 2014. The means, standard deviations, minimum and maximum values and medians for pass rates, average percentages, number of students that wrote mathematics, size of schools and the number of teachers in the sample schools are represented in the table.

Mathematics		Year									
		2010		2011		2012		2013		2014	
		Intervention		Intervention		Intervention		Intervention		Intervention	
		Control	Project	Control	Project	Control	Project	Control	Project	Control	Project
Pass rates project and control schools	N	18	18	18	18	18	18	18	18	18	18
	Mean	45.3	38	45.7	33.6	46.3	51	55.9	63.5	58.4	62.3
	Std	22.1	19.2	21.7	14.1	23.3	22.9	17.9	26.5	21.6	22.5
	Min	8.2	6.5	11.7	11.8	3.2	21.4	26.7	20.8	16.7	24
	Median	39.7	39.3	42.4	34.2	42.7	50.5	57.4	56.5	56.5	65.3
	Max	100	70	100	63.2	87.8	90	81.8	100	94.6	100
Average % (average marks)	N	18	18	18	18	18	18	18	18	18	18
	Mean	29.5	26.8	30.3	26.3	31.4	32.3	34.2	37.5	32.1	35
	Std	6.6	6.8	7.7	5.3	9	8.1	6.3	11	11.9	7.3
	Min	15.5	15.8	15.8	18.8	10.4	21.8	24.4	24	0	21
	Median	29.2	26.5	29.4	25.8	29.8	32.8	33.2	36.4	31.9	36.6
	Max	39.9	36.6	45.3	37.5	45.4	46	45.9	57.7	51.6	47.5
Students that wrote maths	N	18	18	18	18	18	18	18	18	18	18
	Mean	43.2	41.3	37.4	38	36	32.5	39.5	26.4	41.3	35.7
	Std	30	33	26.6	30.3	21.2	22	17.9	14.9	33	24.2
	Min	3	7	7	8	8	10	9	4	11	7
	Median	43	28	30.5	26.5	33	27	38	24	33.5	30.5
	Max	123	126	94	115	89	99	70	58	153	88

Table 4: Descriptive statistics for mathematics 2010 to 2014

6.2.1 Presentation of descriptive analysis pass rates mathematics

See paragraph 4.3 in chapter 4 for statistical methods used.

Figure 35 represents the standard deviation and range of the pass rates mathematics 2011 to 2014.

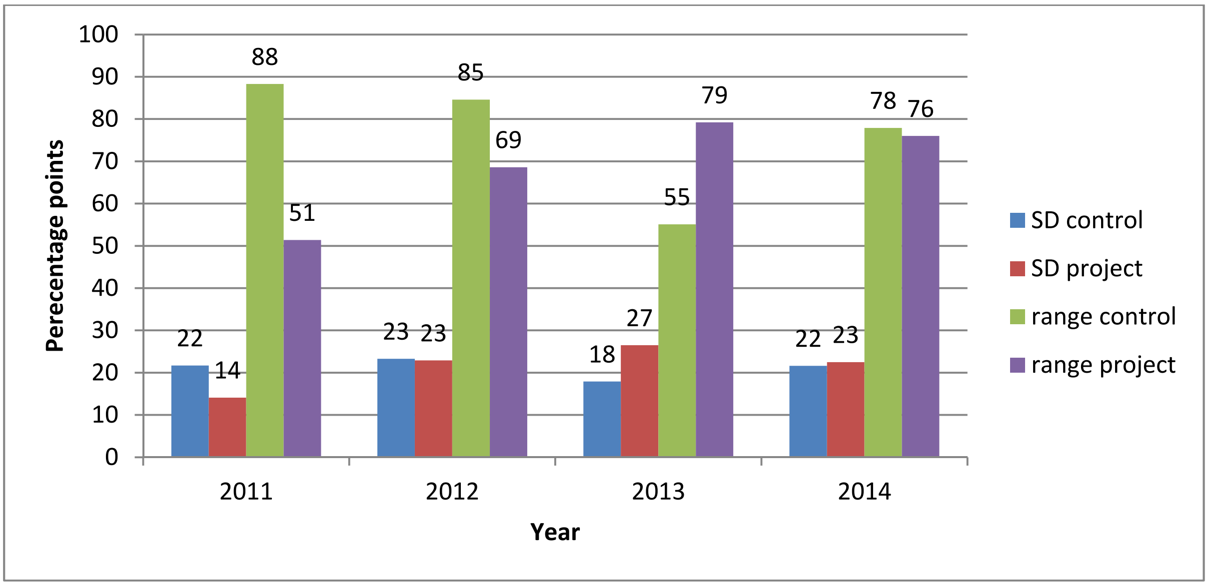

Figure 35. Distribution of pass rates mathematics 2011 to 2014

Figure 36 represents the skewness of the pass rates of mathematics for the period 2011 to 2014. The skewness was determined by using Pearson's measure of skewness.

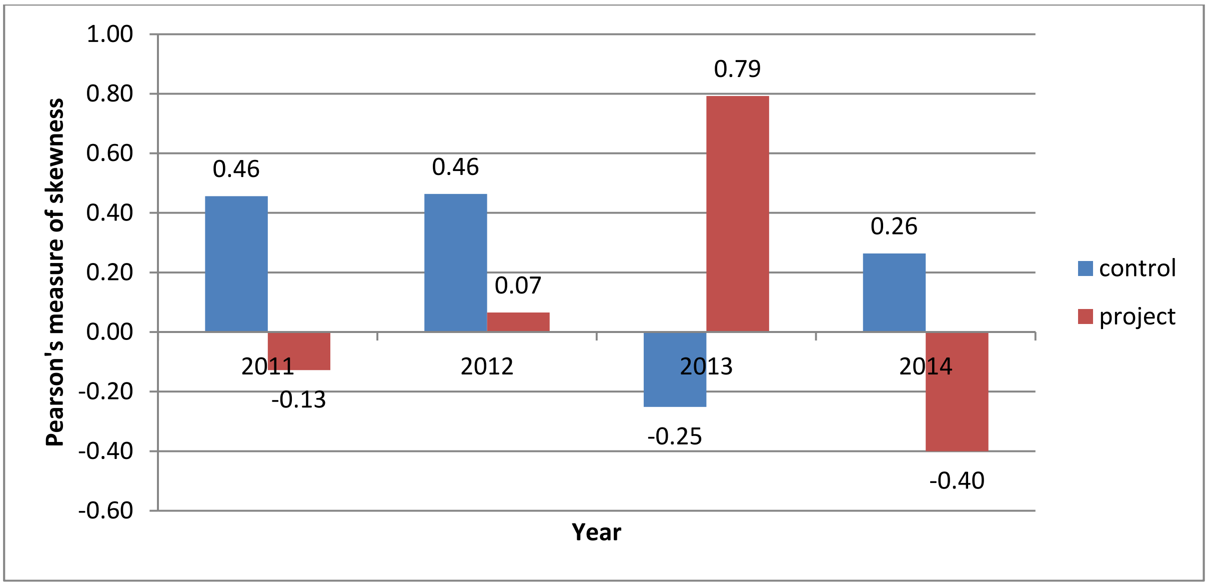

Figure 36. Skewness of pass rates mathematics 2011 to 2014

Figure 37 represents the mathematics mean pass rates of the control and project schools for the years 2011 to 2014.

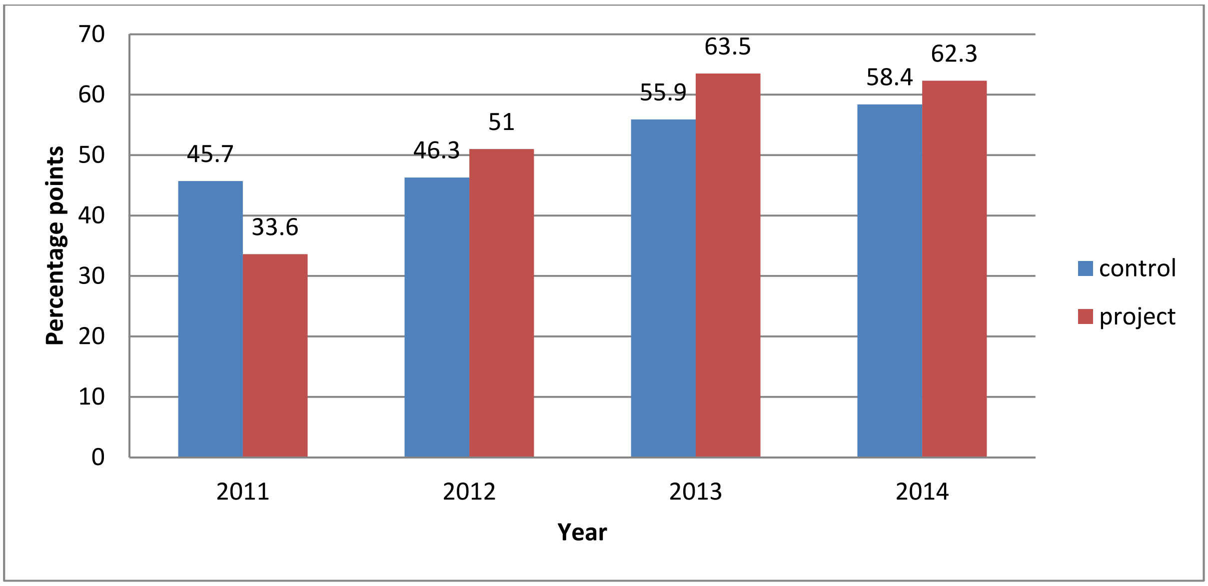

Figure 37. Mean pass rates mathematics 2011 to 2014

In figure 38 the change in mathematics mean pass rates of the project and control schools with 2011 as baseline are indicated. The scores were obtained by subtracting the score obtained in 2011 from the score obtained in the specific year.

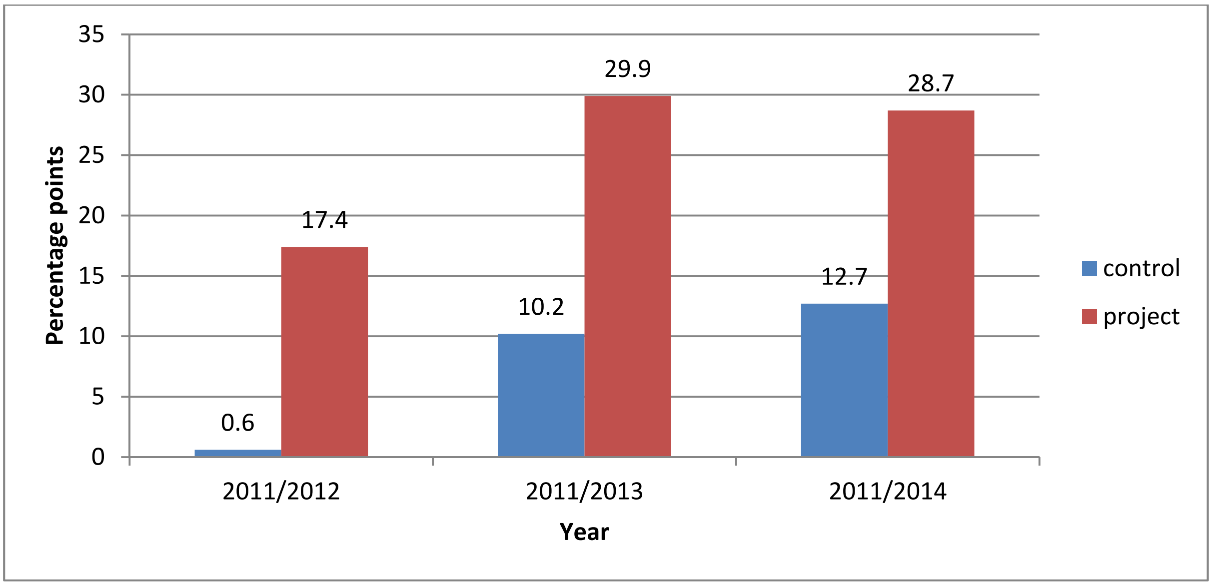

Figure 38. Change in mean pass rates with 2011 as baseline mathematics 2012 to 2014

Figure 39 represents the differences in change in mean pass rates from the baseline (2011) between the project and control schools. The scores were calculated by subtracting the change in mean pass rates from 2011 of the control schools from that of the project schools.

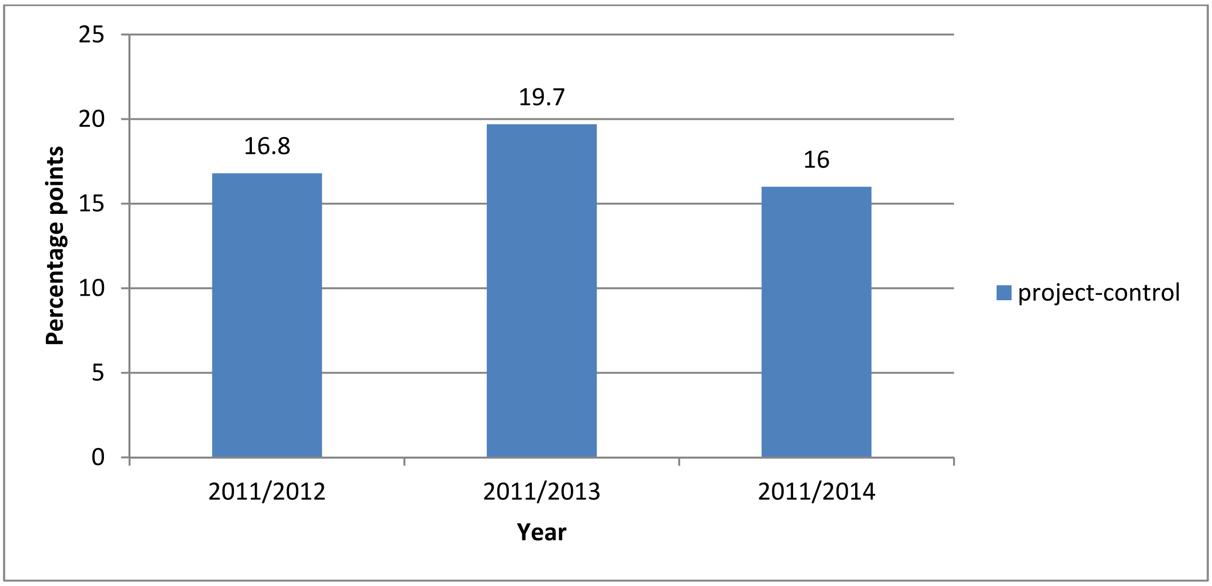

Figure 39. Differences in change in mean pass rates mathematics 2012 to 2014

Figure 40 represents the mathematics median pass rates of the project and control schools for the years 2011 to 2014.

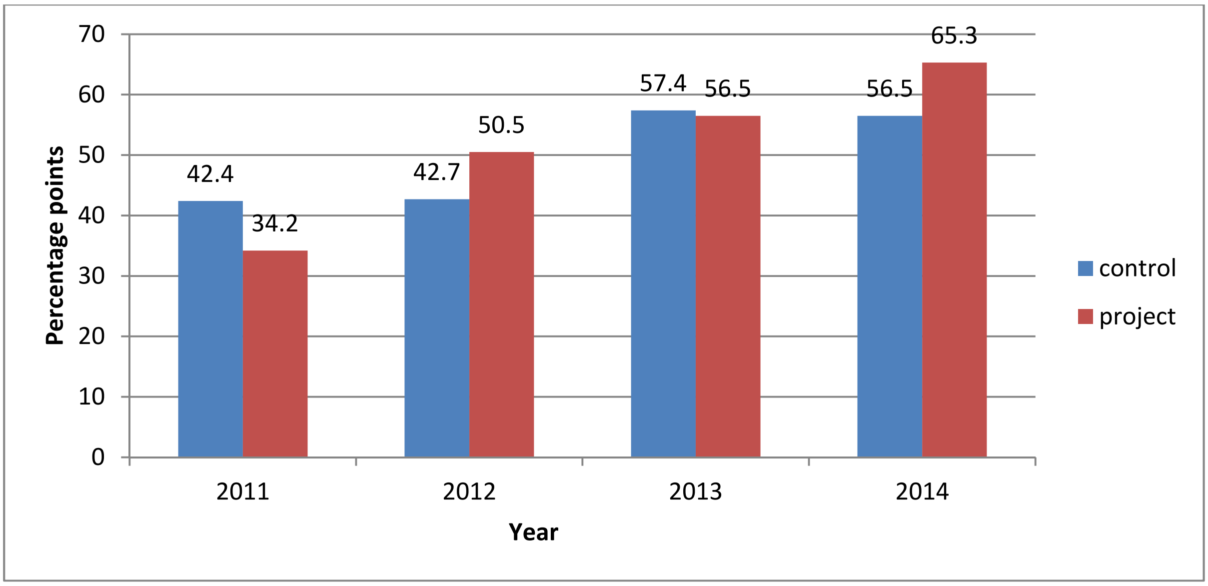

Figure 40. Median pass rates mathematics 2011 to 2014

Figure 41 represents the change in mathematics median pass rates of the project and control schools with 2011 as baseline. The scores were obtained by subtracting the score obtained in 2011 from the score obtained in the specific year.

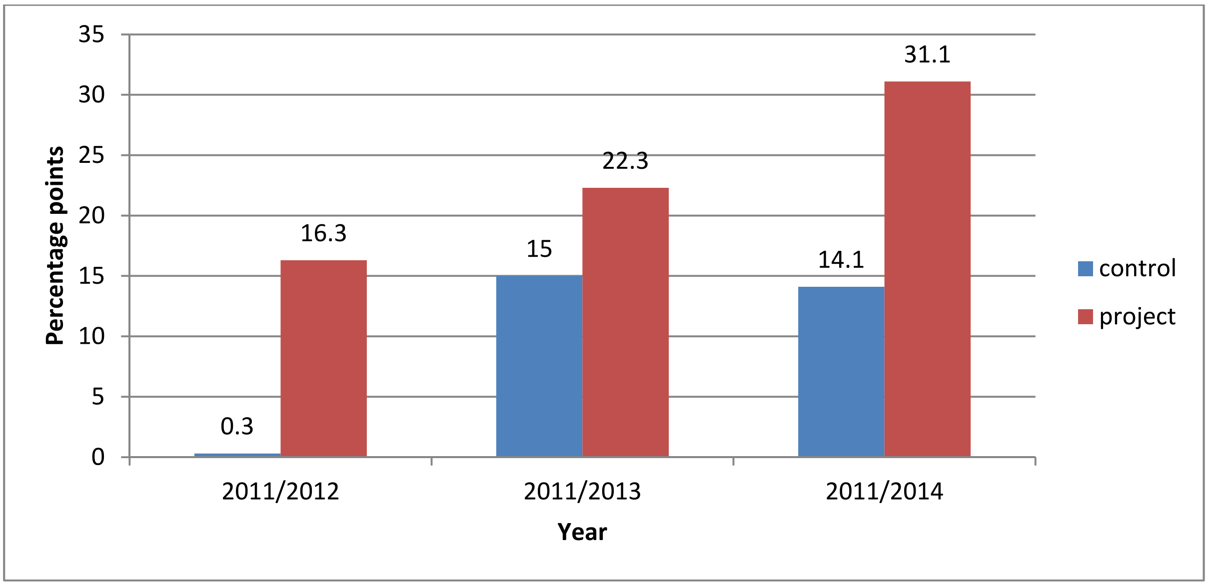

Figure 41. Change in median pass rates with 2011 as baseline mathematics 2012 to 2014

Figure 42 represents the differences in change in median pass rates from the baseline (2011) between the project and control schools. The scores were calculated by subtracting the change in median pass rates from 2011 of the control schools from that of the project schools.

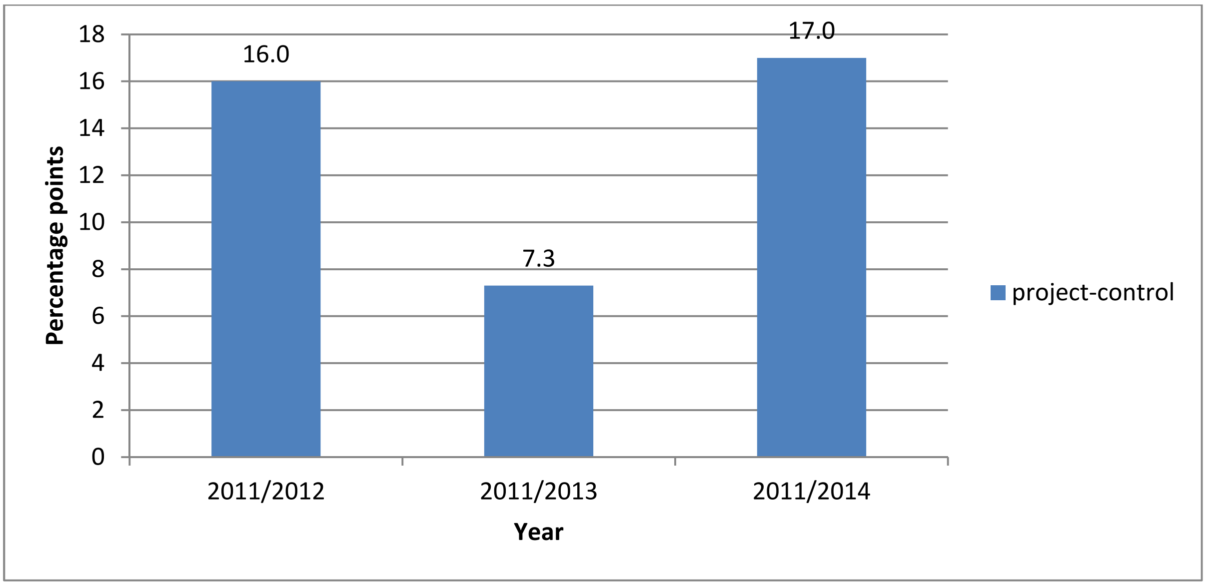

Figure 42. Differences in change in median pass rates mathematics 2012 to 2014

Figure 43 represents the minimum and maximum pass rates of the project and control school of mathematics for the years 2011 to 2014.

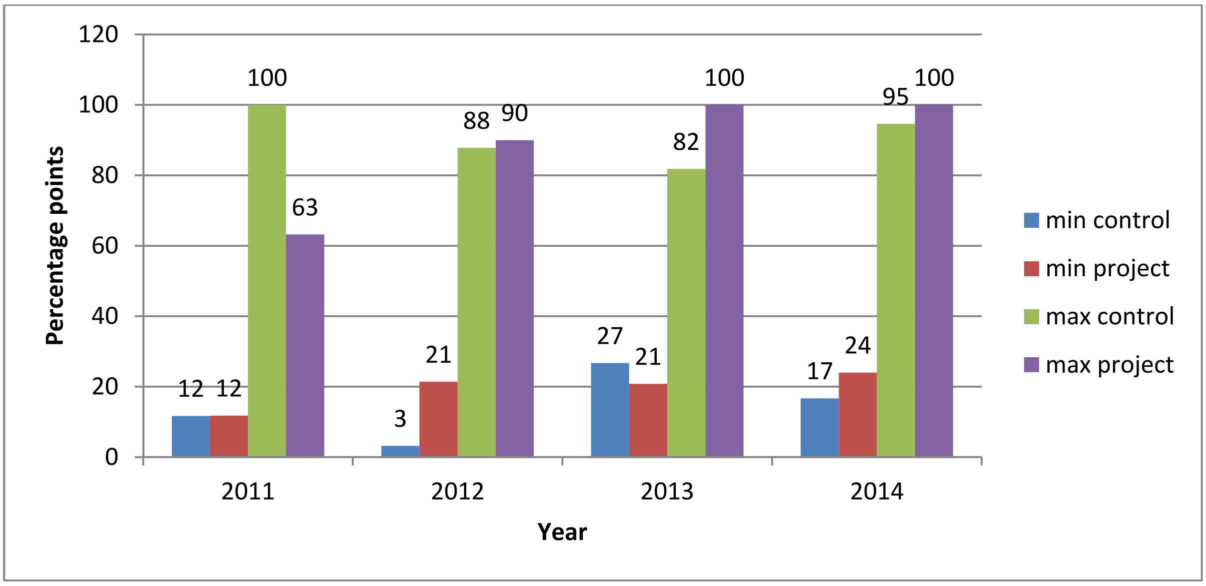

Figure 43. Minimum and maximum pass rates mathematics 2011 to 2014

Figure 44 represents a summary of the descriptive statistics for pass rates mathematics for the period 2011 to 2014.

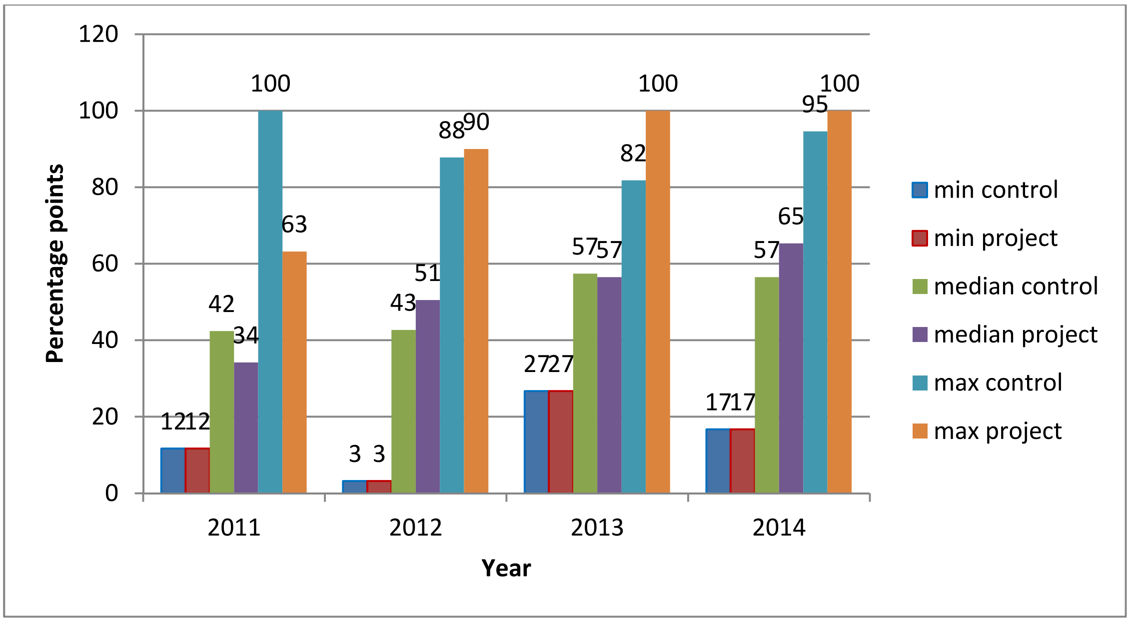

Figure 44. Summary descriptive statistics pass rates mathematics 2011 to 2014

6.2.2 Presentation of inferential analysis pass rates mathematics

Table 5 represents the results of a logistic regression analysis done on the mathematics pass rates data with project versus control and matched pair as fixed effects and pre-project pass rates (2010/2011) as covariate. Based on the logistic regression the mean pass rates per year in the project and control groups were estimated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratio and associated p-values.

Subject	Year	Project Pass Rates (%)	Control Pass Rates (%)	Comparison		
				Odds ratio	95% Confidence interval for odd ratio	p-value (statistical significance)
Mathematics	2012	52.5	41.8	1.5	0.9 to 2.5	0.0903
Mathematics	2013	65.6	55.5	1.5	0.8 to 2.9	0.2053
Mathematics	2014	59.7	56.5	1.1	0.6 to 2.3	0.7120

Table 5. Comparison of model estimated (logistic regression) pass rates and odds ratios mathematics for the years 2012 – 2014.

Figure 45 represents the differences between the logistic regression estimated mean pass rates of mathematics of the project and control schools for the period 2012 to 2014.

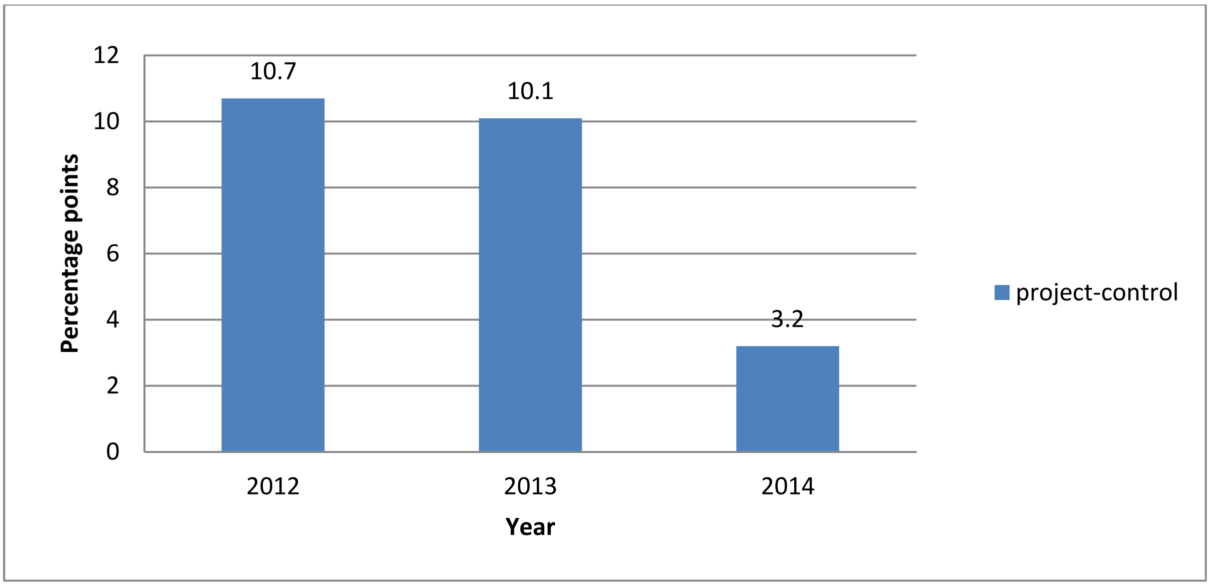

Figure 45. Differences in model estimated (logistic regression) mean pass rates mathematics 2012 to 2014

Figure 46 represents the logistic regression estimated odds ratios for the mean pass rates of mathematics and the 95% confidence interval for the odds ratios for the period 2012 to 2014.

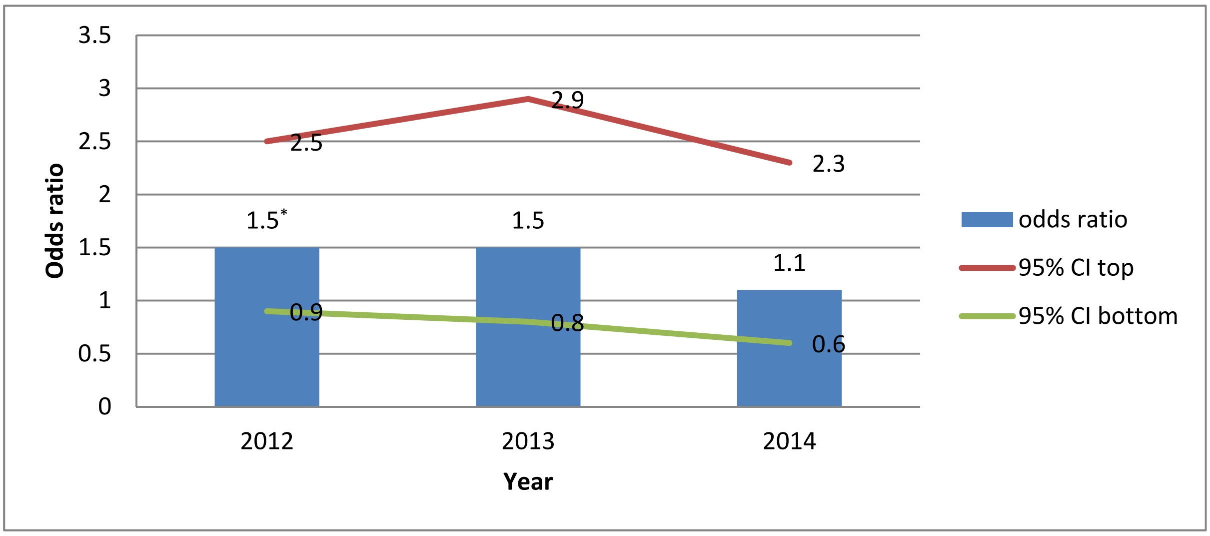

Figure 46. Model estimated (logistic regression) odds ratios mean pass rates mathematics 2012 to 2014. *Treatment-control difference significantly different from zero at the 0.09 level.

Figure 47 represents the impacts on average percentages of mathematics for the periods 2011 to 2012, 2011 to 2013 and 2011 to 2014. The effect size (Cohen's d) of each period was determined by dividing the differences between the change in mean average percentages of the project schools and that of the control schools by the pooled standard deviation of the means of 2011.

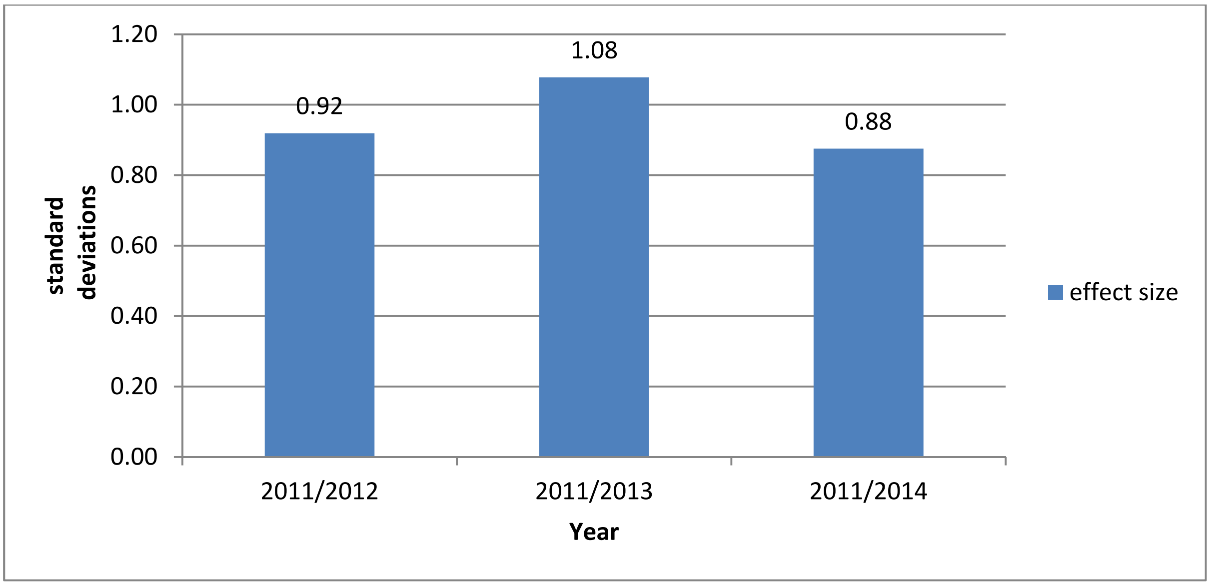

Figure 47. Impacts on pass rates mathematics 2012 to 2014.

6.2.3 Presentation of descriptive analysis average percentages mathematics

Figure 48 represents the standard deviation and range of the mathematics average percentages.

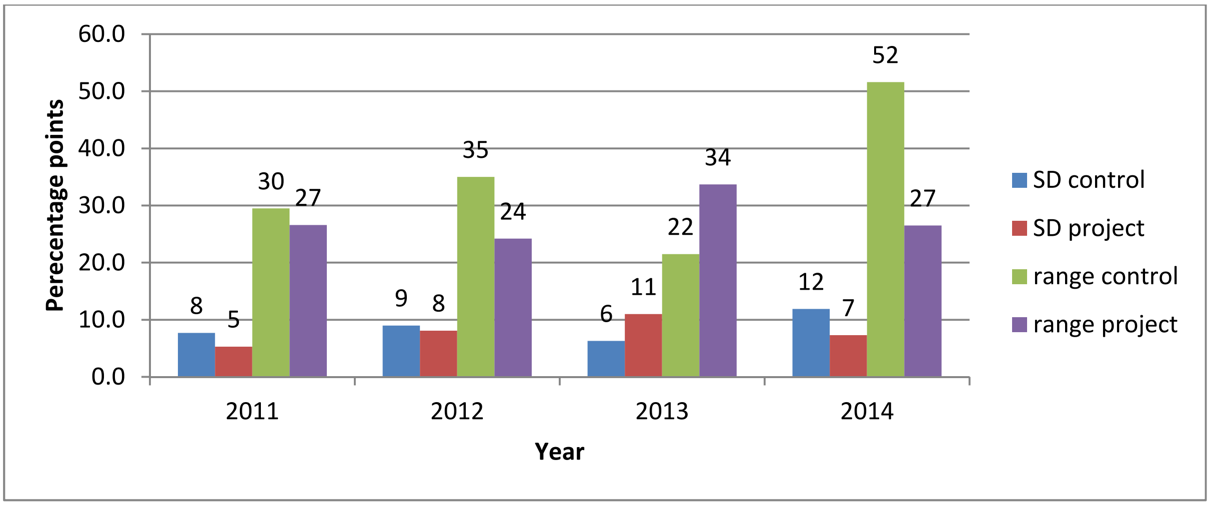

Figure 48. Distribution of average percentages mathematics 2011 to 2014

Figure 49 represents the skewness of the mathematics average percentages. Pearson's measure of skewness was used.

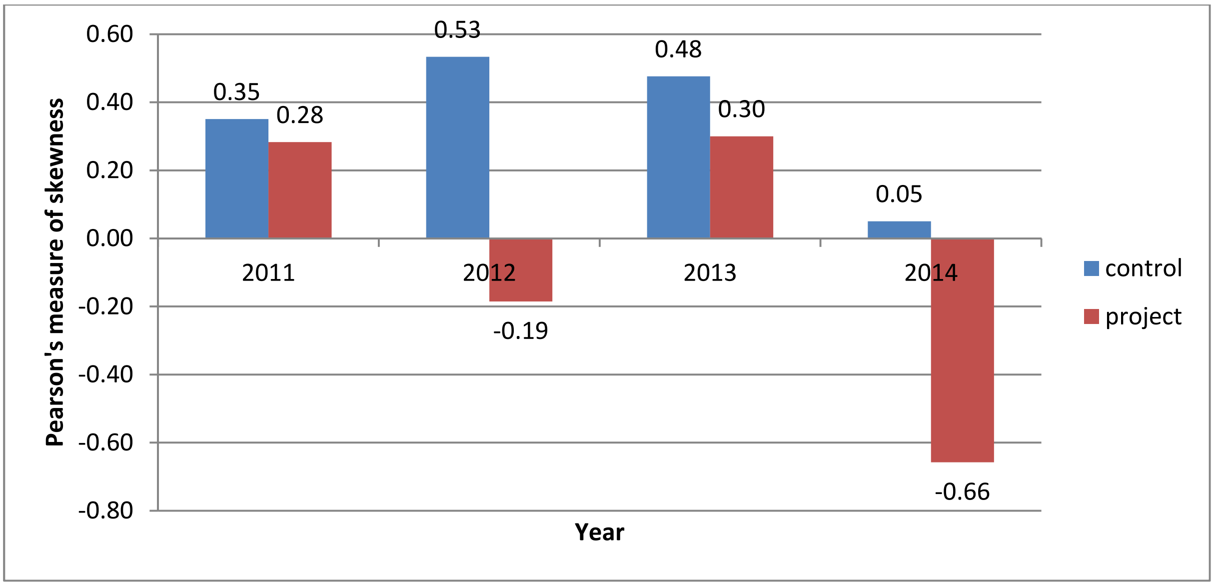

Figure 49. Skewness of average percentages mathematics 2011 to 2014

Figure 50 represents the mathematics mean average percentages of the project and control schools for the years 2011 to 2014.

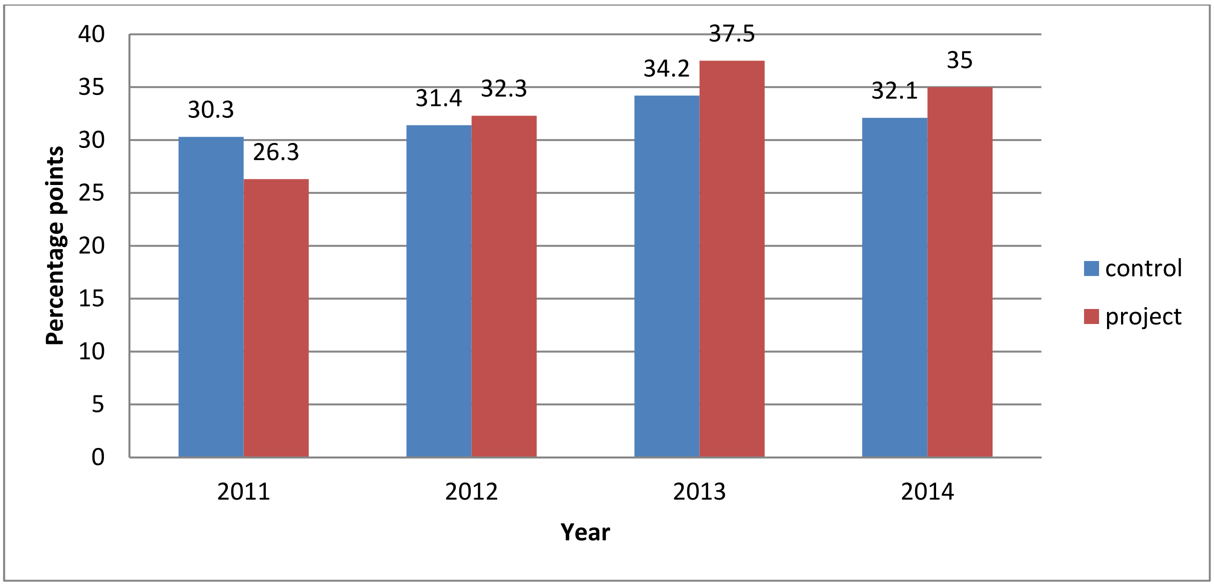

Figure 50. Mean average percentages mathematics 2011 to 2014

Figure 51 represents the change in mathematics mean average percentages with 2011 as baseline. The changes were calculated by subtracting the mean average percentages of 2011 from the mean average percentages of the specific year.

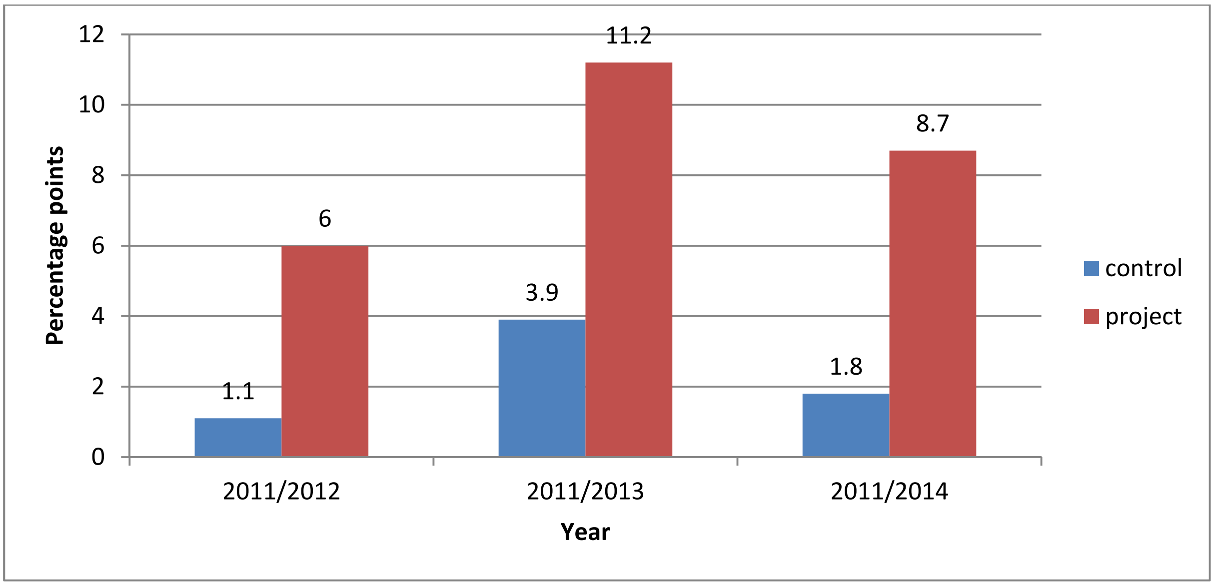

Figure 51. Change in mean average percentages with 2011 as baseline mathematics 2012 to 2014

Figure 52 represents the differences in change in mean average percentages from baseline (2011) between the project and control schools. The scores were calculated by subtracting the change in mean average percentages from 2011 of the control schools from that of the project schools.

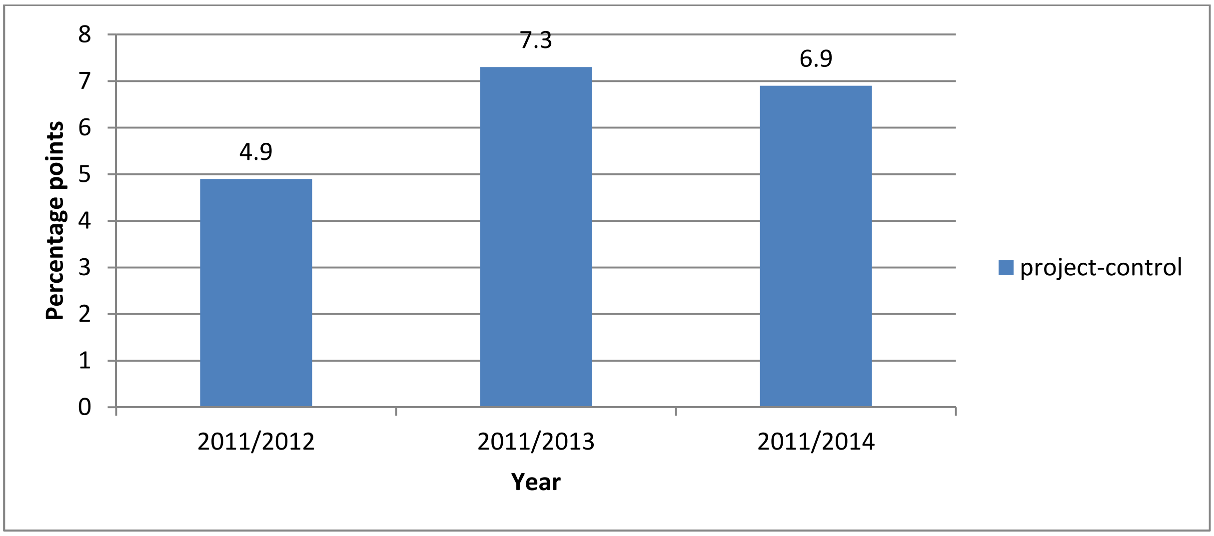

Figure 52. Differences in change in mean average percentages mathematics 2012 to 2014

Figure 53 represents the mathematics median average percentages of the project and control schools for the years 2011 to 2014.

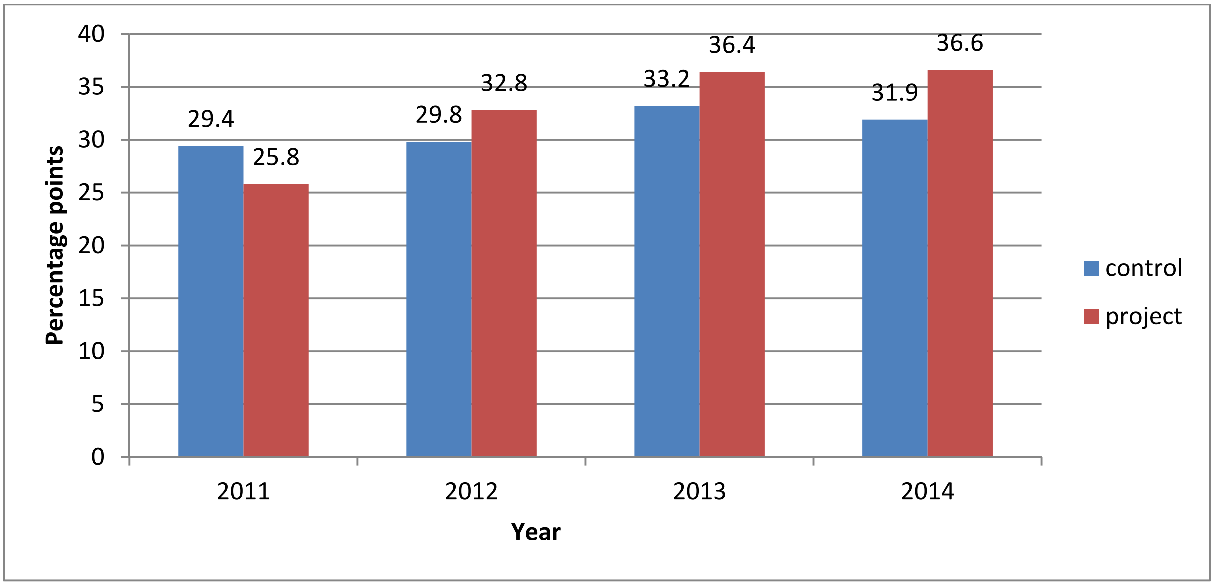

Figure 53. Median average percentages mathematics 2011 to 2014

Figure 54 represents the change in mathematics median average percentages with 2011 as baseline. The changes were calculated by subtracting the median average percentages of 2011 from the median average percentages of the specific year.

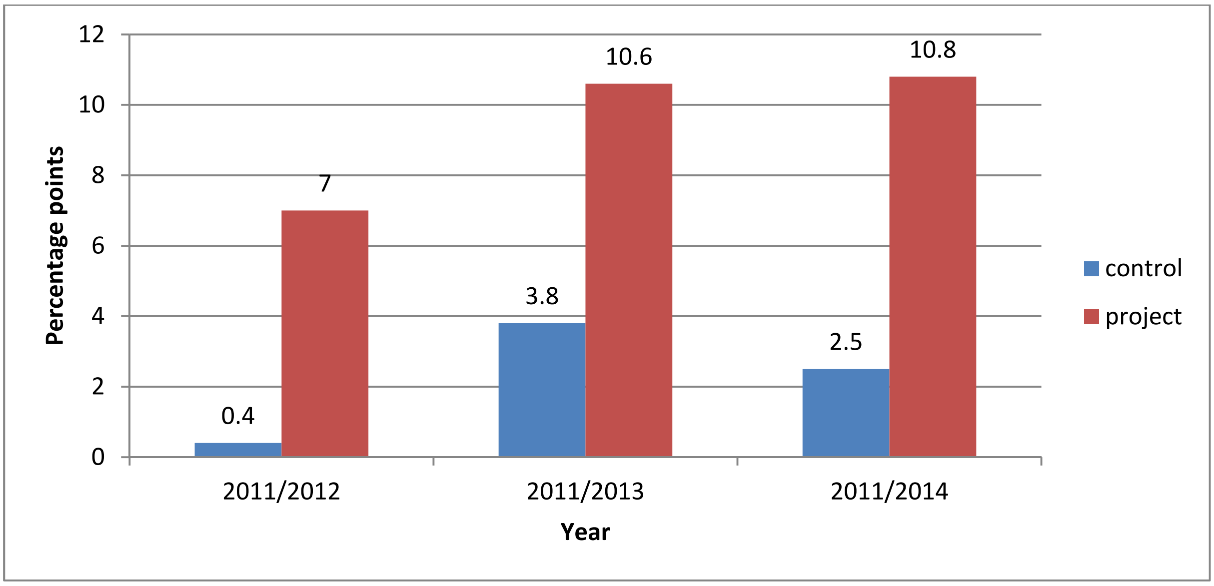

Figure 54. Change in median average percentages with 2011 as baseline mathematics 2012 to 2014

Figure 55 represents the differences in change from baseline (2011) between the project and control schools. The scores were calculated by subtracting the change in median average percentages from 2011 of the control schools from that of the project schools.

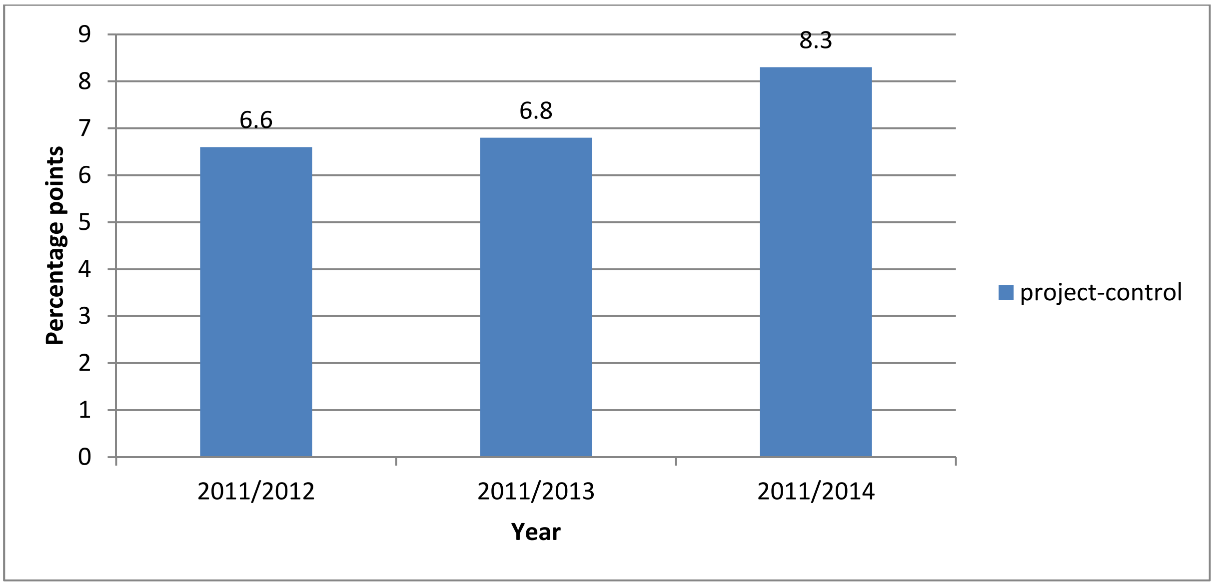

Figure 55. Differences in changes in median average percentages mathematics 2012 to 2014

Figure 56 represents the mathematics minimum and maximum average percentages of the project and control school for the years 2011 to 2014.

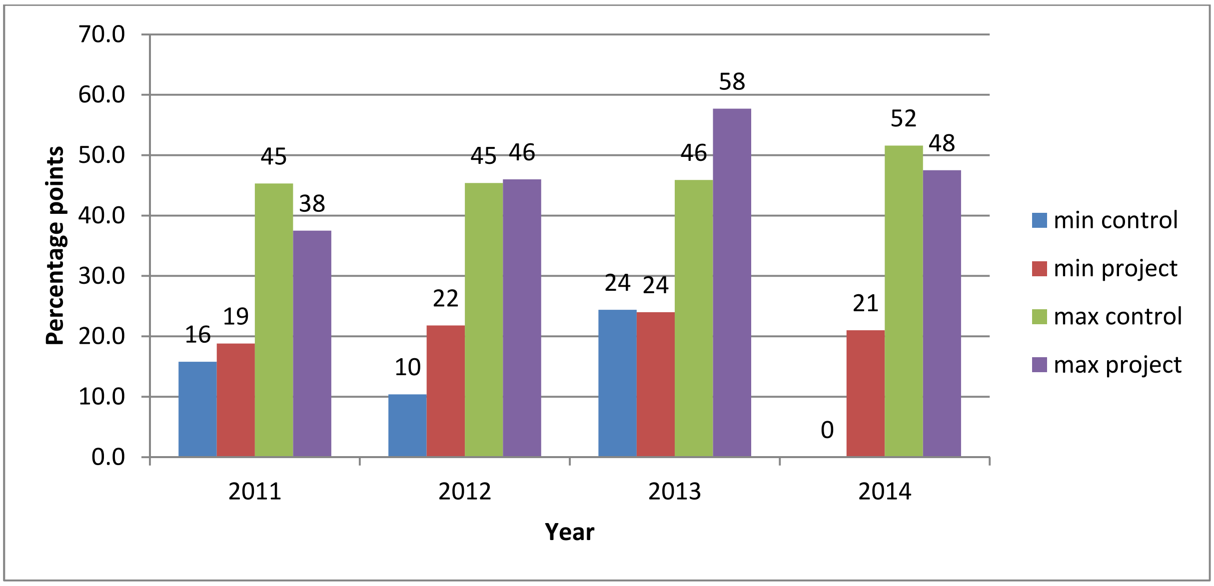

Figure 56. Minimum and maximum average percentages mathematics 2011 to 2014

Figure 57 provides a summary of the descriptive statistics for mathematics average percentages 2011 to 2014.

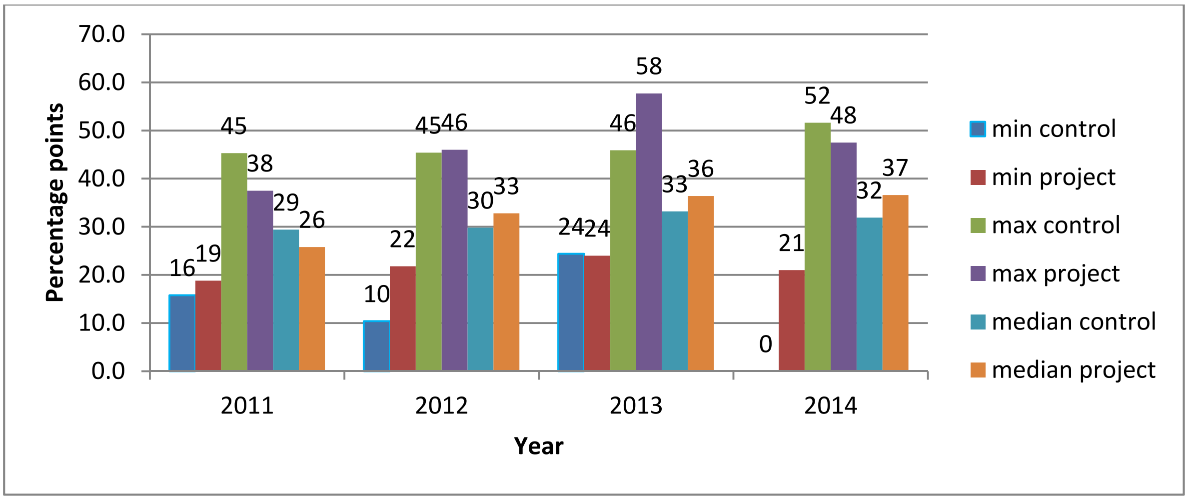

Figure 57. Summary descriptive statistics average percentages mathematics 2011 to 2014

6.2.4 Presentation of inferential analysis average percentages mathematics

Subject	Year	Project mean average mark (%)	Control mean average mark(%)	Comparison		
				Difference "Project – Control "	95% CI for difference	p-value (statistical significance)
Mathematics	2012	33.0	30.1	2.9	-1.3 to 7.1	0.1647
Mathematics	2013	36.9	34.3	2.6	-2.5 to 7.7	0.2944
Mathematics	2014	36.2	30.0	6.2	-0.5 to 12.9	0.0662

Table 6. Comparison of model estimated (ANCOVA) average percentages for mathematics for the years 2012 – 2014.

Figure 58 represents the ANCOVA estimated mathematics mean average percentages.

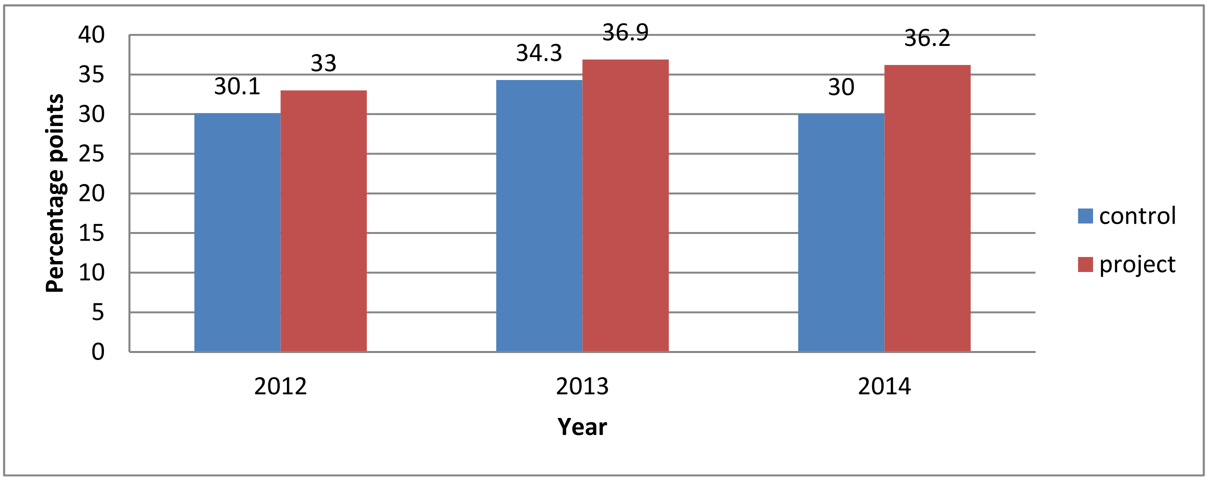

Figure 58. Model estimated (ANCOVA) mean average percentages mathematics

Figure 59 shows the differences in the ANCOVA estimated mathematics mean average percentages between the project and control schools for the period 2012 to 2014..

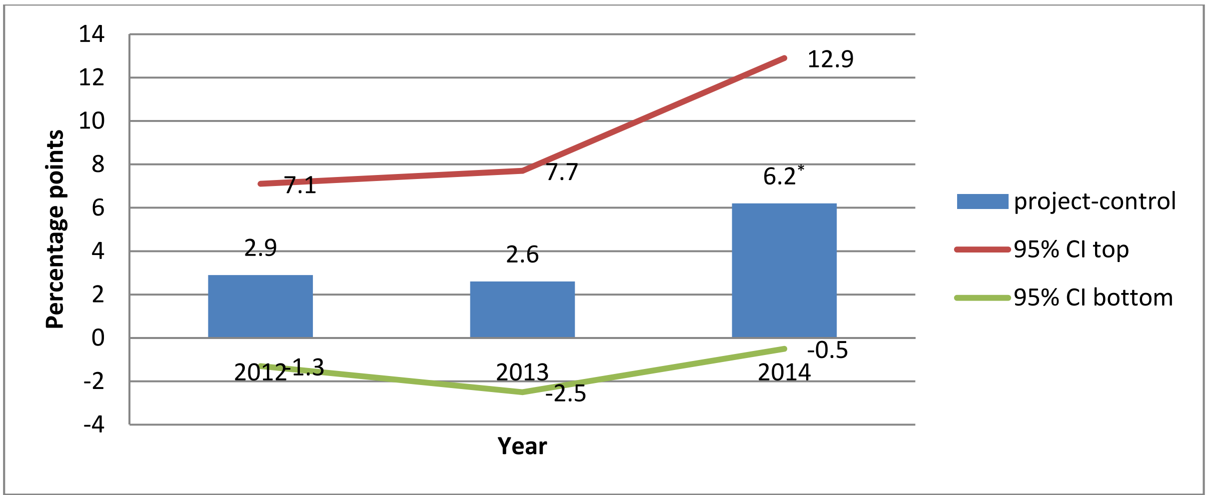

Figure 59. Model estimated (ANCOVA) differences in mean average percentages mathematics 2012 to 2014. *Treatment-control difference significantly different from zero at the 0.07 level.

Figure 60 represents the impacts on mathematics average percentages for the periods 2010 to 2012, 2010 to 2013 and 2010 to 2014. The effect size (Cohen's d) of each period was determined by dividing the differences between the change in mean average percentages of the project schools and that of the control schools by the pooled standard deviation of the means of 2011.

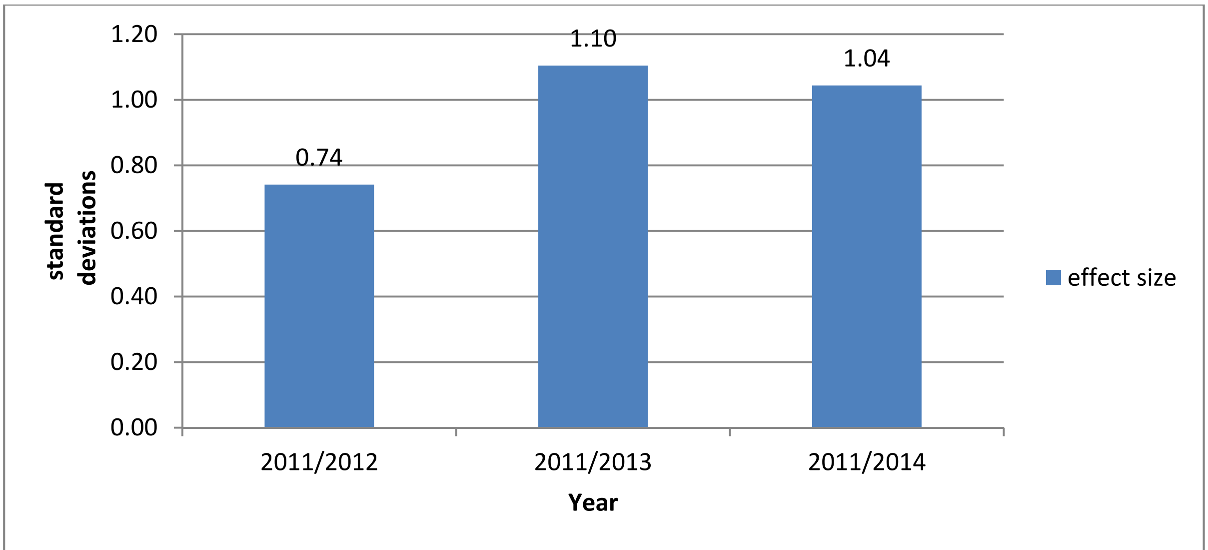

Figure 60. Impacts on average percentages mathematics 2012 to 2014

6.2.5 Presentation of descriptive analysis students that wrote mathematics

Figure 61 provides a summary of the analysis of the students that wrote mathematics for the period 2011 to 2014.

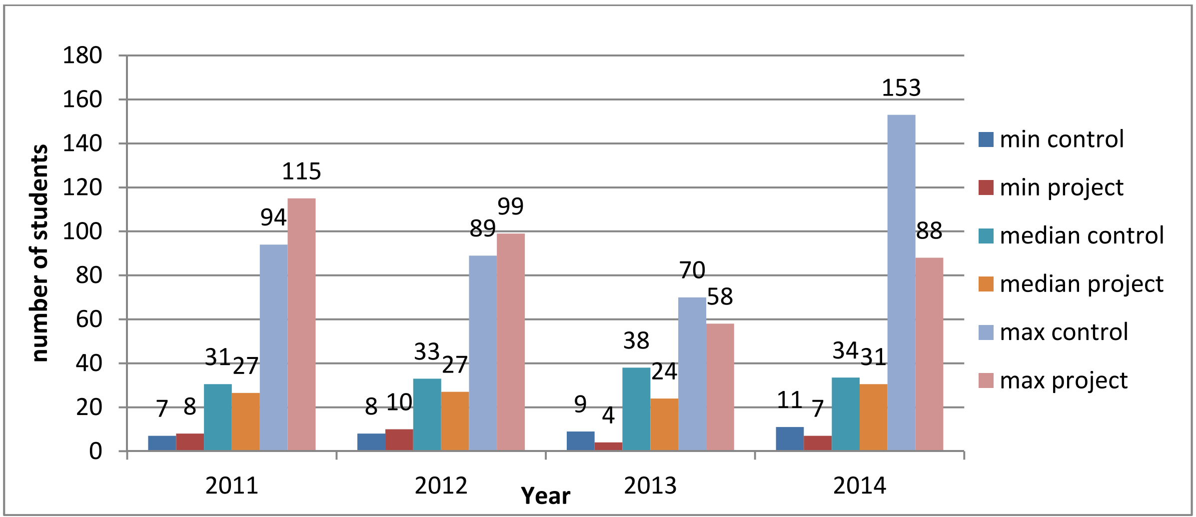

Figure 61. Summary of analysis of students that wrote mathematics 2011 to 2014

6.3 Discussion of results by research question

6.3.1 Secondary research question #2

What is the impact of mentoring mathematics teachers in the UFS SPP on student achievement in mathematics?

6.3.2 Discussion of results of descriptive analysis pass rates mathematics by research question #2

The pass rates were highly variable. That can be derived from figure 35. The standard deviation ranged from 14.1 to 26.5 percentage points and the range from 51.4 to 88.3 percentage points. The skewness of the pass rates was determined by using Pearson's measure of skewness. As can be seen from figure 36 that the mean pass rates data were skewed ranging from -0.40 to 0.79.

The project schools started off at a lower mean pass rates base (33.6 percentage points for 2011) than the control schools (45.7 percentage points for 2011), but achieved higher mean pass rates for all the years 2012 to 2014 (see figure 37). The changes in mean pass rates between that of the different years and that of 2011 for the project schools, were larger than that of the control schools for all the periods (see figure 38). From figure 39 it can be derived that the differences in change in mean pass rates, with 2011 as baseline, between the project schools and the control schools were equal to 16.8 percentage points for the period 2011 to 2012, 19.7 percentage points for the period 2011 to 2013 and 16.0 percentage points for the period 2011 to 2014. This figures for the mathematics mean pass rates indicate that the mentoring of mathematics teachers had a large positive effect on the mathematics mean pass rates and, therefore, on student achievement in mathematics in the mentored schools.

From figure 40 it can be seen that the project schools achieved higher median pass rates than the control schools for all the years except 2013 (-0.9) although they started from a much lower base in 2011 (-8.2 percentage points). The changes for the project schools in median pass rates between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 41). From figure 42 it can be derived that the differences in change in median pass rates between the project schools and the control schools for the period 2011 to 2012 were equal to 16.0 percentage points, 2011 to 2013 equal to 7.3 percentage points and 2011 to 2014 equal to 17.0 percentage points. This figures for the mathematics median pass rates indicate that the mentoring of mathematics teachers had a large positive effect on mathematics median pass rates and, therefore, on student achievement in mathematics in the mentored schools.

From figure 43 it can be concluded that the maximum mean pass rates of the project schools increased from 63.2 and 90 percentage points in 2011 and 2012 to 100 percentage points in 2013 and 2014. This shows that some of the project schools achieved a 100 percent pass rate in 2013 to 2014. None of the control schools managed to achieve a 100 percent pass percentage in the period 2012 to 2014. The differences in change in maximum pass rates of the project schools and that of the control schools with 2011 as baseline were 39.0 for 2012, 55.0 for 2013 and 42.2 percentage points for 2014. The differences in change in minimum pass rates of the project schools and that of the control schools, with 2011 as baseline, were 18.1 for 2012, -6.0 for 2013 and 7.2 percentage points for 2014. From this differences it can be concluded that the mentoring of mathematics teachers had a positive impact on the minimum and maximum pass rates of the project schools and, thus, on the student achievement in mathematics.

6.3.3 Discussion of results of inferential analysis pass rates mathematics by research question #2

Figure 45 represents the logistic regression estimated differences in mean pass rates between the project and control schools. The differences ranged between 3.2 and 10.7 percentage points. By using these differences the odds ratios for the mean pass rates were calculated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratio and associated p-values. The odds ratios ranged between 1.1 and 1.5. The 95% confidence interval's lower values ranged between 0.6 and 0.9 and the top values between 2.3 and 2.9. The odds ratio of the year 2012 was marginally significant ($p = 0.09$) (see figure 46).

The effect sizes with 2011 as baseline were 0.92 for the period 2011 to 2012, 1.08 for 2010 to 2013 and 0.88 standard deviations for 2010 to 2014 (see figure 47). The effect sizes of all the different periods were all positive and large, indicating that the mentoring of mathematics teachers had a large positive impact on mathematics mean pass rates and, therefore, on student achievement in mathematics.

6.3.4 Discussion of results of descriptive analysis average percentages mathematics by research question #2

The average percentages were highly variable. That can be derived from figure 48. The standard deviation ranged from 5.3 to 11.9 percentage points and the range from 21.5 to 51.6 percentage points. The skewness of the average percentages was determined by using Pearson's measure of skewness. As can be seen from figure 49 the average percentages data were skewed ranging from -0.66 to 0.53.

The project schools started off at a lower mean average percentage base (26.3 percentage points for 2011) than the control schools (30.3 percentage points for 2011), but achieved higher mean average percentages for all the years (see figure 50). The changes in mean average percentages of the project schools between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 51). From figure 52 it can be seen that the differences in change in mean average percentages, with 2011 as baseline, between the project schools and the control schools were equal to 4.9 percentage points for the period 2011 to 2012, 7.3 percentage points for the period 2011 to 2013 and 6.9

percentage points for the period 2011 to 2014. This figures for the mathematics mean average percentages indicate that the mentoring of mathematics teachers had a large positive effect on mathematics mean average percentages and, therefore, on student achievement in mathematics in the mentored schools.

From figure 53 it can be seen that the project schools achieved higher median average percentages than the control schools for all the years although they started from a much lower base in 2011 (-3.6 percentage points). The change in median averages between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 54). From figure 55 it can be seen that the differences between the changes in median average percentages, with 2011 as baseline, between the project schools and the control schools were equal to 6.6 percentage points for the period 2011 to 2012, 6.8 percentage points for the period 2011 to 2013 and 8.3 percentage points for the period 2011 to 2014. This figures for the mathematics median average percentages indicate that the mentoring of mathematics teachers had a large positive effect on mathematics median average percentages and, therefore, on student achievement in mathematics in the mentored schools.

From figure 56 it can be concluded that the differences between the increase in maximum mean average percentages of the project schools and that of the control schools, with 2011 as baseline, were 8.4 for 2011 - 2012, 19.6 for 2011 - 2013 and 3.7 percentage points for 2011 - 2014. The differences between the increase in minimum mean average percentages of the project schools and that of the control schools, with 2011 as baseline, were 8.4 for 2011 - 2012, -3.4 for 2011 - 2013 and 18.0 percentage points for 2011 - 2014. From this differences it can be conclude that the mentoring of mathematics teachers had a positive impact on the minimum and maximum average percentages of the project schools and, thus, on the student achievement in mathematics.

6.3.5 Discussion of results of inferential analysis average percentages mathematics by research question #2

Figure 58 represents the ANCOVA estimated differences in mean average percentages between the project and control schools. In order to compare the project with the control group, differences between the estimated mean average percentages were calculated, together with 95% confidence intervals for the differences and associated p-values (see figure 59). The differences were equal to 2.9 percentage points for 2012, 2.6 percentage points for 2013 and 6.2 percentage points for 2014. The difference of 2014 was marginally significant (p =

0.07). The 95% confidence interval's lower values ranged between -0.5 to -2.5 and the top values between 7.1 and 12.9 percentage points.

The effect sizes with 2011 as baseline were 0.74 for the period 2011 to 2012, 1.10 for 2010 to 2013 and 0.1.04 standard deviations for 2010 to 2014 (see figure 60). The effect sizes of the different periods were all positive and large, indicating that the mentoring of mathematics teachers had a large positive impact on the mathematics mean average percentages and, therefore, on student achievement in mathematics.

6.3.6 Discussion of results of descriptive analysis students that wrote mathematics

From figure 61 it can be concluded that the median number of students that wrote mathematics in the project schools decreased from 40 in 2011 to 36 in 2014. This is equal to a decrease of 10%. In the control schools the number of students decreased from 40 in 2011 to 41 in 2014. This is equal to an increase of 2.5%. The trend in the project schools is slightly negative and that in the control schools slightly positive. It can be concluded that the mentoring of mathematics teachers did not have a positive impact on the number of students that wrote mathematics from 2011 to 2014.

6.4 Concluding interpretations mathematics

6.4.1 Pass rates

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median pass rates were also used in the comparison of pass rates results.

The differences in change in mean pass rates, with 2011 as baseline, between the project schools and the control schools ranged between 16.0 and 19.7 percentage points for the period 2012 to 2014. The differences in changes in median pass rates, with 2011 as baseline, between the project schools and the control schools ranged between 7.3 and 17.0 percentage points for the period 2012 to 2014. The largest gain in mean pass rates (19.7 percentage points) was achieved in the period 2011 to 2013 and that in median pass rates (17.0 percentage points) in the period 2011 to 2014. Thus, two (mean) and three (median) years after mentoring started. These large positive differences indicate a large positive impact of mentoring mathematics teachers on student achievement in mathematics.

The odds ratios ranged between 1.1 and 1.5, indicating that the odds of passing mathematics in a project school was 1.1 to 1.5 times better than the odds of passing in a control school for the period 2012 to 2014. The odds ratio of 2012 and 2013 was equal to 1.5. This was achieved one and two years after mentoring started. The 95% confidence interval's lower values ranged between 0.6 and 0.9 and the top values between 2.3 and 2.5. 95% CI values lower than 1 are not desirable. None of the odds ratios was statistically significant at the 0.05 level although the odds ratio for 2012 was marginally significant (p = 0.09). This could be due to the high variability of the pass rates.

The effect sizes with 2011 as baseline were 0.92 for the period 2011 to 2012, 1.08 for 2010 to 2013 and 0.88 standard deviations for 2010 to 2014. The largest effect size was achieved in the period 2011 to 2013, thus, 2 years after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2011 to 2012, 2011 to 2013 and 2011 to 2014 were all large.

These effect sizes compare very well to the effect sizes found in other studies discussed in section 5.4.1. According to Hattie (1992) and Granger & Kane (2004) these effect sizes relates to growths of more than 2 years for the period 2011 – 2012 and 2011 to 2014 and more than 2.5 years for the period 2010/11 – 2013. These growths indicate a large positive impact of mentoring mathematics teachers on student achievement.

6.4.2 Average percentages

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median average percentages were also used in the comparison of results.

The differences in change in mean average percentages, with 2011 as baseline, between the project schools and the control schools ranged between 4.9 and 7.3 percentage points for the period 2012 to 2014. The differences in change in median average percentages, with 2011 as baseline, between the project schools and the control schools ranged between 6.6 and 8.3 percentage points for the period 2012 to 2014. The largest gain in mean average percentage (7.3 percentage points) was achieved in the period 2011 to 2013 and that in median average percentage (8.3 percentage points) in the period 2011 to 2014. Thus, two (mean) and three (median) years after mentoring started. These large positive differences indicate a large positive impact of mentoring mathematics teachers on student achievement in mathematics.

The differences between the ANCOVA estimated mean average percentages were equal to 2.9 percentage points for 2012, 2.6 percentage points for 2013, 6.2 percentage points for 2014. The largest difference (6.2 percentage points) was achieved in 2014, 3 years after mentoring started. The 95% confidence interval's lower values ranged between -0.5 and -2.5 and the top values between 7.1 and 12.9 percentage points. 95% CI values lower than zero are not desirable. None of the differences was statistically significant at the 0.05 level although the difference for 2014 was marginally significant ($p = 0.07$). This could be due to the high variability of the average percentages.

The effect sizes were 0.74 for the period 2011 to 2012, 1.10 for 2010 to 2013 and 1.04 standard deviations for 2010 to 2014. The largest effect size was achieved in the period 2011 to 2013, thus, 2 years after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2011 to 2012, 2011 to 2013 and 2011 to 2014 were all large. These effect sizes compare very good with the effect sizes reported in other studies as indicated in section 5.4.1. According to Hattie (1992) and Granger & Kane (2004) these effect sizes relates to growths of about 2 years for the period 2011 – 2012 and more than 2.5 years for the period 2011 – 2013 and 2011 to 2014. These growths indicate a large positive impact of mentoring mathematics teachers on student achievement.

6.5 Conclusion

From the interpretation of the results it can be concluded that the mentoring of mathematics teachers had a large positive impact on student achievement in mathematics. The large positive impacts were achieved from the first year after mentoring started, and were still present 3 years after mentoring started.

Chapter 7

Findings on the impact of mentoring physical sciences teachers on student achievement in physical sciences

This chapter focuses on the data used for the physical sciences analysis and the presentation, discussion and interpretation of the results of the data analysis. The impact of mentoring physical sciences teachers on student achievement (as informed by the conceptual framework) in physical sciences, are also discussed.

7.1 Data physical sciences

Data level questions:

What are the gr 12 physical sciences final examination pass rates and average percentages (average marks) in the UFS SPP schools for the years 2010, 2011, 2012, 2013 and 2014?

What are gr 12 physical sciences final examination pass rates and average percentages (average marks) in the matched (non-mentored) schools for the years 2010, 2011, 2012, 2013 and 2014?

How do the mentored and non-mentored data compare for the same years?

See appendix III for the documentation of the data used.

7.2 Presentation of results physical sciences

Mentoring started during 2012. The mentoring time up till the end of 2014 is, therefore, equal to 3 years. 2011 data were taken as baseline data.

Table 7 represent the properties of the data distribution for physical sciences for the years 2010 to 2014. The means, standard deviations, minimum and maximum values and medians for pass rates, average percentages, number of students that wrote accounting, size of schools and the number of teachers in the sample schools are represented in the table.

Physical sciences		Year									
		2010		2011		2012		2013		2014	
		Intervention		Intervention		Intervention		Intervention		Intervention	
		Control	Project	Control	Project	Control	Project	Control	Project	Control	Project
Pass rates project and control schools	N	18	18	18	18	18	18	18	18	18	18
	Mean	39.9	33.8	47.1	39.6	56.5	56	64.8	68.1	60.3	57.9
	Std	18.2	19.5	20.7	19.9	17.9	25.5	20.7	23.7	21.6	24.5
	Min	6.9	1.9	12.5	14.6	21.4	18	27.7	22.2	7.4	12.5
	Median	39.3	29.9	51.4	35.8	61.8	51.7	64.8	71.7	63.9	59.6
	Max	68.8	70.8	85.7	81.3	93.5	96.2	98.2	100	91.7	88.9
Average % (average marks)	N	18	18	18	18	18	18	18	18	18	18
	Mean	29.8	27.2	31.2	29.1	34.9	34.9	36.5	38.5	33.5	32.9
	Std	5.9	6.1	5.7	6	6.6	9.2	6.4	8.4	6.5	11.2
	Min	19.2	16.8	21.1	19.7	24.3	21.1	26.5	26.9	17.3	0
	Median	30.8	25.9	31.9	27.7	35.3	35.2	36.4	38.4	33.5	33.9
	Max	39.4	39.2	38.2	39.1	52.6	52.2	50.9	56.1	45.3	46.5
Students that wrote PS	N	18	18	18	18	18	18	18	18	18	18
	Mean	47.6	49.7	45	42.8	34.8	33.6	38.3	25.3	42.1	34
	Std	29.9	28.1	28.4	25.8	19.4	20.4	20.5	13	27	22.5
	Min	11	9	7	12	8	12	9	6	8	8
	Median	38.5	45	38.5	38.5	31	28.5	36.5	25.5	32.5	35
	Max	117	107	126	115	76	90	87	47	113	99

Table 7. Descriptive statistics for physical sciences 2010 to 2014.

7.2.1 Presentation of descriptive analysis pass rates physical sciences

See paragraph 4.3 in chapter 4 for statistical methods used.

Figure 62 represents the standard deviation and range of the pass rates of physical sciences for the period 2011 to 2014.

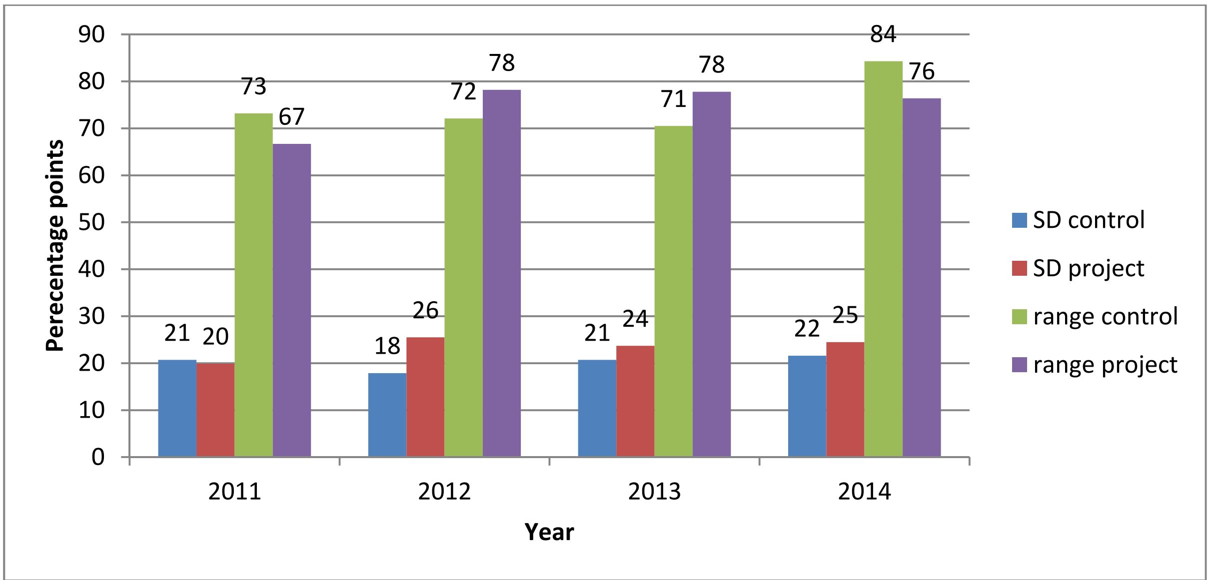

Figure 62. Distribution of pass rates physical sciences 2011 to 2014

Figure 63 represents the skewness of the physical sciences pass rates for the period 2011 to 2014. Pearson's measure of skewness was used.

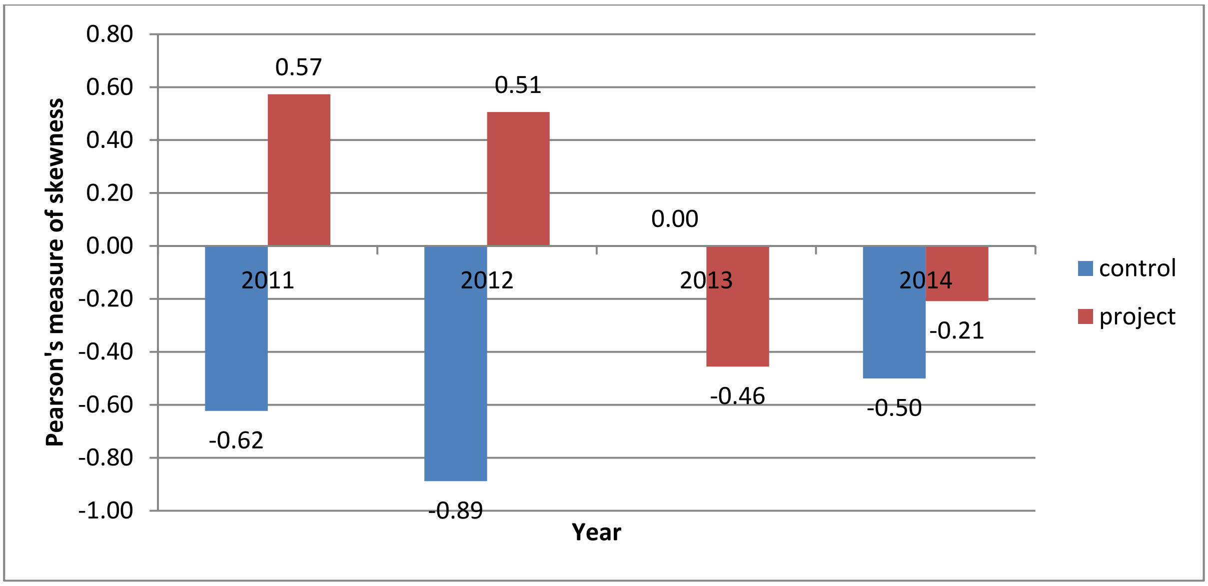

Figure 63. Skewness of pass rates physical sciences 2011 to 2014

Figure 64 represents the physical sciences mean pass rates of the control and project schools for the years 2010 to 2014.

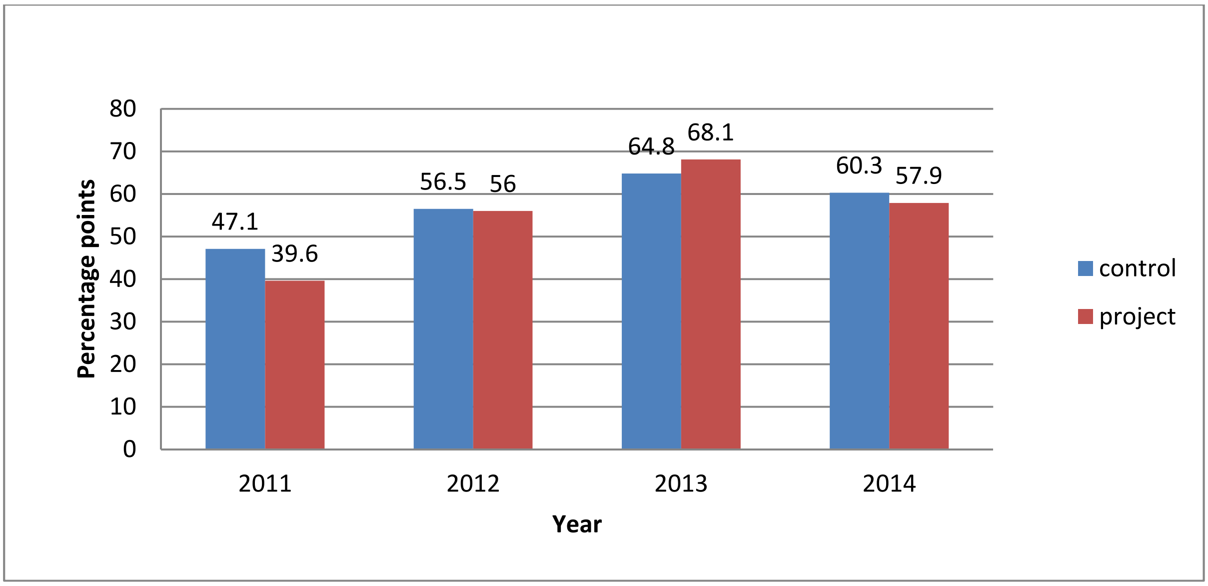

Figure 64. Mean pass rates physical sciences 2011 to 2014

In figure 65 the changes in physical sciences mean pass rates, with 2011 as baseline, of the project and control schools are indicated. The scores were obtained by subtracting the score obtained in 2011 from the score obtained in the specific year.

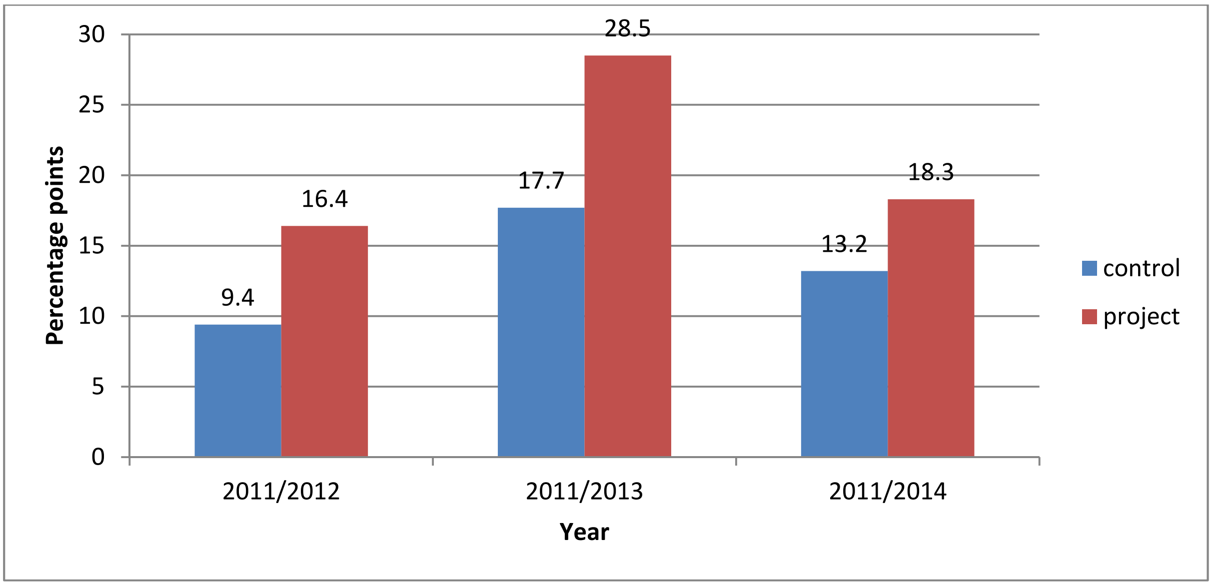

Figure 65. Changes in mean pass rates with 2011 as baseline physical sciences 2012 to 2014

Figure 66 represents the differences in change in mean pass rates, with 2011 as baseline, between project and control schools for the period 2012 to 2014.

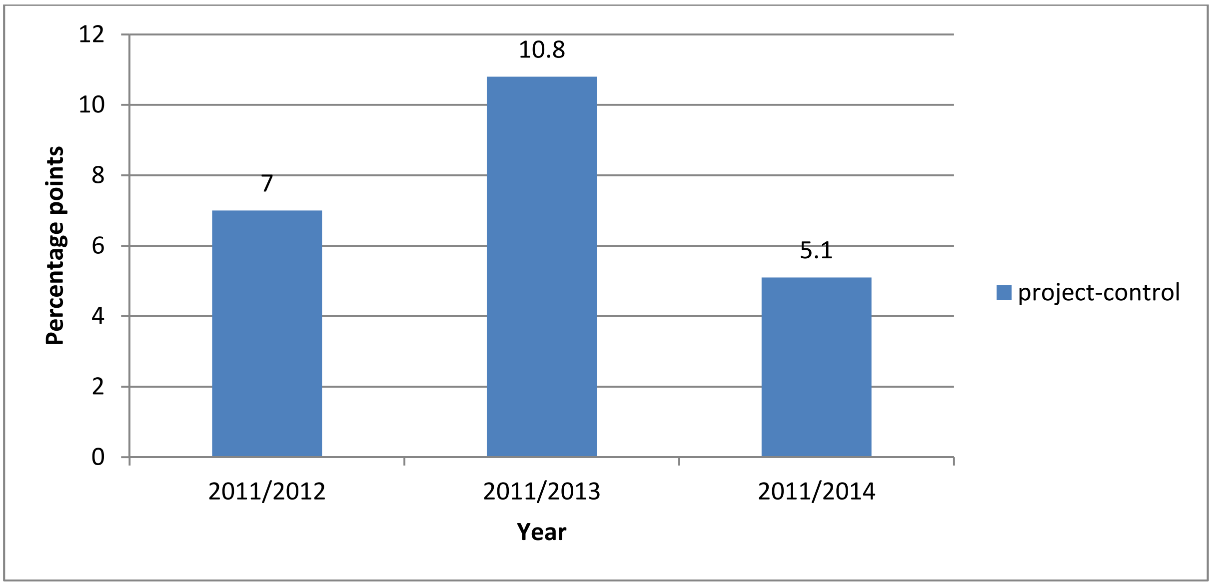

Figure 66. Differences in change in mean pass rates physical sciences 2012 to 2014

Figure 67 represents the physical sciences median pass rates of the project and control schools for the years 2011 to 2014.

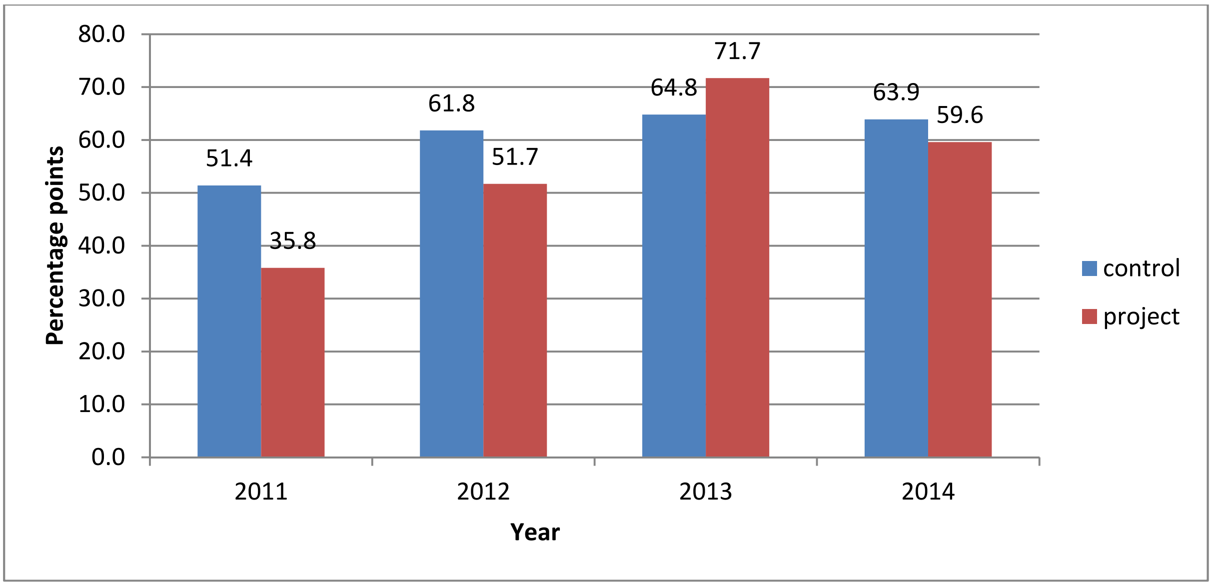

Figure 67. Median pass rates physical sciences 2011 to 2014

Figure 68 represents the changes in physical sciences median pass rates, with 2011 as baseline, of the project and control schools for the period 2012 to 2014. The scores were obtained by subtracting the score obtained in 2011 from the score obtained in the specific year.

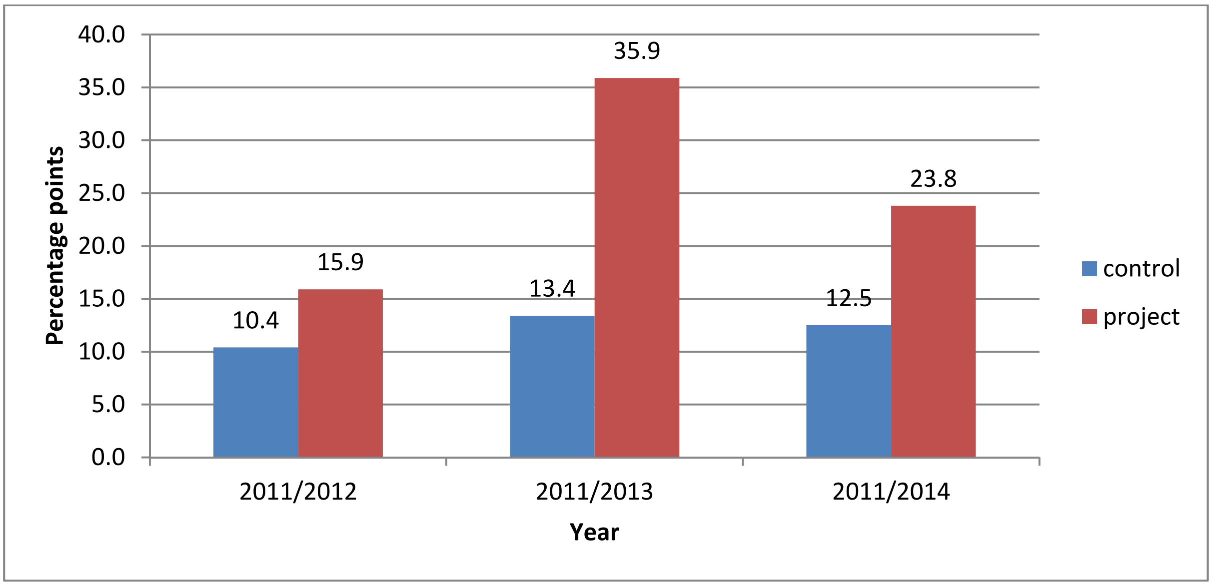

Figure 68. Change in median pass rates with 2011 as baseline physical sciences 2012 to 2014

Figure 69 represents the differences in change in median pass rates between project and control schools for the period 2012 to 2014.

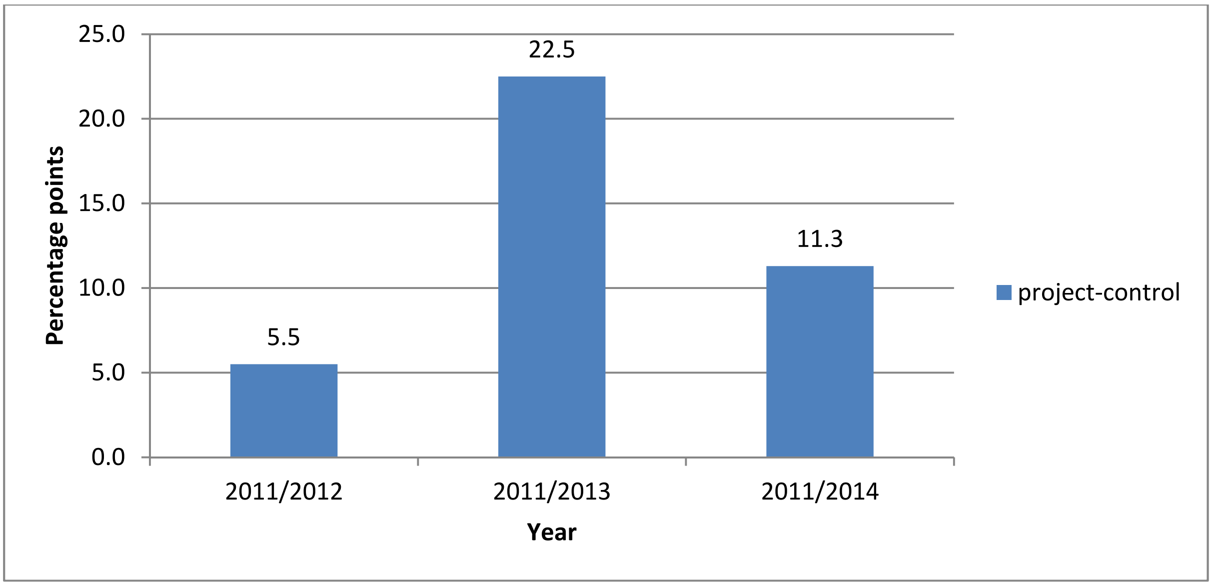

Figure 69. Differences in change in median pass rates physical sciences 2012 to 2014

Figure 70 represents the physical sciences minimum and maximum pass rates of the project and control school for the years 2011 to 2014.

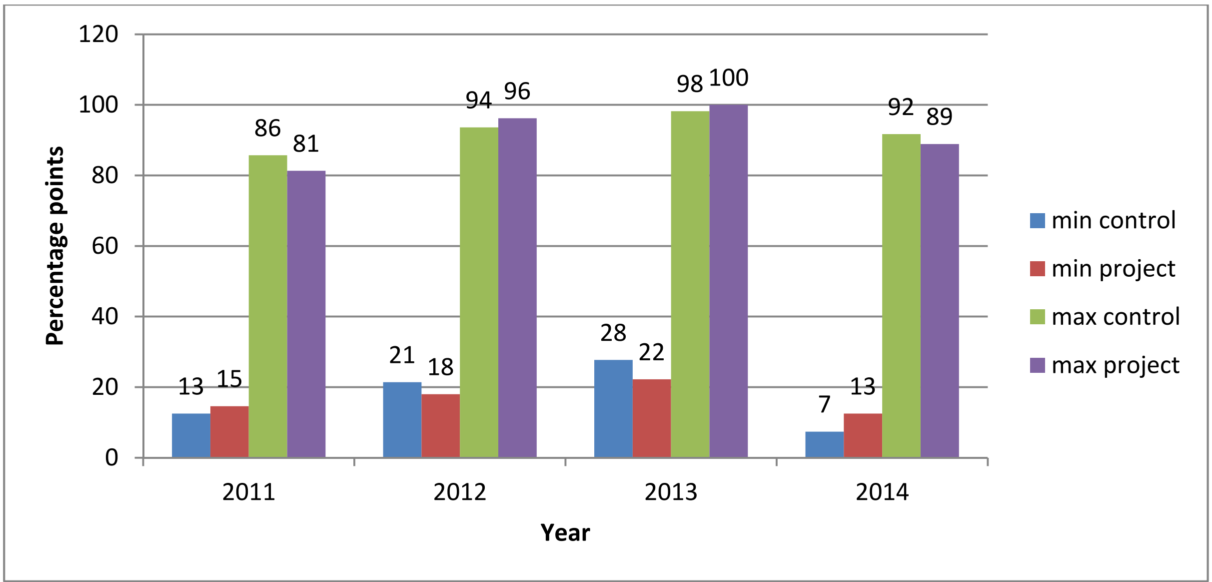

Figure 70. Minimum and maximum pass rates physical sciences 2011 to 2014

Figure 71 represents a summary of the descriptive statistics of pass rates physical sciences for the period 2011 to 2014.

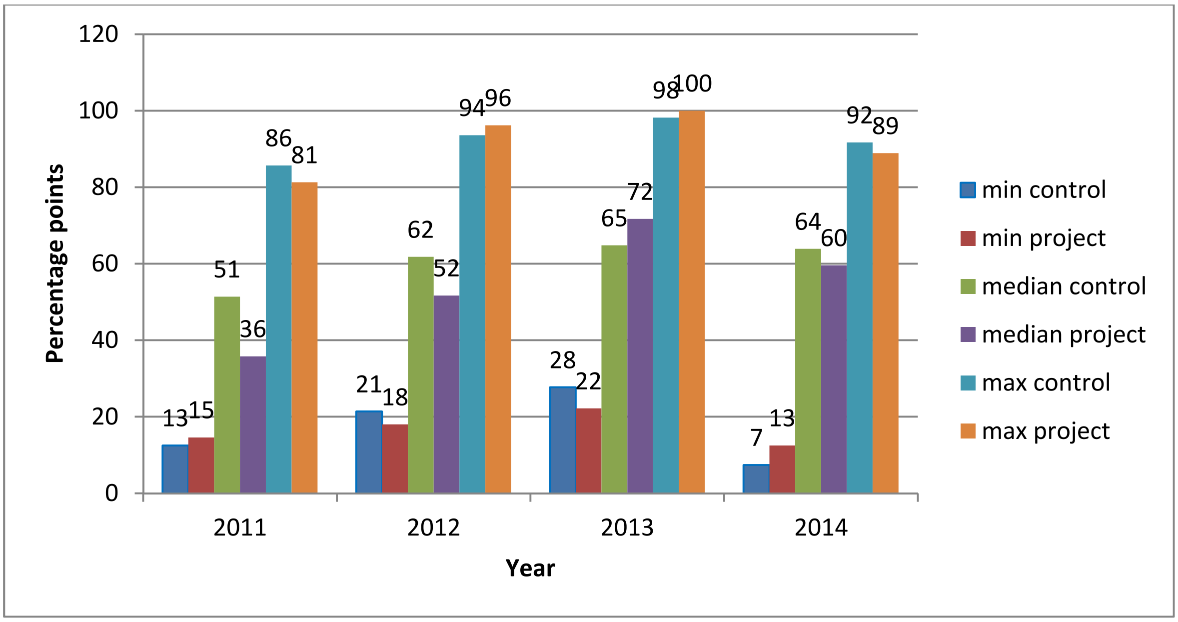

Figure 71. Summary descriptive statistics pass rates physical sciences 2011 to 2014

7.2.2 Presentation of inferential analysis pass rates physical sciences

Table 8 represents the results of a logistic regression analysis done on the physical sciences pass rates data with project versus control and matched pair as fixed effects and pre-project pass rates (2010/2011) as covariate. Based on the logistic regression the mean pass rates per year in the project and control groups were estimated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratio and associated p-values.

Subject	Year	Project Pass Rates (%)	Control Pass Rates (%)	Comparison		
				Odds ratio	95% CI for odd ratio	p-value (statistical significance)
Physical Sciences	2012	55.0	55.2	1.0	0.6 to 1.7	0.9752
Physical Sciences	2013	75.0	65.7	1.6	0.8 to 3.0	0.1726
Physical Sciences	2014	54.3	61.5	0.7	0.4 to 1.6	0.4316

Table 8. Comparison of model estimated (logistic regression) pass rates and odds ratios physical sciences for the years 2012 – 2014.

Figure 72 represents the differences between the logistic regression estimated mean pass rates of physical sciences of the project and control schools for the period 2012 to 2014.

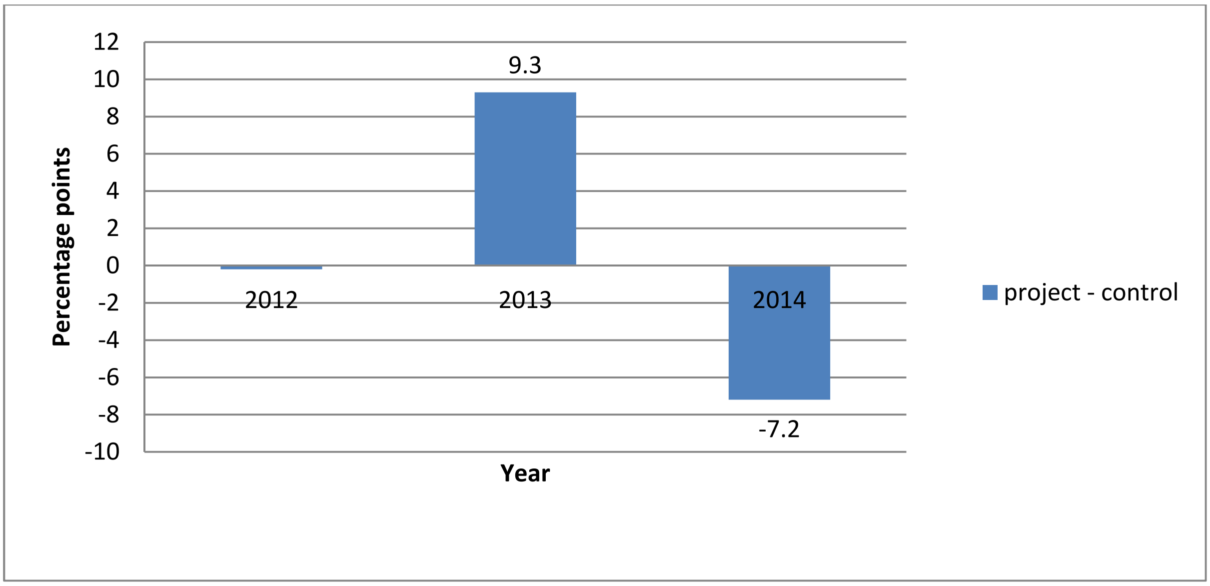

Figure 72. Differences in model estimated (logistic regression) mean pass rates physical sciences 2012 to 2014

Figure 73 represents the logistic regression estimated odds ratios for the mean pass rates of physical sciences and the 95% confidence interval for the odds ratios for the period 2012 to 2014.

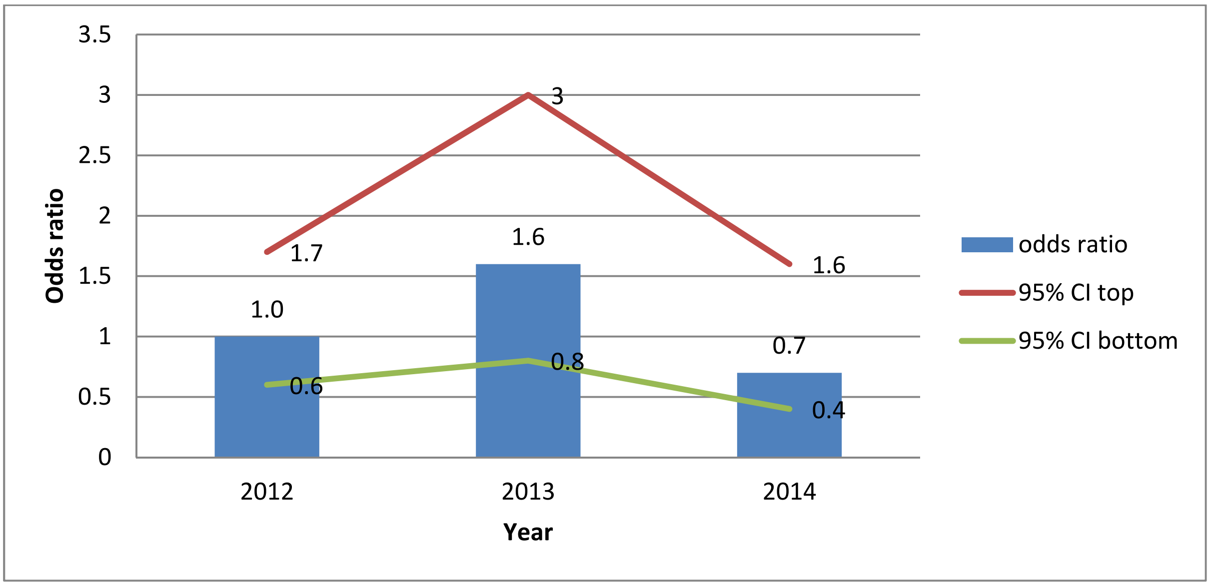

Figure 73. Model estimated (logistic regression) odds ratios mean pass rates physical sciences 2012 to 2014

Figure 74 represents the impacts on mean pass rates of physical sciences for the periods 2011 to 2012, 2011 to 2013 and 2011 to 2014. The effect size (Cohen's d) of each period was determined by dividing the differences between the change in mean pass rates of the project schools and that of the control schools by the pooled standard deviation of the means of 2011.

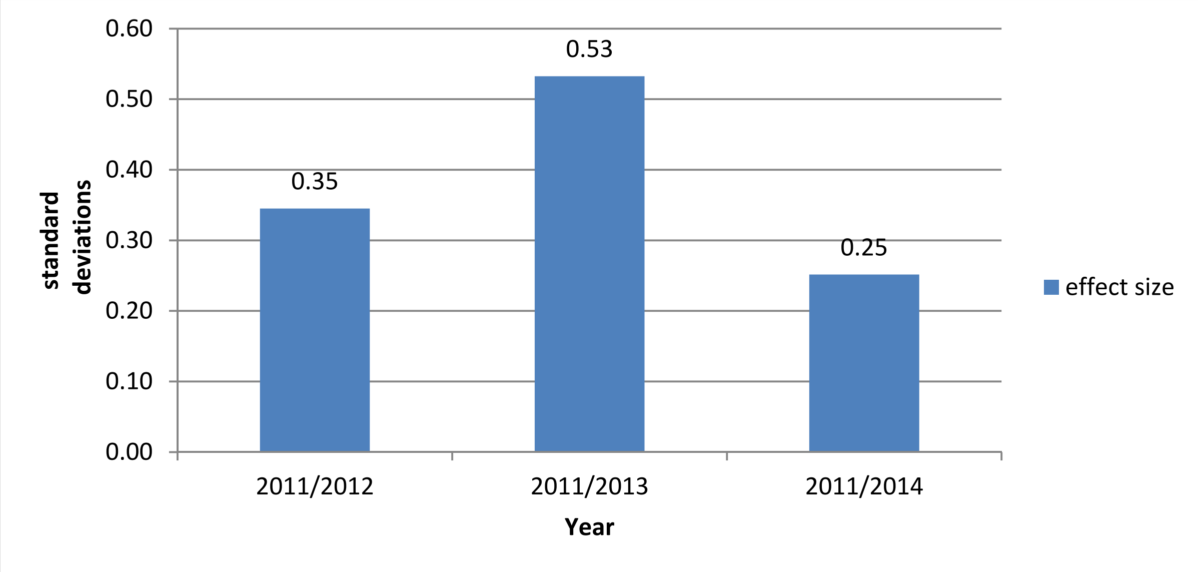

Figure 74. Impacts on pass rates physical sciences 2012 to 2014

7.2.3 Presentation of descriptive analysis average percentages physical sciences

Figure 75 represents the standard deviation and range of the physical sciences average percentages for the years 2011 to 2014.

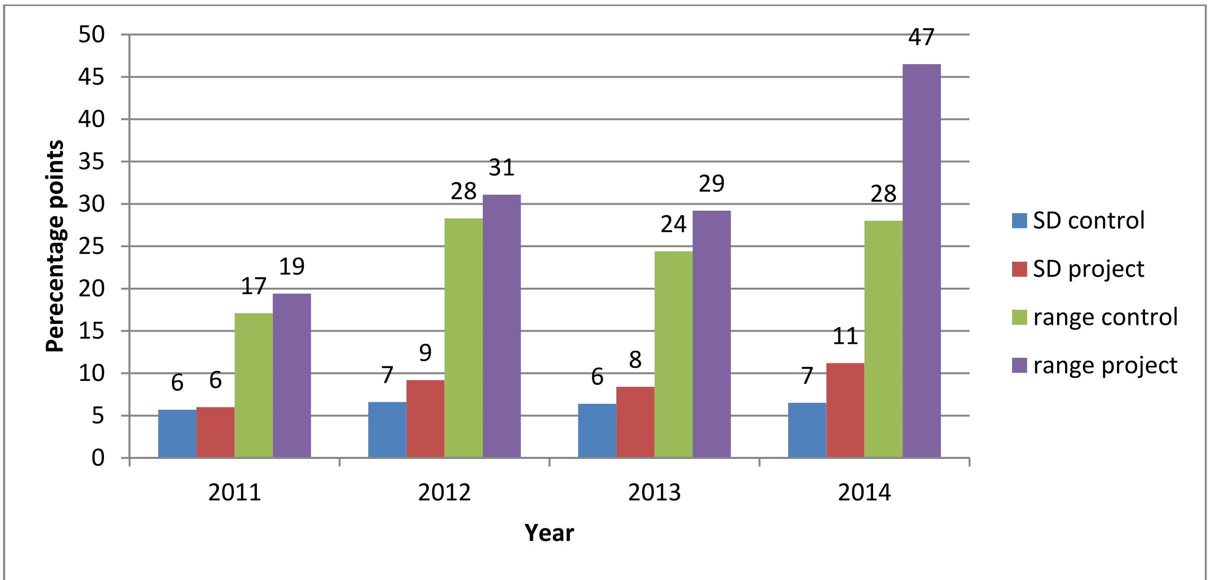

Figure 75. Distribution of average percentages physical sciences 2011 to 2014

Figure 76 represents the skewness of the physical sciences average percentages for the years 2011 to 2014. Pearson's measure of skewness was used.

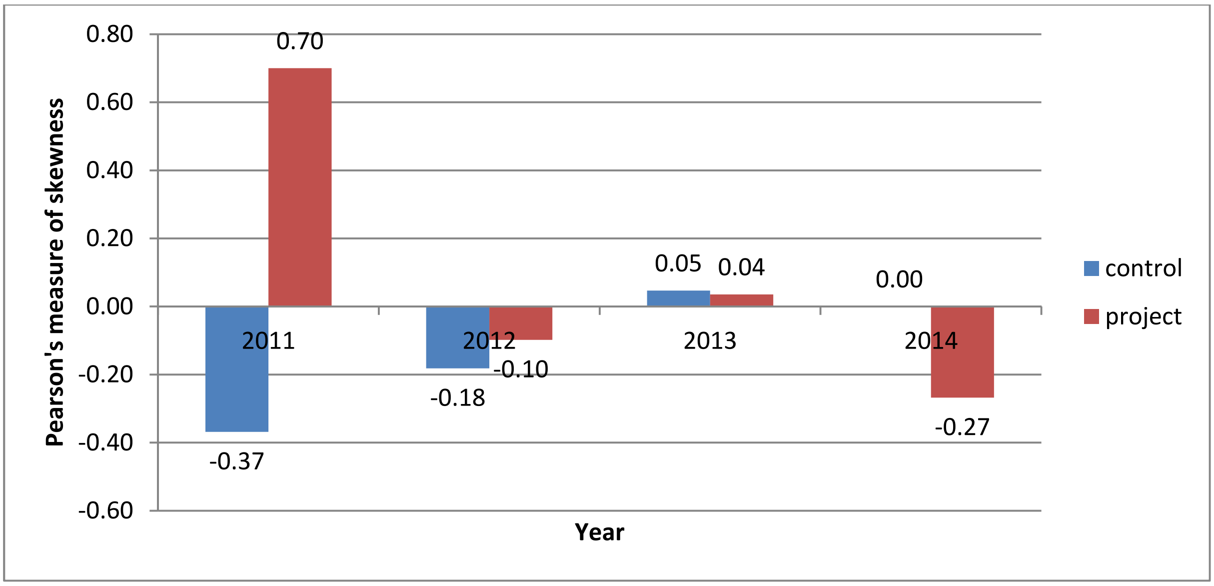

Figure 76. Skewness of average percentages physical sciences 2011 to 2014

Figure 77 represents the physical sciences mean average percentages of the project and control schools for the years 2011 to 2014.

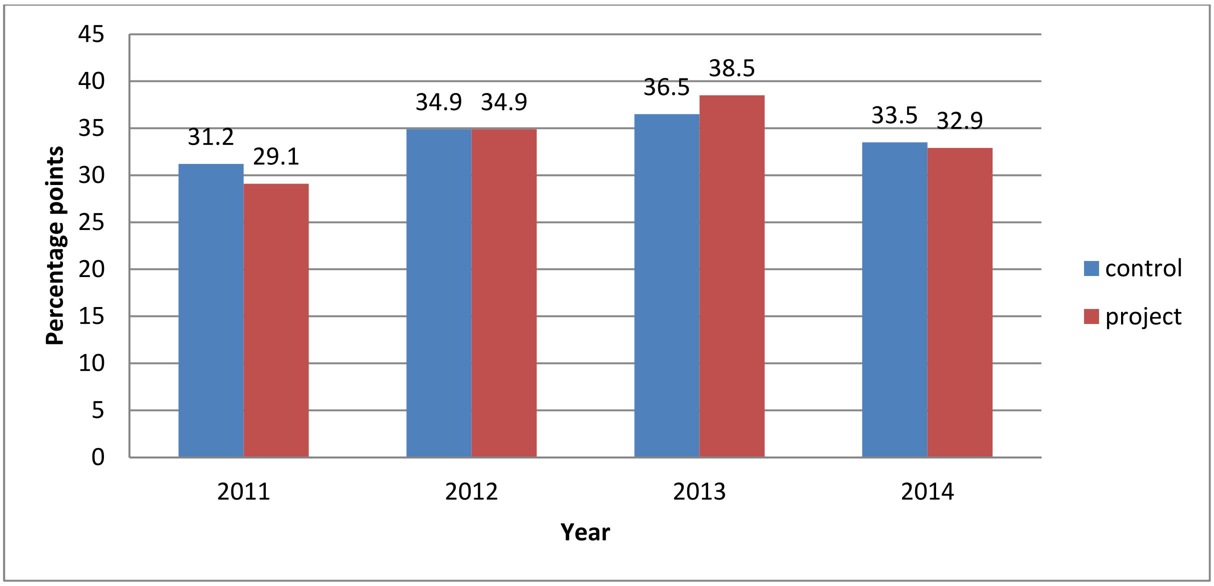

Figure 77. Mean average percentages physical sciences 2011 to 2014

Figure 78 represents the changes in physical sciences mean average percentages, with 2011 as baseline, for the period 2012 to 2014. The changes were calculated by subtracting the mean average percentages of 2011 from the mean average percentages of the specific year.

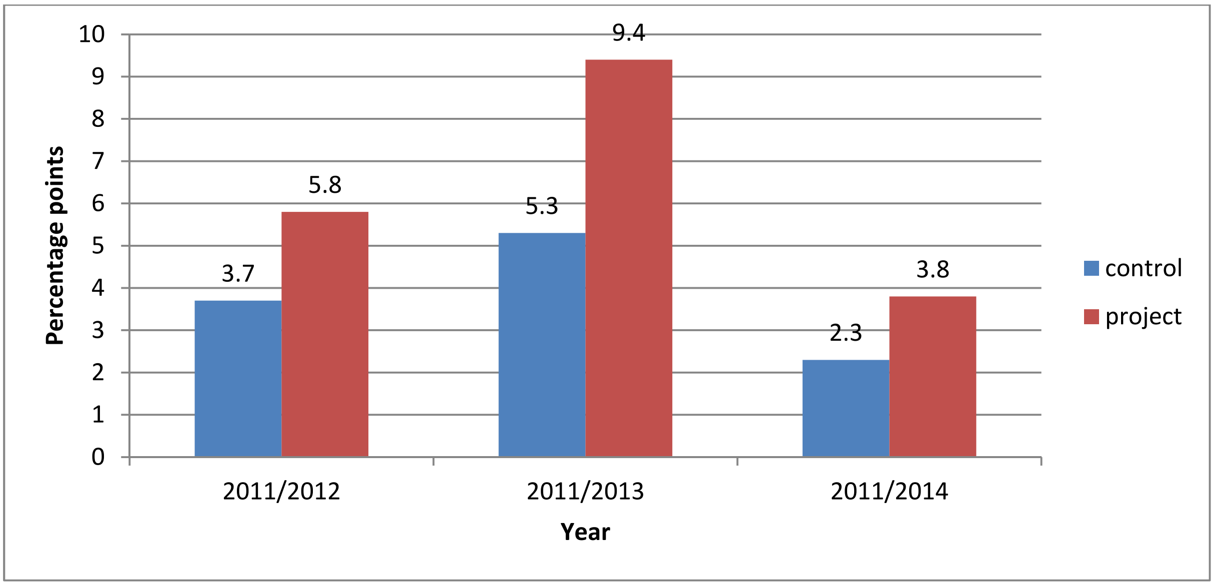

Figure 78. Change in mean average percentages with 2011 as baseline physical sciences 2012 to 2014

Figure 79 represents the differences in change in mean average percentages between project and control schools for the period 2012 to 2014.

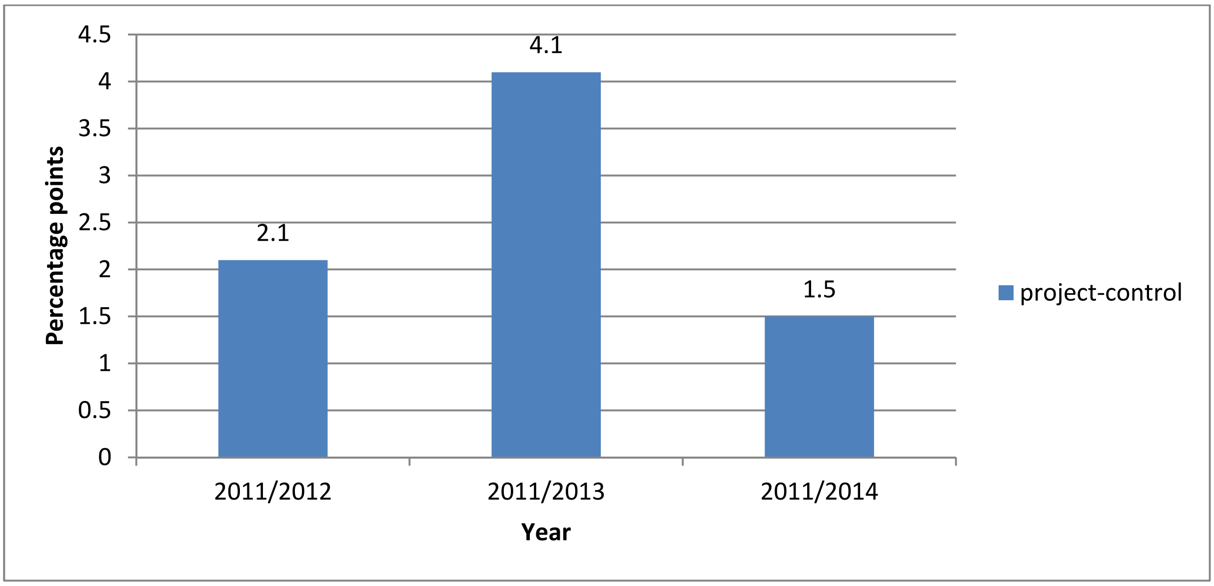

Figure 79. Differences in change in mean pass rates physical sciences 2012 to 2014

Figure 80 represents the physical sciences median average percentages of the project and control schools for the years 2011 to 2014.

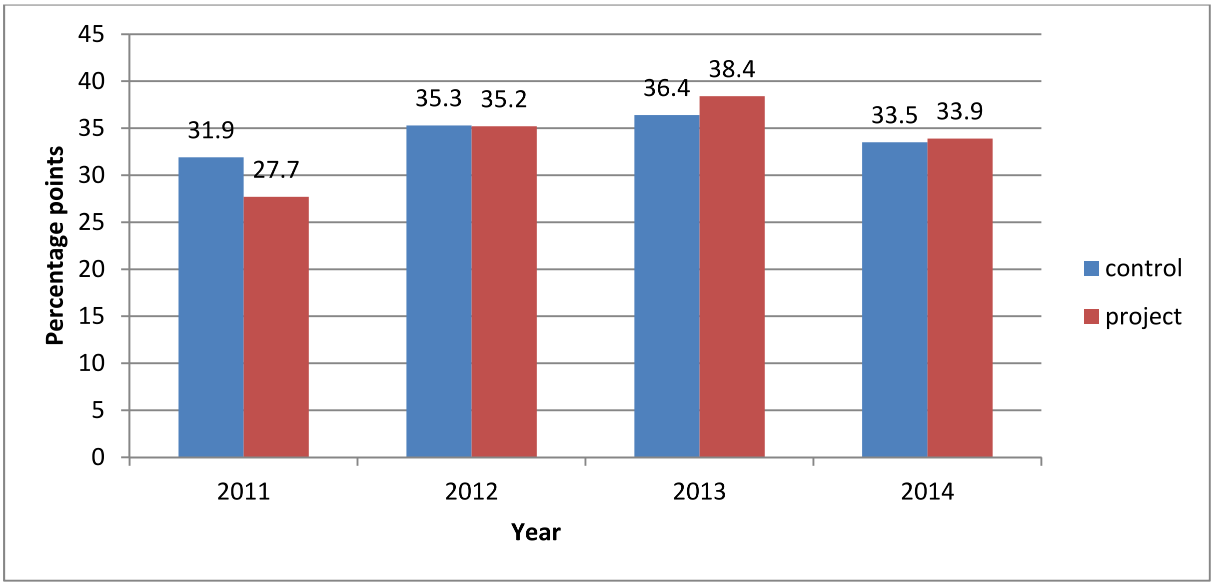

Figure 80. Median average percentages physical sciences 2011 to 2014

Figure 81 represents the changes in physical sciences median average percentages, with 2011 as baseline, for the period 2012 to 2014. The changes were calculated by subtracting the mean average percentages of 2011 from the mean average percentages of the specific year.

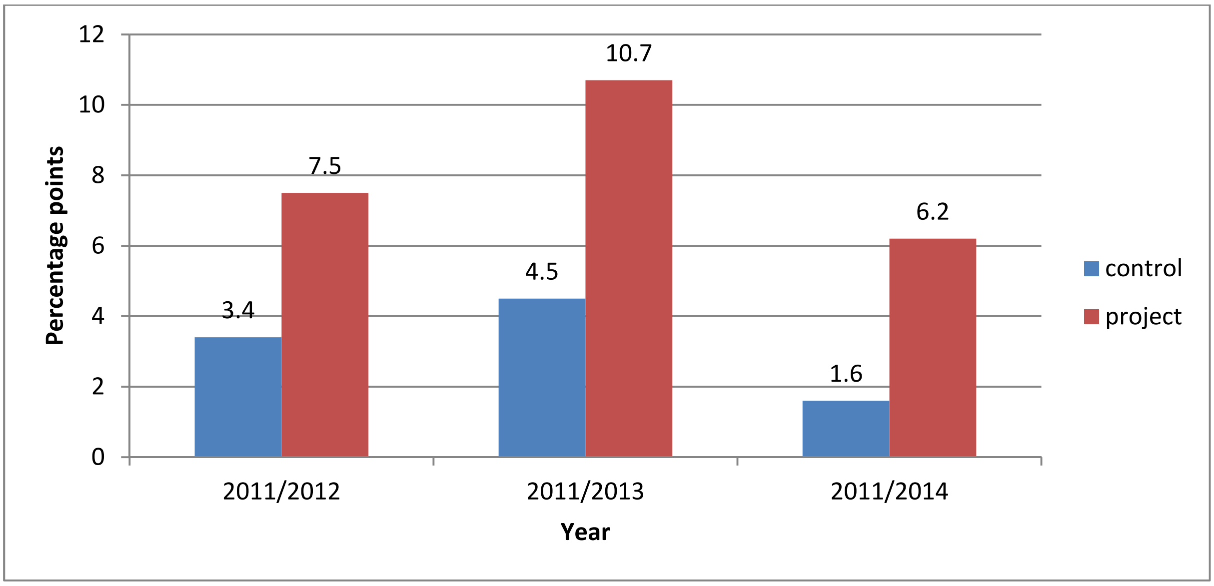

Figure 81. Changes in median average percentages, with 2011 as baseline, physical sciences

Figure 82 represents the differences in change in median average percentages, with 2011 as baseline, between project and control schools for the period 2012 to 2014.

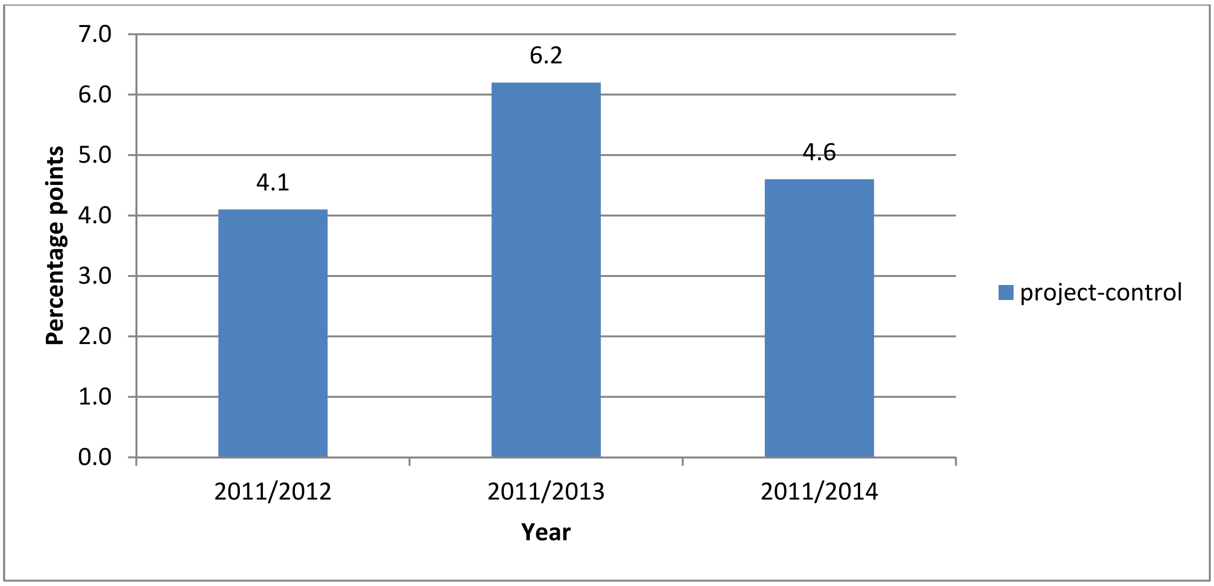

Figure 82. Differences in change in median average percentages physical sciences 2012 to 2014

Figure 83 represents the physical sciences minimum and maximum average percentages of the project and control school for the years 2011 to 2014.

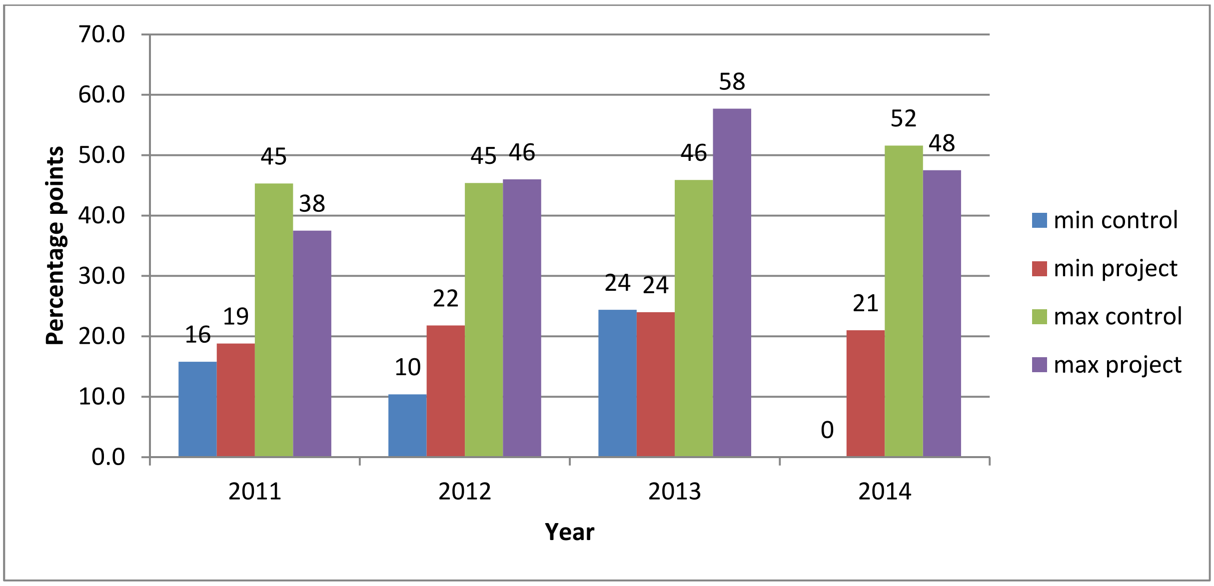

Figure 83. Minimum and maximum average percentage physical sciences 2011 to 2014

Figure 84 provides a summary of the descriptive statistics for physical sciences average percentages 2011 to 2014.

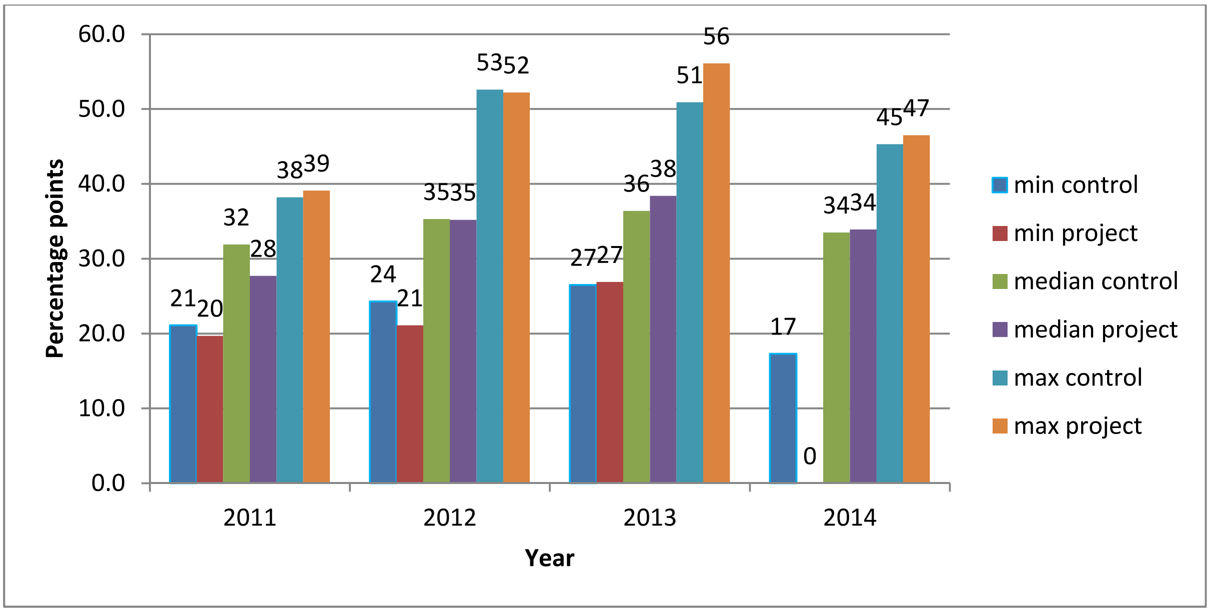

Figure 84. Summary descriptive statistics average percentages physical sciences 2011 to 2014

7.2.4 Presentation of inferential analysis average percentages physical sciences

Subject	Year	Project mean average marks (%)	Control mean average marks (%)	Comparison		
				Difference "Project – Control"	95% Confidence interval for difference	p-value (statistical significance)
Physical Sciences	2012	34.3	33.8	0.5	-4.3 to 5.3	0.8370
Physical Sciences	2013	39.2	35.8	3.5	-0.3 to 7.3	0.0708
Physical Sciences	2014	30.5	34.5	-4.1	-10.8 to 2.7	0.2191

Table 9. Comparison of model estimated (ANCOVA) mean average percentages for physical sciences for the years 2012 – 2014

Figure 85 represents the ANCOVA estimated physical sciences mean average percentages of the project and control schools for the period 2012 to 2014.

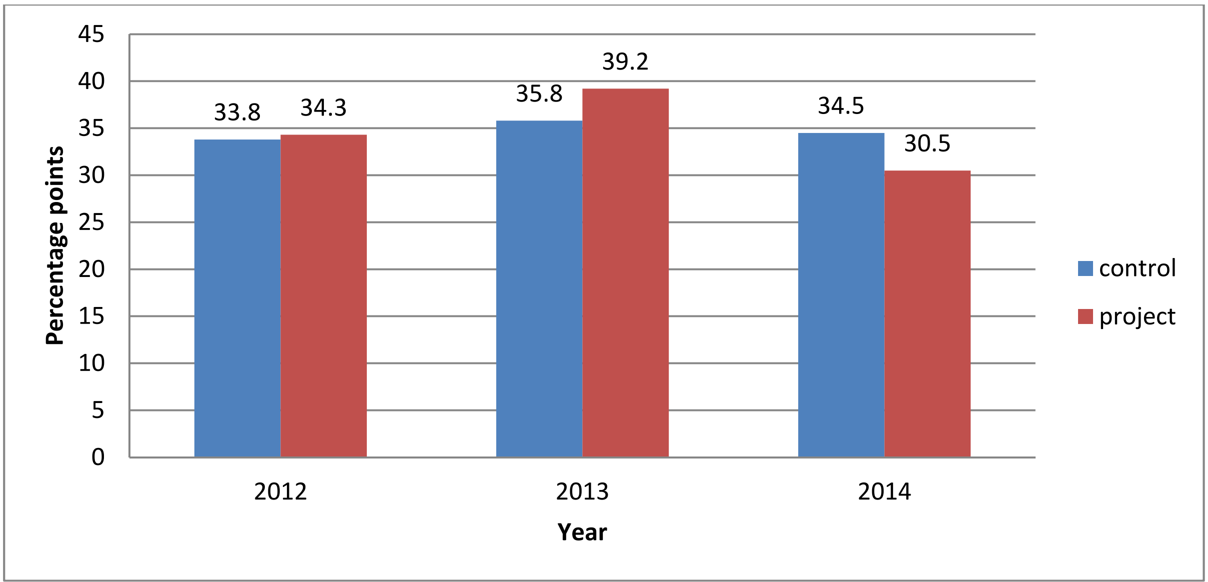

Figure 85. Model estimated (ANCOVA) mean average percentages physical sciences 2012 to 2014

Figure 86 shows the differences in the ANCOVA estimated physical sciences mean average percentages between the project and control schools for the period 2012 to 2014.

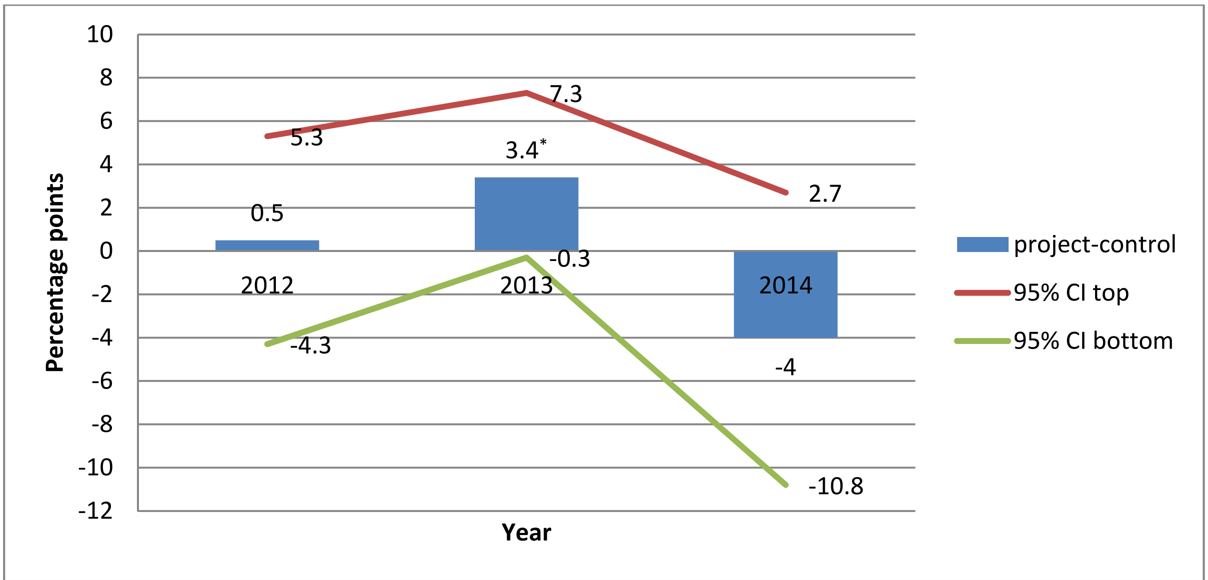

Figure 86. Model estimated (ANCOVA) differences in mean average percentages physical sciences 2012 to 2014. *Treatment-control difference is significantly different from zero at the 0.07 level.

Figure 87 represents the impacts on mean average percentages of physical sciences for the periods 2011 to 2012, 2011 to 2013 and 2011 to 2014. The effect size (Cohen's d) of each period was determined by dividing the differences between the change in mean average percentages of the project schools and that of the control schools by the pooled standard deviation of the means of 2011.

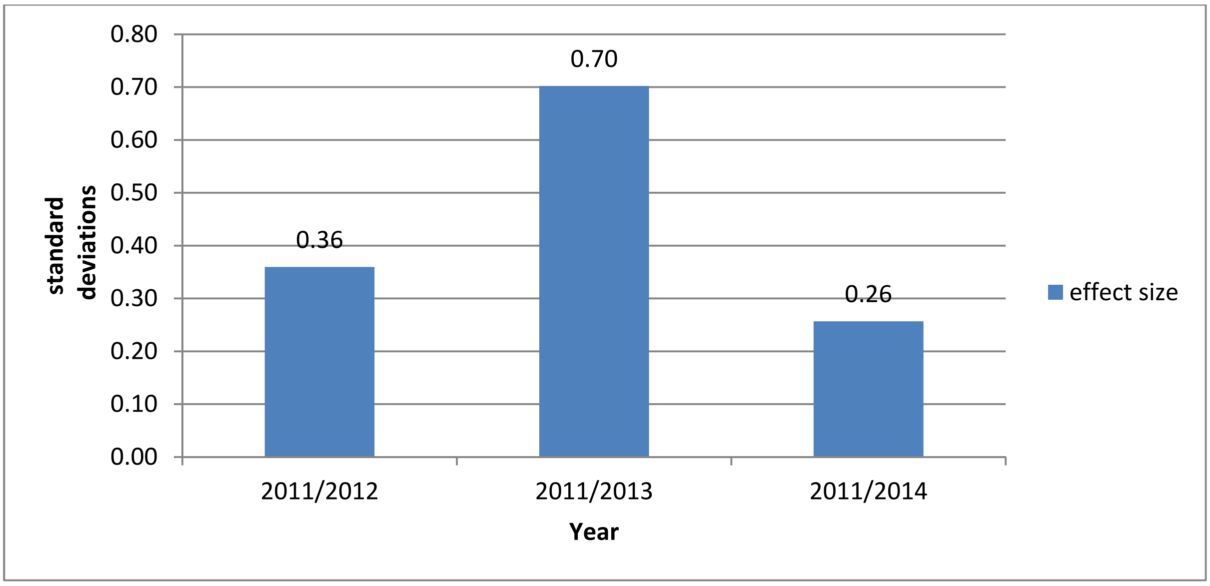

Figure 87. Impacts on average percentages physical sciences 2012 to 2014

7.2.5 Presentation of descriptive analysis students that wrote physical sciences

Figure 88 provides a summary of the analysis of the students that wrote physical sciences for the period 2011 to 2014.

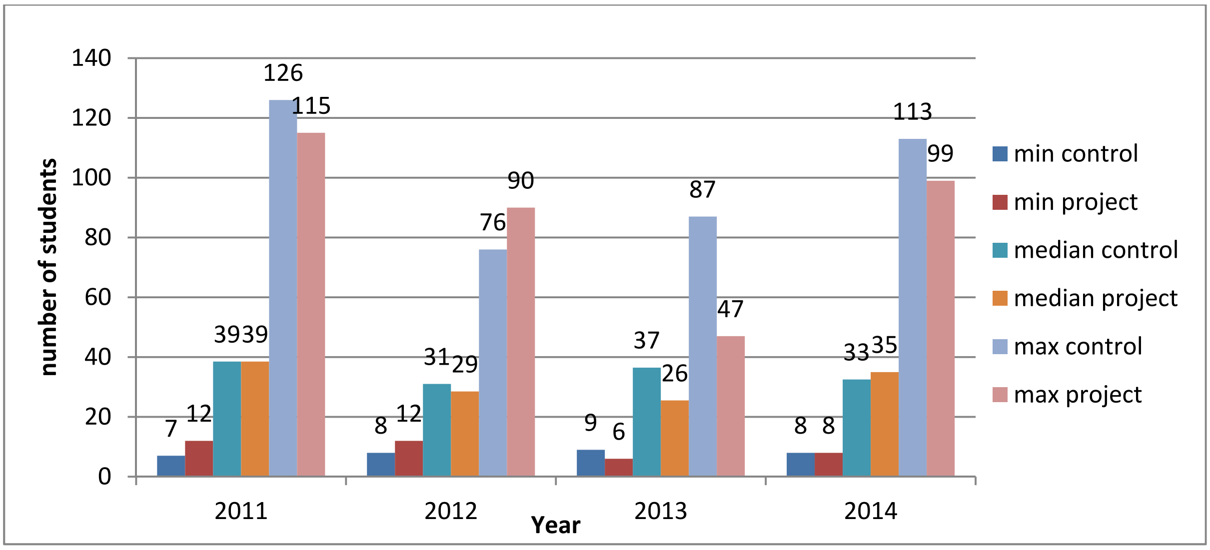

Figure 88. Summary of analysis of students that wrote physical sciences 2011 to 2014

7.3 Discussion of results by research question

7.3.1 Secondary research question #3

What is the impact of mentoring physical science teachers in the UFS SPP on student achievement in physical science?

7.3.2 Discussion of results of descriptive analysis pass rates physical science by research question #3

The pass rates were highly variable. That can be derived from figure 62. The standard deviation ranged from 17.9 to 25.5 percentage points and the range from 66.7 to 84.3 percentage points. The skewness of the pass rates was determined by using Pearson's measure of skewness. As can be seen from figure 63 the mean pass rates data were skewed ranging from -0.89 to 0.57.

The project schools started off at a lower mean pass rates base (39.6 percentage points for 2011) than the control schools (47.1 percentage points for 2011), but achieved higher mean pass rates for all the years 2012 to 2014 (see figure 64). The changes in mean pass rates between that of the different years and that of 2011 for the project schools, were larger than that of the control schools for all the periods (see figure 65). From figure 66 it can be derived that the differences in changes in mean pass rates, with 2011 as baseline, between the project schools and the control schools were equal to 7.0 percentage points for the period 2011 to 2012, 10.8 percentage points for the period 2011 to 2013 and 5.1 percentage points for the period 2011 to 2014. This figures for the physical sciences mean pass rates indicate that the mentoring of mathematics teachers had a large positive effect on the mathematics mean pass rates and, therefore, on student achievement in mathematics in the mentored schools.

The changes for the project schools in median pass rates between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 68). From figure 69 it can be derived that the differences in change in median pass rates between the project schools and the control schools for the period 2011 to 2012 were equal to 5.5 percentage points, 2011 to 2013 equal to 22.5 percentage points and 2011 to 2014 equal to 11.3 percentage points. This figures for the physical sciences median pass rates indicate that the mentoring of physical sciences teachers had a large positive effect on physical sciences median pass rates and, therefore, on student achievement in physical sciences in the mentored schools.

From figure 70 it can be concluded that some of the project schools achieved a 100 percent pass rate in 2013. None of the control schools managed to achieve a 100 percent pass percentage in the period 2012 to 2014. The differences in change in maximum pass rates of the project schools and that of the control schools with 2011 as baseline were 7.0 percentage points for 2012, 6.2 percentage points for 2013 and 1.6 percentage points for 2014. The differences in change in minimum pass rates of the project schools and that of the control schools with 2011 as baseline were -5.5 for 2012, -7.6 for 2013 and 3.0 percentage points for 2014. From this differences it can be concluded that the mentoring of mathematics teachers had a positive impact on the maximum pass rates of the project schools and, thus, on the student achievement in mathematics.

7.3.3 Discussion of results of inferential analysis pass rates physical sciences by research question #3

Figure 72 represents the logistic regression estimated differences in mean pass rates between the project and control schools. The differences ranged between -0.7.2 to 9.3 percentage points. By using this differences the odds ratios for the mean pass rates were calculated. In order to compare the project with the control group, odds ratios of passing in the project group relative to the control group were estimated, together with 95% confidence intervals for the odds ratio and associated p-values. The odds ratios ranged between 0.7 and 1.6. The 95% confidence interval's lower values ranged between 0.4 and 0.6 and the top values between 1.6 and 3.0 (see figure 73).

The effect sizes were 0.35 for the period 2011 to 2012, 0.53 for 2010 to 2013 and 0.25 standard deviations for 2010 to 2014 (see figure 74). The effect sizes for all the different periods were all positive, indicating that the mentoring of physical sciences teachers had a positive impact on physical sciences mean pass rates and, therefore, on student achievement in physical sciences.

7.3.4 Discussion of results of descriptive analysis average percentages physical sciences by research question #3

The average percentages were highly variable. That can be derived from figure 75. The standard deviation ranged from 5.7 to 11.2 percentage points and the range from 17.1 to 46.5 percentage points. The skewness of the average percentages was determined by using

Pearson's measure of skewness. As can be seen from figure 76 the average percentages data were skewed ranging from -0.37 to 0.70.

The project schools started off at a lower mean average percentage base (29.1 percentage points for 2011) than the control schools (31.2 percentage points for 2011), but achieved higher mean average percentages for all the years except 2014 (see figure 77). The changes in mean average percentages of the project schools between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 78). From figure 79 it can be seen that the differences in change in mean average percentages, with 2011 as baseline, between the project schools and the control schools were equal to 2.1 percentage points for the period 2011 to 2012, 4.1 percentage points for the period 2011 to 2013 and 1.5 percentage points for the period 2011 to 2014. This figures for the physical sciences mean average percentages indicate that the mentoring of physical sciences teachers had a positive effect on physical sciences mean average percentages and, therefore, on student achievement in physical sciences in the mentored schools.

From figure 80 it can be seen that the project schools achieved higher median average percentages than the control schools for all the years although they started from a much lower base in 2011 (-4.2 percentage points). The change in median averages between the different years and that of 2011 were larger than that of the control schools for all the periods (see figure 81). From figure 82 it can be seen that the differences in change in median average percentages, with 2011 as baseline, between the project schools and the control schools were equal to 4.1 percentage points for the period 2011 to 2012, 6.2 percentage points for the period 2011 to 2013 and 4.6 percentage points for the period 2011 to 2014. This figures for the physical sciences median average percentages indicate that the mentoring of physical sciences teachers had a positive effect on physical sciences median average percentages and, therefore, on student achievement in physical sciences in the mentored schools.

From figure 83 it can be concluded that the differences in the increase in maximum mean average percentages of the project schools and that of the control schools, with 2011 as baseline, were 8.4 for 2011 - 2012, 19.6 for 2011 - 2013 and 3.7 percentage points for 2011 - 2014. The differences in the increase in minimum mean average percentages of the project schools and that of the control schools, with 2011 as baseline, were 8.4 for 2011 - 2012, -3.4 for 2011 - 2013 and 18.0 percentage points for 2011 - 2014. From this differences it can be conclude that the mentoring of physical sciences teachers had a positive impact on the minimum and maximum average percentages of the project schools and, thus, on the student achievement in physical sciences.

7.3.5 Discussion of results of inferential analysis average percentages physical sciences by research question #3

Figure 85 represents the ANCOVA estimated differences in mean average percentages between the project and control schools. In order to compare the project with the control group, differences between the estimated mean average percentages were calculated, together with 95% confidence intervals for the differences and associated p-values (see figure 86). The differences were equal to 0.5 percentage points for 2012, 3.4 percentage points for 2013 and -4.0 percentage points for 2014. The difference for 2013 is marginally significant ($p = 0.07$). The 95% confidence interval's lower values ranged between -10.8 and -0.3 and the top values between 2.7 and 7.3 percentage points.

The effect sizes were 0.36 for the period 2011 to 2012, 0.70 for 2010 to 2013 and 0.26 standard deviations for 2010 to 2014 (see figure 87). The effect sizes for the different periods were all positive, indicating that the mentoring of physical sciences teachers had a positive impact on the physical sciences mean average percentages and, therefore, on student achievement in physical sciences.

7.3.6 Discussion of results of descriptive analysis students that wrote physical sciences

From figure 88 it can be concluded that the mean number of students that wrote physical sciences in the project schools decreased from 39 in 2011 to 35 in 2014. This is equal to a decrease of 10.3%. In the control schools the number of students decreased from 39 in 2011 to 33 in 2014. This is equal to a decrease of 15.4%. The trend in the project schools and control schools are more or less the same. It can be concluded that the mentoring of physical sciences teachers did not have a positive impact on the number of students that wrote physical sciences from 2011 to 2014.

7.4 Concluding interpretations physical sciences

7.4.1 Pass rates

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median pass rates were also used in the comparison of pass rates results.

The differences between the changes in mean pass rates, with 2011 as baseline, between the project schools and the control schools ranged between 5.1 and 10.8 percentage points for the period 2012 to 2014. The differences between the changes in median pass rates, with 2011 as baseline, between the project schools and the control schools ranged between 5.5 and 22.5 percentage points for the period 2012 to 2014. The largest gain in mean pass rates (10.8 percentage points) was achieved in the period 2011 to 2013 and that in median pass rates (22.5 percentage points) also in the period 2011 to 2013. Thus, two years after mentoring started. These positive differences indicate a positive impact of mentoring physical sciences teachers on student achievement in physical sciences.

The odds ratios ranged between 0.7 and 1.6 indicating that the odds of passing physical sciences in a project school was 0.7 to 1.6 times better than the odds of passing in a control school for the period 2012 to 2014. The odds ratio of 2013 was equal to 1.6. This was achieved two years after mentoring started. The 95% confidence interval's lower values ranged between 0.4 and 0.8 and the top values between 1.6 and 3.0. 95% CI values lower than 1 are not desirable. None of the odds ratios was statistically significant at the 0.05 level. This could be due to the high variability of the pass rates.

The effect sizes were 0.35 for the period 2011 to 2012, 0.53 for 2010 to 2013 and 0.25 standard deviations for 2010 to 2014. The largest effect size was achieved in the period 2011 to 2013, thus, 2 years after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2011 to 2012 and 2011 to 2014 were medium and that of 2011 to 2013 was large.

These effect sizes compare very well to the effect sizes found in other studies discussed in section 5.4.1. According to Hattie (1992) and Granger & Kane (2004) the effect sizes relates to growths of 0.9 years for the period 2011 – 2012, 1.3 years for the period 2011 – 2013 and 0.6 years for the period 2011 to 2014. These growths indicate a large positive impact of mentoring physical sciences teachers on student achievement.

7.4.2 Average percentages

Because the median is insensitive to skewed or highly variable data (Cohen et al. 2007), the median average percentages were also used in the comparison of results.

The differences between the changes in mean average percentages, with 2011 as baseline, between the project schools and the control schools ranged between 1.5 and 4.1 percentage points for the period 2012 to 2014. The differences between the changes in median average percentages, with 2011 as baseline, between the project schools and the control schools ranged between 4.1 and 6.2 percentage points for the period 2012 to 2014. The largest gain in mean average percentage (4.1 percentage points) was achieved in the period 2011 to 2013 and that in median average percentage (6.2 percentage points) also in the period 2011 to 2013. Thus, two years after mentoring started. These positive differences indicate a positive impact of mentoring mathematics teachers on student achievement in mathematics.

The differences between the ANCOVA estimated mean average percentages were equal to 0.5 percentage points for 2012, 3.4 percentage points for 2013 and -4.0 percentage points for 2014. The largest difference (3.4 percentage points) was achieved in 2013, 2 years after mentoring started. The 95% confidence interval's lower values ranged between -10.8 and -0.3 and the top values between 2.7 and 7.3 percentage points. 95% CI values lower than zero are not desirable. None of the differences was statistically significant at the 0.05 level. The difference for 2013 is marginally significant ($p = 0.07$). This could be due to the high variability of the average percentages.

The effect sizes were 0.36 for the period 2011 to 2012, 0.70 for 2010 to 2013 and 0.26 standard deviations for 2010 to 2014. The largest effect size (0.70) was achieved in the period 2011 to 2013, thus, 2 years after mentoring started. According to the general guidelines for effect size (Salkind 2014), the effect sizes for the periods 2011 to 2012 and 2011 to 2014 were medium and that of 2011 – 2013 was large. These effect sizes compare very good with the effect sizes reported in other studies as indicated in section 5.4.1. According to Hattie (1992) and Granger & Kane (2004) the effect sizes relates to growths of 0.9 years for the period 2011 – 2012, 1.8 years for the period 2011 – 2013 and 0.7 years for the period 2011 to 2014. These growths indicate a large positive impact of mentoring physical sciences teachers on student achievement in physical sciences.

7.5 Conclusion

From the interpretation of the results it can be concluded that the mentoring of physical sciences teachers had a large positive impact on student achievement in physical sciences. The large positive impacts were achieved from the first year after mentoring started, and were still present 3 years after mentoring started.

Chapter 8

Conclusion on the impact of teacher mentoring on student achievement in disadvantaged schools

8.1 Key findings on the impact of mentoring teachers on student achievement

The purpose of this study was to determine the impact of mentoring of teachers in disadvantaged schools on student achievement in accounting, mathematics and physical sciences.

The mentoring of accounting, mathematics and physical sciences teachers had a large positive impact on the student achievement in these subjects. The positive impacts were achieved from the first year after mentoring started, and were still present until 4 years after mentoring started. It seems that the impact of the mentoring is not influenced by the settings of the disadvantaged poor-performing schools.

These findings agree with the findings of Thompson et al. (2004), Fletcher et al. (2008), Fletcher & Strong (2009) and Rockoff (2008) that found positive impacts on student achievement after one year of mentoring teachers. It, however, differs from the findings of Glazerman et al. (2010) that found no positive impacts on student achievement over three years of students of teachers that received only one year of mentoring. They found positive impacts on student achievement of students of teachers that were mentored for two years, but only at the end of the third year after mentoring started.

The size of the impacts found in this study is larger than most of the impacts found in previous research. I suspect that because of the very low base of performance in South African schools, intervention effects are likely to be more significant than in USA school systems that are reasonably stable and well-resourced. The model studied included the mentoring of principals by management mentors. That could also contribute to the impacts being larger than that achieved in previous research. The fact that a principal can have a large effect on student achievement is well-described in research literature.

The findings for accounting and mathematics were very similar, but the findings for physical sciences differed from them. I suspect that the national policy that grade 12 students are allowed to make only one subject change during their final year could contribute to this difference. In most project schools students that performed poor in mathematics in the March examination, are forced to change to mathematical literacy. I suspect that these students are normally the poor performers in physical sciences, but they cannot make another change and have to stay with physical sciences. The analysis of the students that wrote the different subjects clearly shows that the number of mathematics students is more or less the same than the number of physical sciences students, although quite a significant number of mathematics learners are studying accounting instead of physical sciences. This indicates that there are a significant number of physical sciences learners that do not study mathematics.

The size of the impacts found in previous research showed much larger effect sizes for mathematics than for reading. I suspect that because of the fact that students' reading skills are tested more extensively in physical sciences than in mathematics and accounting, the impact on student achievement in physical sciences should be smaller.

8.2 Relating findings to theory

According to Fullan's change theory, a change in school context can be achieved by learning in context. A change in school context gives rise to accomplished teaching (Fullan 2006) and accomplished teaching, in turn, gives rise to improved student learning and achievement (Linn et al. 2011). Learning in context can be facilitated by mentoring teachers (Tovey 1999). Therefore, mentoring of teachers can cause improved student achievement.

In retrospect, the large positive impacts that the mentoring of teachers had on the student achievement in the researched subjects in mentored schools, support this theory.

8.3 Significance of the research

8.3.1 Intellectual significance

Researchers questioned the generalizability of previous research on the impact of mentoring on student achievement in disadvantaged poor-performing schools as well as the magnitude of these impacts. This study shows that the mentoring of teachers has a large positive impact on student achievement in disadvantaged poor-performing schools in all contexts.

Contradictory findings in the research literature with regards to the time that it takes to get meaningful improvement in student achievement after teacher mentoring started as well as the length of mentoring needed to achieve meaningful improvement in student achievement in disadvantaged, poor-performing schools, are cleared by the findings of this study. The study finds that there is no delay in the impact that mentoring of teachers has on student achievement and that it not necessary to mentor teachers for at least two years to get significant impacts on student achievement as suggested by Glazerman et al. (2010). Large positive impacts appeared from the first year after mentoring started and were still achieved after 3 to 4 years.

8.3.2 Practical significance

The findings of the study indicate that the mentoring of teachers in disadvantaged poor-performing schools yields large positive impacts on student achievement. Mentoring of teachers can, therefore, be used to improve student achievement in disadvantaged poor-performing schools in all settings. The model offers practical ideas as to how to turn around the performance of teachers, students and schools in disadvantaged communities.

8.3.3 Social justice significance

Many students are not performing to their innate potential just because they have to attend disadvantaged poor-performing schools. This study shows that this socially unjust situation can be changed by mentoring teachers so that they can assist students to perform to their potential. Mentoring of teachers can be used to better the results in the so-called gateway subjects with the result of more bachelor-passes. More bachelor-passes can contribute to more students getting access to tertiary education. Students with the innate potential to contribute to the country's development will get the opportunity to do so.

The findings of this study will convince governments, NGO's and the corporate world to invest in the mentoring of teachers in order to rectify this injustice.

8.4 Future research

Future research should focus on the intermediary variables in the conceptual framework which was not addressed in this study:

- The impact of mentoring on improved/accomplished teaching.
- The impact of improved/accomplished teaching on student learning.
- The impact of student learning on student achievement.

The impact of mentoring on bachelor-passes, overall passes and access to tertiary institutions can also be studied. The place of mentors and mentees in professional learning communities also needs exploration.

8.5 The limitations of the research

The pass rates and average percentages were skewed and highly variable. To deal with this median pass rates and average percentages were also used in the descriptive analysis of the results. The median analysis showed larger positive impacts than the mean analysis.

These properties of the data also gave rise to the fact that statistical significance was only achieved for certain years and only for average percentages. To deal with this effect sizes were also used to evaluate the impact of mentoring. According to Cohen et al. (2007) effect sizes are a much better way of reporting the magnitude of impacts in educational programs.

The effect sizes may be biased because: (1) they are based on the change from baseline. The baselines of the project schools were lower than that of the control schools. Some of the gains in the projects schools could partly be the result of regression to the mean; (2) the study sample was not a randomized sample. This was the result of the way in which the project schools were selected for the mentoring program. To deal with this limitation a concurrent, matched but non-randomized control study was used instead of a simple correlational design. This type of study yields more valid results than a simple correlational design. The generalizability is limited due to the study sample. The results are, however, useful to all similar populations.

I assumed that the principal, teacher and organizational effects, as well as class-to-teacher ratio, were the same in the project sample as in the control sample, because of the size and nature of the sample (the sample consisted of 68% of all the quintile 1 – 4 schools in the school district in which the research was conducted) and the high principal and teacher turnover in the project and control schools during the research period, which made it impossible to account for these effects. According to (Bamberger & White 2007), in a control study implemented over a sufficiently large sample with no contagion by the intervention, the only difference between the treatment and control groups on average is that the control group does not receive the intervention. The difference between the treatment group and control group can, therefore, be attributed to the impact of the intervention.

I also assumed that the mentoring of teachers will improve their teaching/classroom practices in order to become accomplished teachers and that accomplished teaching will improve student learning as well as student achievement. I based this assumption on the findings of Thompson et al. (2004), who found that the mentoring of teachers improved teaching, thus, the content knowledge, knowledge of teaching and learning as well as the commitment and professional values of teachers. Ingersoll & Strong (2011) also included this fact into their model of teacher development (see Figure 4 p26). Linn et al. (2011) indicated that accomplished teaching results in improved student learning and achievement.

The effect sizes and significance test statistics are likely to be underestimates because of the following factors:

- Higher quintile control schools had to be matched with lower quintile project schools in some matching pairs in order to stay in the same district.
- During 2014 the percentage of progressed learners in the project schools was about 10 percentage points higher than that in the control schools, which could have influenced the 2014 results of the project schools negatively.
- Contamination occurred during 2014. Control schools got mentored by another organization in the same subjects from the beginning of 2014. This could have influenced the results of the control schools for 2014 positively.
- The extent to which more effective teachers moved to more attractive teaching positions or even into school administration.
- The impacts achieved in physical sciences were lower than that of the other subjects. See discussion in paragraphs 5 and 6 of section 8.1 (p143).

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Appendices

Appendix I

Pairing of project and control schools

Pairs of schools for matched control study						
Pairs	Quintile	Type	Category	Learners	Teachers	L:T ratio
Pair 1						
Project school 1	Q1	Public	Ordinary Sec.	954	33	29
Control school 1	Q2	Public	Ordinary Sec.	867	32	27
Pair 2						
Project school 2	Q1	Public	Ordinary Sec.	542	22	25
Control school 2	Q1	Public	Ordinary Sec.	430	18	24
Pair 3						
Project school 3	Q1	Public	Ordinary Sec.	864	38	23
Control school 3	Q2	Public	Ordinary Sec.	960	36	27
Pair 4						
Project school 4	Q1	Public	Ordinary Sec.	1029	40	26
Control school 4	Q1	Public	Ordinary Sec.	1184	46	26
Pair 5						
Project school 5	Q1	Public	Ordinary Sec.	865	32	27
Control school 5	Q2	Public	Ordinary Sec.	961	35	27
Pair 6						
Project school 6	Q2	Public	Ordinary Sec.	1128	42	27
Control school 6	Q2	Public	Ordinary Sec.	1360	50	27
Pair 7						
Project school 7	Q2	Public	Ordinary Sec.	513	19	27
Control school 7	Q2	Public	Ordinary Sec.	354	12	30
Pair 8						
Project school 8	Q3	Public	Ordinary Sec.	560	23	24
Control school 8	Q3	Public	Ordinary Sec.	718	27	27
Pair 9						
Project school 9	Q3	Public	Ordinary Sec.	628	30	21
Control school 9	Q3	Public	Ordinary Sec.	802	30	27
Pair 10						
Project school 10	Q3	Public	Ordinary Sec.	1161	45	26
Control school 10	Q3	Public	Ordinary Sec.	1029	37	28
Pair 11						
Project school 11	Q3	Public	Ordinary Sec.	774	29	27
Control school 11	Q3	Public	Ordinary Sec.	928	35	27
Pair 12						
Project school 12	Q3	Public	Comp. Sec.	1262	47	27
Control school 12	Q3	Public	Comp. Sec.	1275	49	26

Pairs	Quintile	Type	Category	Learners	Teachers	L:T ratio
Pair 13						
Project school 13	Q3	Public	Ordinary Sec.	839	31	27
Control school 13	Q3	Public	Ordinary Sec.	1097	43	26
Pair 14						
Project school 14	Q3	Public	Ordinary Sec.	854	29	29
Control school 14	Q3	Public	Ordinary Sec.	1100	37	30
Pair 15						
Project school 15	Q3	Public	Combined	367	15	24
Control school 15	Q4	Public	Combined	478	23	21
Pair 16						
Project school 16	Q3	Public	Ordinary Sec.	1009	36	28
Control school 16	Q3	Public	Ordinary Sec.	1062	40	27
Pair 17						
Project school 17	Q4	Public	Ordinary Sec.	1312	40	33
Control school 17	Q4	Public	Ordinary Sec.	1333	42	32
Pair 18						
Project school 18	Q4	Public	Ordinary Sec.	655	29	23
Control school 18	Q4	Public	Agric. Sec.	681	29	23

Appendix II

Format in which data were received from the FSDOE

DISTRICT	Municipality	R	C	Centre name	SUBJECT	CANDIDATES		SUBJECT	AVERAGE % with CONDONEMENTS:		TOTAL CANDIDATES	TOT L7	T90-100	T80-89	TOT L6	TOT L5	TOT L4	TOT L3	TOT L2	T20-29	T10-19	T0-9	TOT L1
						TOTAL	ACIEVED	PASS%	EXCLUDED	INCLUDED	CONDONED	T80-100			T70-79	T60-69	T50-59	T40-49	T30-39				TL1
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Motheo					ACCN	7	5	71.43%	39.14	39.14	0	0	0	0	0	1	0	2	2	2	0	0	2
Motheo					ACCN	25	14	56.00%	33.88	33.88	0	0	0	0	0	1	1	6	6	9	2	0	11
Motheo					MATH	60	34	56.67%	31.72	31.75	1	0	0	0	1	3	7	9	13	10	14	3	27
Motheo					PHSC	35	27	77.14%	37.74	37.74	0	0	0	0	0	4	1	8	14	7	1	0	8
Motheo					ACCN	27	26	96.30%	59.26	59.26	0	5	2	3	0	7	6	8	0	1	0	0	1
Motheo					MATH	24	24	100.00%	57.79	57.79	0	2	0	2	6	1	7	4	4	0	0	0	0
Motheo					PHSC	18	12	66.67%	40.83	40.83	0	0	0	0	0	2	4	4	2	6	0	0	6
Motheo					ACCN	115	105	91.30%	51.24	51.25	1	11	2	9	11	10	20	35	17	10	0	1	11
Motheo					MATH	135	101	74.81%	38.76	38.76	0	2	0	2	6	10	9	21	53	26	7	1	34
Motheo					PHSC	103	92	89.32%	41.86	41.89	2	1	0	1	5	6	17	21	40	11	1	1	13
Motheo					ACCN	9	9	100.00%	47.89	47.89	0	0	0	0	0	1	3	3	2	0	0	0	0
Motheo					MATH	21	8	38.10%	27.19	27.19	0	0	0	0	0	0	2	3	3	6	7	0	13
Motheo					PHSC	14	12	85.71%	38.93	38.93	0	0	0	0	0	0	4	1	7	2	0	0	2
Motheo					ACCN	7	7	100.00%	47.14	47.14	0	0	0	0	0	1	2	2	2	0	0	0	0
Motheo					MATH	8	3	37.50%	26.63	26.63	0	0	0	0	0	0	2	0	1	1	3	1	5
Motheo					PHSC	5	1	20.00%	19.80	19.80	0	0	0	0	0	0	0	1	0	0	4	0	4
Motheo					ACCN	9	9	100.00%	82.11	82.11	0	5	1	4	4	0	0	0	0	0	0	0	0
Motheo					MATH	16	16	100.00%	57.06	57.06	0	1	0	1	2	5	3	3	2	0	0	0	0
Motheo					PHSC	13	13	100.00%	61.54	61.54	0	1	0	1	3	5	1	2	1	0	0	0	0
Motheo					ACCN	34	22	64.71%	36.06	36.12	1	0	0	0	1	0	3	10	7	11	2	0	13
Motheo					MATH	45	33	73.33%	41.07	41.07	0	3	1	2	1	3	4	11	11	7	4	1	12
Motheo					PHSC	61	47	77.05%	42.77	42.77	0	2	0	2	3	6	11	9	16	5	8	1	14
Motheo					ACCN	27	23	85.19%	41.96	42.07	2	1	0	1	1	1	4	6	8	6	0	0	6
Motheo					MATH	33	18	54.55%	32.09	32.12	1	0	0	0	0	3	1	4	9	10	5	1	16
Motheo					PHSC	24	13	54.17%	31.17	31.17	0	0	0	0	0	1	2	0	10	8	3	0	11
Motheo					ACCN	12	9	75.00%	47.92	47.92	0	0	0	0	1	2	2	4	0	2	1	0	3
Motheo					MATH	28	10	35.71%	28.36	28.36	0	0	0	0	1	0	0	8	1	9	9	0	18
Motheo					PHSC	33	12	36.36%	28.45	28.48	1	0	0	0	0	0	4	2	5	13	9	0	22
Motheo					ACCN	53	53	100.00%	79.75	79.75	0	29	12	17	13	7	2	2	0	0	0	0	0
Motheo					MATH	113	113	100.00%	71.89	71.89	0	38	12	26	29	24	15	7	0	0	0	0	0
Motheo					PHSC	85	85	100.00%	69.08	69.08	0	25	9	16	22	13	13	9	3	0	0	0	0
Motheo					ACCN	61	58	95.08%	59.72	59.72	0	10	4	6	8	12	14	9	5	2	1	0	3
Motheo					MATH	78	75	96.15%	55.60	55.60	0	6	0	6	13	13	15	18	10	3	0	0	3
Motheo					PHSC	48	42	87.50%	53.23	53.23	0	4	1	3	7	9	5	12	5	5	1	0	6
Motheo					ACCN	77	77	100.00%	71.48	71.48	0	30	6	24	16	13	9	5	4	0	0	0	0
Motheo					MATH	163	161	98.77%	62.19	62.20	1	25	2	23	34	38	25	28	10	1	1	1	3
Motheo					PHSC	125	119	95.20%	60.97	60.97	0	22	4	18	23	27	17	18	12	4	1	1	6
Motheo					ACCN	7	7	100.00%	42.00	42.00	0	0	0	0	0	0	2	2	3	0	0	0	0
Motheo					MATH	25	17	68.00%	33.88	33.88	0	0	0	0	0	0	0	9	8	6	2	0	8
Motheo					PHSC	25	24	96.00%	38.32	38.48	2	0	0	0	0	0	2	9	11	3	0	0	3
Motheo					MATH	49	14	28.57%	26.76	26.76	0	1	0	1	2	2	2	3	4	12	16	7	35
Motheo					PHSC	49	17	34.69%	27.65	27.80	4	1	0	1	0	2	3	4	3	21	14	1	36
Motheo					ACCN	54	47	87.04%	45.06	45.09	1	3	1	2	5	1	6	17	14	5	3	0	8
Motheo					MATH	100	43	43.00%	30.64	30.69	3	1	0	1	1	3	9	11	15	33	26	1	60
Motheo					PHSC	88	67	76.14%	38.44	38.53	6	1	1	0	2	7	5	16	30	25	2	0	27
Motheo					ACCN	8	6	75.00%	41.88	41.88	0	0	0	0	0	2	1	1	2	1	1	0	2
Motheo					MATH	22	21	95.45%	54.73	54.73	0	0	0	0	1	8	6	4	2	1	0	0	1
Motheo					PHSC	20	18	90.00%	46.80	46.90	1	0	0	0	2	3	1	9	2	3	0	0	3
Motheo					ACCN	59	59	100.00%	64.10	64.10	0	15	3	12	6	13	9	11	5	0	0	0	0
Motheo					MATH	90	90	100.00%	62.81	62.81	0	13	4	9	15	20	22	16	4	0	0	0	0
Motheo					PHSC	53	53	100.00%	68.28	68.28	0	19	6	13	6	10	11	4	3	0	0	0	0
Motheo					ACCN	12	11	91.67%	40.50	40.50	0	0	0	0	0	1	2	5	3	0	0	1	1
Motheo					MATH	13	5	38.46%	24.38	24.38	0	0	0	0	0	0	0	2	3	4	2	2	8
Motheo					PHSC	8	4	50.00%	26.00	26.00	0	0	0	0	0	0	0	0	4	2	1	1	4
Motheo					ACCN	24	18	75.00%	35.92	36.04	2	0	0	0	1	1	1	6	7	7	1	0	8
Motheo					MATH	56	18	32.14%	27.84	27.84	0	0	0	0	2	1	3	7	5	19	16	3	38
Motheo					PHSC	48	29	60.42%	36.15	36.19	1	2	1	1	0	2	6	5	13	15	4	1	20
Motheo					ACCN	16	14	87.50%	41.56	41.56	0	0	0	0	0	0	4	6	4	2	0	0	2
Motheo					MATH	33	16	48.48%	30.00	30.00	0	0	0	0	2	0	0	3	11	9	8	0	17
Motheo					PHSC	17	9	52.94%	32.76	32.76	0	0	0	0	1	1	0	2	5	5	3	0	8
Motheo					ACCN	8	7	87.50%	38.50	38.50	0	0	0	0	0	0	2	2	3	0	1	0	1
Motheo					MATH	39	13	33.33%	26.67	26.67	0	0	0	0	1	0	3	2	7	10	13	3	26
Motheo					PHSC	29	22	75.86%	37.31	37.34	1	0	0	0	1	1	3	7	9	7	1	0	8
Motheo					ACCN	24	16	66.67%	34.75	34.75	0	0	0	0	0	0	3	6	7	4	4	0	8
Motheo					MATH	78	13	16.67%	19.37	19.40	1	0	0	0	0	0	1	1	10	23	30	13	66
Motheo					PHSC	54	4	7.41%	17.30	17.30	0	0	0	0	0	0	0	2	2	10	37	3	50
Motheo					ACCN	45	45	100.00%	48.04	48.04	0	4	0	4	1	4	6	11	19	0	0	0	0
Motheo					MATH	71	46	64.79%	37.37	37.39	1	2	0	2	2	5	9	7	20	19	6	1	26
Motheo					PHSC	62	46	74.19%	38.26	38.27	1	1	0	1	1	4	5	13	21	15	1	1	17
Motheo					ACCN	42	41	97.62%	74.64	74.64	0	19	8	11	8	8	3	3	0	1	0	0	1
Motheo					MATH	58	58	100.00%	69.28	69.29	1	15	1	14	17	13	9	2	1	1	0	0	1
Motheo					PHSC	47	45	95.74%	61.36	61.36	0	8	2	6	11	6	8	6	6	2	0	0	2
Motheo					ACCN	19	15	78.95%	37.84	37.84	0	0	0	0	1	0	2	3	9	4	0	0	4
Motheo					MATH	25	19	76.00%	39.28	39.28	0	0	0	0	0	2	3	9	5	4	2	0	6
Motheo					PHSC	23	15	65.22%	33.83	33.83	0	0	0	0	0	1	0	6	8	6	2	0	8
Motheo					ACCN	9	9	100.00%	61.89	61.89	0	1	0	1	2	3	1	1	1	0	0	0	0
Motheo					MATH	14	14	100.00%	44.86	44.93	1	0	0	0	1	1	3	3	5	1	0	0	1
Motheo					PHSC	11	10	90.91%	46.36	46.36	0	0	0	0	1	1	1	4	3	1	0	0	1
Motheo					ACCN	40	36	90.00%	53.30	53.30	0	4	2	2	4	6	6	10	6	4	0	0	4
Motheo					MATH	28	25	89.29%	48.36	48.36	0	2	0	2	2	3	4	9	5	2	1	0	3
Motheo					PHSC	19	13	68.42%	44.89	44.89	0	3	1	2	1	1	1	2	5	4	2	0	6
Motheo					ACCN	36	36	100.00%	53.25	53.25	0	1	0	1	3	6	10	14	2	0	0	0	0
Motheo					MATH	41	23	56.10%	36.07	36.07	0	2	0	2	1	0	7	5	8	11	7	0	18
Motheo					PHSC	49	30	61.22%	33.61	33.65	1	0	0	0	1	2	2	10	14	18	2	0	20
Motheo					ACCN	51	50	98.04%	68.67	68.67	0	15	5	10	13	6	10	5	1	1	0	0	1
Motheo					MATH	103	102	99.03%	57.89	57.89	0	13	2	11	10	23	23	23	10	1	0	0	1
Motheo					PHSC	59	56	94.92%	61.14	61.14	0	11	5	6	12	8	9	11	5	3	0	0	3
Motheo					ACCN	23	23	100.00%	73.52	73.52	0	9	3	6	5	6	2	1	0	0	0	0	0
Motheo					MATH	41	41	100.00%	65.90	65.90	0	10	2	8	7	10	8	2	4	0	0	0	0
Motheo					PHSC	36	36	100.00%	63.33	63.33	0	7	4	3	5	8	9	4	3	0	0	0	0
Motheo					ACCN	13	13	100.00%	57.54	57.54	0	1	0	1	1	4	2	5	0	0	0	0	0
Motheo					MATH	54	38	70.37%	35.76	35.80	1	0	0	0	4	1	2	9	21	8	9	0	17
Motheo					PHSC	42	29	69.05%	35.33	35.40	3	0	0	0	1	2	3	3	17	14	2	0	16
Motheo					ACCN	11	11	100.00%	83.18	83.18	0	7	3	4	3	1	0	0	0	0	0	0	0
Motheo					MATH	36	36	100.00%	56.83	56.83	0	4	1	3	3	4	16	3	6	0	0	0	0
Motheo					PHSC	24	23	95.83%	56.79	56.79	0	2	1	1	4	4	6	4	3	1	0	0	1

Appendix III

Documentation of data

SUBJECT	YEAR	TOTAL MARK	ENTRIES	INCOMPLE	WROTE	PASS	FAIL	PASS %	FAIL %	AVG %	A-SYMBOLS	100%	SCHOOL NUMBER	QUINTILE	CATEGORY OF SCHOOL	DISTRICT	LEARNERS	TEACHERS	INTERVENTION	MATCHING
ACCN	2010	607	22	0	22	10	12	45.45%	54.55%	27.59	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
ACCN	2011	456	14	0	14	8	6	57.14%	42.86%	32.57	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
ACCN	2012	417	17	0	17	3	14	17.65%	82.35%	24.53	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
ACCN	2013	315	8	0	8	7	1	87.50%	12.50%	39.38	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
ACCN	2014				3	3		100.00%		41.00	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
MATH	2010	857	24	0	24	15	9	62.50%	37.50%	35.71	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
MATH	2011	397	13	0	13	5	8	38.46%	61.54%	30.54	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
MATH	2012	556	16	0	16	9	7	56.25%	43.75%	34.75	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
MATH	2013	786	22	0	22	12	10	54.55%	45.45%	35.73	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
MATH	2014				9	8		88.89%		41.22	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
PHSC	2010	940	24	0	24	17	7	70.83%	29.17%	39.17	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
PHSC	2011	447	13	0	13	7	6	53.85%	46.15%	34.38	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
PHSC	2012	609	16	0	16	10	6	62.50%	37.50%	38.06	1	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
PHSC	2013	733	21	0	21	12	9	57.14%	42.86%	34.90	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
PHSC	2014				9	8		88.89%		46.22	0	0	8	3	Ordinary Secondary	Motheo	560	23	Project	8
ACCN	2010	1489	60	2	58	18	40	31.03%	68.97%	25.67	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
ACCN	2011	647	26	0	26	6	20	23.08%	76.92%	24.88	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
ACCN	2012	538	17	0	17	8	9	47.06%	52.94%	31.65	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
ACCN	2013	1175	36	1	35	20	15	57.14%	42.86%	33.57	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
ACCN	2014				12	9		75.00%		47.92	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
MATH	2010	522	31	0	31	2	29	6.45%	93.55%	16.84	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
MATH	2011	319	17	0	17	2	15	11.76%	88.24%	18.76	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
MATH	2012	546	25	0	25	6	19	24.00%	76.00%	21.84	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
MATH	2013	577	24	0	24	5	19	20.83%	79.17%	24.04	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
MATH	2014				28	10		35.71%		28.36	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
PHSC	2010	919	52	0	52	1	51	1.92%	98.08%	17.67	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
PHSC	2011	929	41	0	41	6	35	14.63%	85.37%	22.66	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
PHSC	2012	822	39	0	39	7	32	17.95%	82.05%	21.08	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
PHSC	2013	725	27	0	27	6	21	22.22%	77.78%	26.85	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
PHSC	2014				33	12		36.36%		28.48	0	0	17	4	Ordinary Secondary	Motheo	1312	40	Project	17
ACCN	2010	423	13	0	13	8	5	61.54%	38.46%	32.54	0	0	15	3	Combined	Motheo	367	15	Project	15
ACCN	2011	375	12	0	12	7	5	58.33%	41.67%	31.25	0	0	15	3	Combined	Motheo	367	15	Project	15
ACCN	2012	224	6	0	6	5	1	83.33%	16.67%	37.33	0	0	15	3	Combined	Motheo	367	15	Project	15
ACCN	2013	418	12	0	12	7	5	58.33%	41.67%	34.83	0	0	15	3	Combined	Motheo	367	15	Project	15
ACCN	2014				10	7		70.00%		36.90	0	0	15	3	Combined	Motheo	367	15	Project	15
MATH	2010	296	9	0	9	5	4	55.56%	44.44%	32.89	0	0	15	3	Combined	Motheo	367	15	Project	15
MATH	2011	509	19	0	19	7	12	36.84%	63.16%	26.79	0	0	15	3	Combined	Motheo	367	15	Project	15
MATH	2012	336	14	0	14	3	11	21.43%	78.57%	24.00	0	0	15	3	Combined	Motheo	367	15	Project	15
MATH	2013	154	6	0	6	3	3	50.00%	50.00%	25.67	0	0	15	3	Combined	Motheo	367	15	Project	15
MATH	2014				13	8		61.54%		31.38	0	0	15	3	Combined	Motheo	367	15	Project	15
PHSC	2010	285	9	0	9	5	4	55.56%	44.44%	31.67	0	0	15	3	Combined	Motheo	367	15	Project	15
PHSC	2011	652	19	0	19	10	9	52.63%	47.37%	34.32	0	0	15	3	Combined	Motheo	367	15	Project	15
PHSC	2012	377	14	0	14	5	9	35.71%	64.29%	26.93	0	0	15	3	Combined	Motheo	367	15	Project	15
PHSC	2013	169	6	0	6	4	2	66.67%	33.33%	28.17	0	0	15	3	Combined	Motheo	367	15	Project	15
PHSC	2014				13	11		84.62%		35.00	0	0	15	3	Combined	Motheo	367	15	Project	15
ACCN	2010	1401	41	1	40	23	17	57.50%	42.50%	35.03	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
ACCN	2011	931	27	0	27	15	12	55.56%	44.44%	34.48	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
ACCN	2012	914	25	1	24	14	10	58.33%	41.67%	38.08	1	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
ACCN	2013	817	20	0	20	14	6	70.00%	30.00%	40.85	1	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
ACCN	2014				35	13		37.14%		27.66	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
MATH	2010	854	26	1	25	16	9	64.00%	36.00%	34.16	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
MATH	2011	807	29	0	29	12	17	41.38%	58.62%	27.83	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
MATH	2012	778	28	1	27	13	14	48.15%	51.85%	28.81	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
MATH	2013	635	20	0	20	10	10	50.00%	50.00%	31.75	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
MATH	2014				78	35		44.87%		27.72	1	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
PHSC	2010	1646	52	0	52	26	26	50.00%	50.00%	31.65	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
PHSC	2011	1278	43	0	43	16	27	37.21%	62.79%	29.72	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
PHSC	2012	1382	63	2	61	12	49	19.67%	80.33%	22.66	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
PHSC	2013	502	13	0	13	9	4	69.23%	30.77%	38.62	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
PHSC	2014				63	18		28.57%		26.63	0	0	9	3	Ordinary Secondary	Motheo	628	30	Project	9
ACCN	2010	2312	84	1	83	23	60	27.71%	72.29%	27.86	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
ACCN	2011	1457	41	0	41	31	10	75.61%	24.39%	35.54	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
ACCN	2012	1537	65	2	63	19	44	30.16%	69.84%	24.40	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
ACCN	2013	2041	70	3	67	29	38	43.28%	56.72%	30.46	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
ACCN	2014				24	18		75.00%		36.04	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
MATH	2010	1563	72	0	72	18	54	25.00%	75.00%	21.71	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
MATH	2011	851	42	1	41	8	33	19.51%	80.49%	20.76	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
MATH	2012	1206	39	0	39	15	24	38.46%	61.54%	30.92	2	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
MATH	2013	1557	58	0	58	21	37	36.21%	63.79%	26.84	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
MATH	2014				56	18		32.14%		27.84	0	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
PHSC	2010	2596	108	1	107	21	86	19.63%	80.37%	24.26	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
PHSC	2011	919	32	0	32	11	21	34.38%	65.63%	28.72	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
PHSC	2012	1152	34	0	34	17	17	50.00%	50.00%	33.88	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
PHSC	2013	1702	47	0	47	34	13	72.34%	27.66%	36.21	1	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
PHSC	2014				48	29		60.42%		36.19	2	0	12	3	Comprehensive Secondary	Motheo	1262	47	Project	12
ACCN	2010	1828	75	0	75	18	57	24.00%	76.00%	24.37	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
ACCN	2011	1307	48	0	48	13	35	27.08%	72.92%	27.23	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
ACCN	2012	2482	60	1	59	45	14	76.27%	23.73%	42.07	1	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
ACCN	2013	3197	71	1	70	54	16	77.14%	22.86%	45.67	5	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
ACCN	2014				58	26		44.83%		32.50	1	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
MATH	2010	1965	83	0	83	25	58	30.12%	69.88%	23.67	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
MATH	2011	2176	115	0	115	19	96	16.52%	83.48%	18.92	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
MATH	2012	1266	39	3	36	19	17	52.78%	47.22%	35.17	1	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
MATH	2013	1659	35	0	35	34	1	97.14%	2.86%	47.40	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
MATH	2014				42	24		57.14%		37.33	2	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
PHSC	2010	2071	83	0	83	19	64	22.89%	77.11%	24.95	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
PHSC	2011	2606	115	0	115	23	92	20.00%	80.00%	22.66	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
PHSC	2012	1453	39	3	36	24	12	66.67%	33.33%	40.36	1	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
PHSC	2013	1196	32	1	31	22	9	70.97%	29.03%	38.58	0	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3
PHSC	2014				41	18		43.90%		28.78	2	0	3	1	Ordinary Secondary	Motheo	864	38	Project	3

ACCN	2010	2164	76	1	75	24	51	32.00%	68.00%	28.85	1	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
ACCN	2011	1031	37	0	37	13	24	35.14%	64.86%	27.86	0	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
ACCN	2012	1437	33	0	33	25	8	75.76%	24.24%	43.55	3	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
ACCN	2013	3109	76	0	76	60	16	78.95%	21.05%	40.91	0	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
ACCN	2014				76	60		78.95%		44.07	3	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
MATH	2010	1651	74	1	73	20	53	27.40%	72.60%	22.62	0	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
MATH	2011	881	34	0	34	10	24	29.41%	70.59%	25.91	1	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
MATH	2012	788	19	0	19	14	5	73.68%	26.32%	41.47	0	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
MATH	2013	1499	26	0	26	25	1	96.15%	3.85%	57.65	4	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
MATH	2014				54	46		85.19%		44.59	2	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
PHSC	2010	2432	74	0	74	39	35	52.70%	47.30%	32.86	0	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
PHSC	2011	1917	72	0	72	24	48	33.33%	66.67%	26.63	1	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
PHSC	2012	1358	26	0	26	25	1	96.15%	3.85%	52.23	1	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
PHSC	2013	2021	36	0	36	36	0	100.00%	0.00%	56.14	4	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
PHSC	2014				37	32		86.49%		46.46	1	0	6	2	Ordinary Secondary	Motheo	1128	42	Project	6
ACCN	2010	300	12	0	12	3	9	25.00%	75.00%	25.00	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
ACCN	2011	704	22	0	22	11	11	50.00%	50.00%	32.00	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
ACCN	2012	457	9	0	9	7	2	77.78%	22.22%	50.78	1	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
ACCN	2013	230	5	0	5	5	0	100.00%	0.00%	46.00	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
ACCN	2014				16	14		87.50%		41.56	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
MATH	2010	366	11	1	10	7	3	70.00%	30.00%	36.60	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
MATH	2011	711	19	0	19	12	7	63.16%	36.84%	37.42	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
MATH	2012	1128	31	0	31	18	13	58.06%	41.94%	36.39	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
MATH	2013	611	20	0	20	11	9	55.00%	45.00%	30.55	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
MATH	2014				33	16		48.48%		30.00	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
PHSC	2010	614	22	2	20	9	11	45.00%	55.00%	30.70	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
PHSC	2011	1205	39	2	37	16	21	43.24%	56.76%	32.57	1	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
PHSC	2012	974	30	0	30	13	17	43.33%	56.67%	32.47	1	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
PHSC	2013	473	15	0	15	8	7	53.33%	46.67%	31.53	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
PHSC	2014				17	9		52.94%		32.76	0	0	13	3	Ordinary Secondary	Motheo	839	31	Project	13
ACCN	2010	610	27	1	26	2	24	7.69%	92.31%	23.46	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
ACCN	2011	317	9	1	8	5	3	62.50%	37.50%	39.63	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
ACCN	2012	364	11	0	11	5	6	45.45%	54.55%	33.09	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
ACCN	2013	429	13	0	13	9	4	69.23%	30.77%	33.00	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
ACCN	2014				13	10		76.92%		34.92	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
MATH	2010	822	53	1	52	6	46	11.54%	88.46%	15.81	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
MATH	2011	1036	46	0	46	9	37	19.57%	80.43%	22.52	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
MATH	2012	516	23	0	23	5	18	21.74%	78.26%	22.43	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
MATH	2013	612	23	0	23	7	16	30.43%	69.57%	26.61	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
MATH	2014				17	5		29.41%		24.29	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
PHSC	2010	781	39	0	39	4	35	10.26%	89.74%	20.03	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
PHSC	2011	954	40	0	40	7	33	17.50%	82.50%	23.85	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
PHSC	2012	548	15	0	15	8	7	53.33%	46.67%	36.53	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
PHSC	2013	841	22	0	22	17	5	77.27%	22.73%	38.23	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
PHSC	2014				17	10		58.82%		31.82	0	0	16	3	Ordinary Secondary	Motheo	1009	36	Project	16
ACCN	2010	1178	35	1	34	23	11	67.65%	32.35%	34.65	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
ACCN	2011	1089	29	0	29	21	8	72.41%	27.59%	37.55	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
ACCN	2012	1844	40	0	40	33	7	82.50%	17.50%	46.10	1	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
ACCN	2013	1956	47	0	47	35	12	74.47%	25.53%	41.62	1	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
ACCN	2014				61	49		80.33%		39.25	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
MATH	2010	1227	52	0	52	12	40	23.08%	76.92%	23.60	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
MATH	2011	917	34	1	33	12	21	36.36%	63.64%	27.79	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
MATH	2012	2397	63	0	63	39	24	61.90%	38.10%	38.05	2	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
MATH	2013	1854	41	0	41	35	6	85.37%	14.63%	45.22	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
MATH	2014				51	37		72.55%		38.37	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
PHSC	2010	1521	52	1	51	27	24	52.94%	47.06%	29.82	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
PHSC	2011	1217	34	1	33	21	12	63.64%	36.36%	36.88	1	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
PHSC	2012	2143	54	0	54	33	21	61.11%	38.89%	39.69	1	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
PHSC	2013	1616	37	0	37	30	7	81.08%	18.92%	43.68	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
PHSC	2014				48	23		47.92%	34.44	0	0	0	1	1	Ordinary Secondary	Motheo	954	33	Project	1
ACCN	2010	1037	36	0	36	16	20	44.44%	55.56%	28.81	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
ACCN	2011	385	13	0	13	7	6	53.85%	46.15%	29.62	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
ACCN	2012	415	13	0	13	6	7	46.15%	53.85%	31.92	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
ACCN	2013	171	4	0	4	2	2	50.00%	50.00%	42.75	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
ACCN	2014				6	6		100.00%		47.67	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
MATH	2010	351	14	0	14	5	9	35.71%	64.29%	25.07	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
MATH	2011	300	8	0	8	5	3	62.50%	37.50%	37.50	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
MATH	2012	365	13	0	13	6	7	46.15%	53.85%	28.08	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
MATH	2013	180	7	0	7	3	4	42.86%	57.14%	25.71	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
MATH	2014				25	6		24.00%		21.04	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
PHSC	2010	985	39	1	38	11	27	28.95%	71.05%	25.92	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
PHSC	2011	614	16	0	16	13	3	81.25%	18.75%	38.38	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
PHSC	2012	552	13	0	13	12	1	92.31%	7.69%	42.46	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
PHSC	2013	272	7	0	7	6	1	85.71%	14.29%	38.86	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
PHSC	2014				19	16		84.21%		37.95	0	0	11	3	Ordinary Secondary	Motheo	774	29	Project	11
ACCN	2010	1741	74	5	69	15	54	21.74%	78.26%	25.23	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
ACCN	2011	1322	56	4	52	14	38	26.92%	73.08%	25.42	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
ACCN	2012	845	27	0	27	15	12	55.56%	44.44%	31.30	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
ACCN	2013	821	24	0	24	9	15	37.50%	62.50%	34.21	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
ACCN	2014				38	21		55.26%		32.61	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
MATH	2010	251	9	0	9	4	5	44.44%	55.56%	27.89	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
MATH	2011	552	24	4	20	8	12	40.00%	60.00%	27.60	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
MATH	2012	453	10	0	10	9	1	90.00%	10.00%	45.30	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
MATH	2013	1150	31	0	31	18	13	58.06%	41.94%	37.10	1	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
MATH	2014				26	17		65.38%		38.58	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
PHSC	2010	885	39	0	39	7	32	17.95%	82.05%	22.69	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
PHSC	2011	847	37	1	36	8	28	22.22%	77.78%	23.53	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
PHSC	2012	797	21	0	21	16	5	76.19%	23.81%	37.95	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
PHSC	2013	1062	37	0	37	13	24	35.14%	64.86%	28.70	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4
PHSC	2014				29	13		44.83%		28.38	0	0	4	1	Ordinary Secondary	Motheo	1029	40	Project	4

ACCN	2010	538	27	0	27	1	26	3.70%	96.30%	19.93	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
ACCN	2011	561	20	0	20	7	13	35.00%	65.00%	28.05	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
ACCN	2012	896	30	0	30	13	17	43.33%	56.67%	29.87	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
ACCN	2013	684	24	1	23	9	14	39.13%	60.87%	29.74	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
ACCN	2014				31	13		41.94%		28.32	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
MATH	2010	203	7	0	7	3	4	42.86%	57.14%	29.00	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
MATH	2011	270	12	0	12	3	9	25.00%	75.00%	22.50	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
MATH	2012	623	27	0	27	7	20	25.93%	74.07%	23.07	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
MATH	2013	187	4	0	4	4	0	100.00%	0.00%	46.75	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
MATH	2014				8	8		100.00%		47.50	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
PHSC	2010	299	16	3	13	4	9	30.77%	69.23%	23.00	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
PHSC	2011	319	12	0	12	5	7	41.67%	58.33%	26.58	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
PHSC	2012	724	27	0	27	9	18	33.33%	66.67%	26.81	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
PHSC	2013	357	11	0	11	4	7	36.36%	63.64%	32.45	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
PHSC	2014				13	11		84.62%		45.23	0	0	7	2	Ordinary Secondary	Motheo	513	19	Project	7
ACCN	2010	1709	54	0	54	30	24	55.56%	44.44%	31.65	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
ACCN	2011	1658	52	0	52	29	23	55.77%	44.23%	31.88	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
ACCN	2012	2045	43	0	43	39	4	90.70%	9.30%	47.56	1	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
ACCN	2013	1396	34	0	34	29	5	85.29%	14.71%	41.06	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
ACCN	2014				74	14		18.92%		22.69	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
MATH	2010	1916	54	1	53	30	23	56.60%	43.40%	36.15	2	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
MATH	2011	1806	73	0	73	19	54	26.03%	73.97%	24.74	1	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
MATH	2012	2199	53	0	53	40	13	75.47%	24.53%	41.49	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
MATH	2013	1853	35	0	35	32	3	91.43%	8.57%	52.94	3	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
MATH	2014				43	28		65.12%		38.91	0	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
PHSC	2010	2637	79	3	76	37	39	48.68%	51.32%	34.70	2	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
PHSC	2011	2382	61	0	61	42	19	68.85%	31.15%	39.05	3	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
PHSC	2012	2507	53	0	53	47	6	88.68%	11.32%	47.30	1	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
PHSC	2013	1879	35	0	35	34	1	97.14%	2.86%	53.69	2	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
PHSC	2014				39	32		82.05%		46.36	1	0	10	3	Ordinary Secondary	Motheo	1161	45	Project	10
ACCN	2010	771	29	0	29	8	21	27.59%	72.41%	26.59	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
ACCN	2011	427	17	1	16	6	10	37.50%	62.50%	26.69	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
ACCN	2012	1189	51	0	51	11	40	21.57%	78.43%	23.31	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
ACCN	2013	487	18	0	18	6	12	33.33%	66.67%	27.06	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
ACCN	2014				46	17		36.96%		25.48	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
MATH	2010	670	22	0	22	10	12	45.45%	54.55%	30.45	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
MATH	2011	616	24	0	24	8	16	33.33%	66.67%	25.67	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
MATH	2012	847	39	1	38	9	29	23.68%	76.32%	22.29	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
MATH	2013	640	24	0	24	8	16	33.33%	66.67%	26.67	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
MATH	2014				7	6		85.71%		40.71	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
PHSC	2010	1394	54	0	54	14	40	25.93%	74.07%	25.81	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
PHSC	2011	1365	58	2	56	14	42	25.00%	75.00%	24.38	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
PHSC	2012	1012	39	1	38	13	25	34.21%	65.79%	26.63	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
PHSC	2013	741	24	0	24	8	16	33.33%	66.67%	30.88	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
PHSC	2014				37	6		16.22%		21.81	0	0	2	1	Ordinary Secondary	Motheo	542	22	Project	2
ACCN	2010	2603	91	0	91	35	56	38.46%	61.54%	28.60	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
ACCN	2011	1836	54	0	54	32	22	59.26%	40.74%	34.00	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
ACCN	2012	1065	26	0	26	22	4	84.62%	15.38%	40.96	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
ACCN	2013	1125	22	0	22	20	2	90.91%	9.09%	51.14	2	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
ACCN	2014				79	67		84.81%		43.56	2	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
MATH	2010	2054	127	1	126	13	113	10.32%	89.68%	16.30	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
MATH	2011	2275	96	0	96	24	72	25.00%	75.00%	23.70	1	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
MATH	2012	2631	101	2	99	38	61	38.38%	61.62%	26.58	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
MATH	2013	1946	36	0	36	36	0	100.00%	0.00%	54.06	2	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
MATH	2014				88	65		73.86%		41.01	2	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
PHSC	2010	2383	98	1	97	22	75	22.68%	77.32%	24.57	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
PHSC	2011	1964	77	1	76	23	53	30.26%	69.74%	25.84	1	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
PHSC	2012	2473	92	2	90	35	55	38.89%	61.11%	27.48	0	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
PHSC	2013	2042	45	0	45	41	4	91.11%	8.89%	45.38	1	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
PHSC	2014				99	60		60.61%		38.58	1	0	5	1	Ordinary Secondary	Motheo	865	32	Project	5
ACCN	2010	1502	36	0	36	33	3	91.67%	8.33%	41.72	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
ACCN	2011	1032	26	0	26	21	5	80.77%	19.23%	39.69	1	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
ACCN	2012	1210	20	0	20	20	0	100.00%	0.00%	60.50	1	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
ACCN	2013	1191	23	1	22	21	1	95.45%	4.55%	54.14	2	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
ACCN	2014				13	13		100.00%		57.54	1	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
MATH	2010	1997	66	0	66	30	36	45.45%	54.55%	30.26	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
MATH	2011	1963	65	0	65	29	36	44.62%	55.38%	30.20	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
MATH	2012	1838	40	0	40	35	5	87.50%	12.50%	45.95	1	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
MATH	2013	2119	54	2	52	41	11	78.85%	21.15%	40.75	2	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
MATH	2014				54	38		70.37%		35.80	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
PHSC	2010	1090	33	0	33	15	18	45.45%	54.55%	33.03	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
PHSC	2011	1418	41	0	41	24	17	58.54%	41.46%	34.59	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
PHSC	2012	1264	26	0	26	25	1	96.15%	3.85%	48.62	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
PHSC	2013	1389	33	1	32	28	4	87.50%	12.50%	43.41	2	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
PHSC	2014				42	29		69.05%		35.40	0	0	18	4	Ordinary Secondary	Motheo	655	29	Project	18
ACCN	2010	952	35	0	35	9	26	25.71%	74.29%	27.20	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
ACCN	2011	805	30	0	30	10	20	33.33%	66.67%	26.83	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
ACCN	2012	292	9	0	9	2	7	22.22%	77.78%	32.44	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
ACCN	2013	301	7	0	7	5	2	71.43%	28.57%	43.00	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
ACCN	2014				10	8		80.00%		40.60	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
MATH	2010	366	15	0	15	4	11	26.67%	73.33%	24.40	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
MATH	2011	502	21	1	20	7	13	35.00%	65.00%	25.10	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
MATH	2012	415	12	0	12	9	3	75.00%	25.00%	34.58	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
MATH	2013	441	11	0	11	7	4	63.64%	36.36%	40.09	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
MATH	2014				11	9		81.82%		34.91	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
PHSC	2010	572	36	2	34	2	32	5.88%	94.12%	16.82	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
PHSC	2011	533	28	1	27	4	23	14.81%	85.19%	19.74	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
PHSC	2012	330	12	0	12	5	7	41.67%	58.33%	27.50	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
PHSC	2013	416	9	0	9	8	1	88.89%	11.11%	46.22	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14
PHSC	2014				8	1		12.50%		26.13	0	0	14	3	Ordinary Secondary	Motheo	854	29	Project	14

ACCN	2010	1616	34	0	34	33	1	97.06%	2.94%	47.53	0	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
ACCN	2011	1401	38	0	38	26	12	68.42%	31.58%	36.87	0	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
ACCN	2012	1105	26	0	26	24	2	92.31%	7.69%	42.50	0	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
ACCN	2013	1366	31	0	31	29	2	93.55%	6.45%	44.06	0	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
ACCN	2014				30	29		96.67%		49.70	3	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
MATH	2010	2181	58	0	58	40	18	68.97%	31.03%	37.60	2	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
MATH	2011	1410	41	0	41	23	18	56.10%	43.90%	34.39	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
MATH	2012	2224	49	0	49	43	6	87.76%	12.24%	45.39	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
MATH	2013	2523	55	0	55	45	10	81.82%	18.18%	45.87	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
MATH	2014				55	52		94.55%		48.24	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
PHSC	2010	2000	58	0	58	38	20	65.52%	34.48%	34.48	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
PHSC	2011	1699	48	0	48	28	20	58.33%	41.67%	35.40	1	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
PHSC	2012	2421	46	0	46	43	3	93.48%	6.52%	52.63	3	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
PHSC	2013	2747	54	0	54	53	1	98.15%	1.85%	50.87	2	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
PHSC	2014				72	66		91.67%		45.26	0	0	10	3	Ordinary Secondary	Motheo	1029	37	Control	10
ACCN	2010	1833	72	4	68	25	43	36.76%	63.24%	26.96	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
ACCN	2011	1845	68	0	68	25	43	36.76%	63.24%	27.13	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
ACCN	2012	1522	50	0	50	26	24	52.00%	48.00%	30.44	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
ACCN	2013	896	24	0	24	17	7	70.83%	29.17%	37.33	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
ACCN	2014				25	14		56.00%		33.88	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
MATH	2010	1488	52	0	52	21	31	40.38%	59.62%	28.62	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
MATH	2011	922	31	0	31	14	17	45.16%	54.84%	29.74	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
MATH	2012	1040	23	0	23	17	6	73.91%	26.09%	45.22	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
MATH	2013	2167	60	0	60	41	19	68.33%	31.67%	36.12	2	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
MATH	2014				60	34		56.67%		31.75	1	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
PHSC	2010	1621	51	0	51	23	28	45.10%	54.90%	31.78	1	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
PHSC	2011	1221	37	0	37	18	19	48.65%	51.35%	33.00	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
PHSC	2012	1582	40	0	40	29	11	72.50%	27.50%	39.55	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
PHSC	2013	1663	38	0	38	33	5	86.84%	13.16%	43.76	2	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
PHSC	2014				35	27		77.14%		37.74	0	0	14	3	Ordinary Secondary	Motheo	1100	37	Control	14
ACCN	2010	909	34	1	33	16	17	48.48%	51.52%	27.55	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
ACCN	2011	998	34	0	34	17	17	50.00%	50.00%	29.35	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
ACCN	2012	1485	40	0	40	24	16	60.00%	40.00%	37.13	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
ACCN	2013	920	24	0	24	14	10	58.33%	41.67%	38.33	1	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
ACCN	2014				34	22		64.71%		36.12	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
MATH	2010	759	49	0	49	4	45	8.16%	91.84%	15.49	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
MATH	2011	1505	96	2	94	11	83	11.70%	88.30%	16.01	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
MATH	2012	1084	37	2	35	16	19	45.71%	54.29%	30.97	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
MATH	2013	927	29	0	29	13	16	44.83%	55.17%	31.97	1	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
MATH	2014				45	33		73.33%	41.07	0	3	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
PHSC	2010	867	40	1	39	7	32	17.95%	82.05%	22.23	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
PHSC	2011	1694	83	5	78	14	64	17.95%	82.05%	21.72	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
PHSC	2012	1600	49	2	47	23	24	48.94%	51.06%	34.04	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
PHSC	2013	1719	65	0	65	18	47	27.69%	72.31%	26.45	0	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
PHSC	2014				61	47		77.05%		42.77	2	0	12	3	Comprehensive Secondary	Motheo	1275	49	Control	12
ACCN	2010	500	21	1	20	3	17	15.00%	85.00%	25.00	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
ACCN	2011	222	10	0	10	1	9	10.00%	90.00%	22.20	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
ACCN	2012	305	12	0	12	4	8	33.33%	66.67%	25.42	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
ACCN	2013	147	6	0	6	1	5	16.67%	83.33%	24.50	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
ACCN	2014				12	3		25.00%		24.67	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
MATH	2010	275	11	0	11	4	7	36.36%	63.64%	25.00	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
MATH	2011	217	7	0	7	3	4	42.86%	57.14%	31.00	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
MATH	2012	352	14	0	14	4	10	28.57%	71.43%	25.14	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
MATH	2013	288	9	0	9	6	3	66.67%	33.33%	32.00	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
MATH	2014				16	9		56.25%		35.38	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
PHSC	2010	339	11	0	11	5	6	45.45%	54.55%	30.82	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
PHSC	2011	262	7	0	7	6	1	85.71%	14.29%	37.43	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
PHSC	2012	340	14	0	14	3	11	21.43%	78.57%	24.29	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
PHSC	2013	272	9	0	9	4	5	44.44%	55.56%	30.22	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
PHSC	2014				25	8		32.00%		28.32	0	0	7	2	Ordinary Secondary	Motheo	354	12	Control	7
ACCN	2010	884	23	1	22	17	5	77.27%	22.73%	40.18	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
ACCN	2011	587	19	0	19	8	11	42.11%	57.89%	30.89	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
ACCN	2012	573	15	0	15	12	3	80.00%	20.00%	38.20	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
ACCN	2013	1055	26	0	26	20	6	76.92%	23.08%	40.58	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
ACCN	2014				12	11		91.67%		40.50	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
MATH	2010	1377	51	0	51	19	32	37.25%	62.75%	27.00	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
MATH	2011	875	37	0	37	9	28	24.32%	75.68%	23.65	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
MATH	2012	1023	46	0	46	10	36	21.74%	78.26%	22.24	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
MATH	2013	738	31	1	30	8	22	26.67%	73.33%	24.60	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
MATH	2014				13	5		38.46%		24.38	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
PHSC	2010	806	36	0	36	5	31	13.89%	86.11%	22.39	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
PHSC	2011	791	27	1	26	14	12	53.85%	46.15%	30.42	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
PHSC	2012	1271	38	0	38	24	14	63.16%	36.84%	33.45	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
PHSC	2013	537	18	1	17	9	8	52.94%	47.06%	31.59	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
PHSC	2014				8	4		50.00%		26.00	0	0	16	3	Ordinary Secondary	Motheo	1062	40	Control	16
ACCN	2010	1110	36	1	35	18	17	51.43%	48.57%	31.71	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
ACCN	2011	975	34	0	34	11	23	32.35%	67.65%	28.68	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
ACCN	2012	1659	44	1	43	28	15	65.12%	34.88%	38.58	1	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
ACCN	2013	1703	41	0	41	31	10	75.61%	24.39%	41.54	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
ACCN	2014				16	14		87.50%		46.50	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
MATH	2010	1881	71	0	71	25	46	35.21%	64.79%	26.49	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
MATH	2011	2147	89	0	89	30	59	33.71%	66.29%	24.12	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
MATH	2012	1612	61	0	61	19	42	31.15%	68.85%	26.43	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
MATH	2013	1884	65	0	65	24	41	36.92%	63.08%	28.98	2	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
MATH	2014				40	20		50.00%		32.05	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
PHSC	2010	2292	71	0	71	34	37	47.89%	52.11%	32.28	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
PHSC	2011	2351	74	0	74	37	37	50.00%	50.00%	31.77	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
PHSC	2012	2104	58	0	58	40	18	68.97%	31.03%	36.28	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
PHSC	2013	1958	51	0	51	40	11	78.43%	21.57%	38.39	2	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3
PHSC	2014				35	28		80.00%		35.71	0	0	3	2	Ordinary Secondary	Motheo	960	36	Control	3

ACCN	2010	2832	96	2	94	37	57	39.36%	60.64%	30.13	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
ACCN	2011	2368	93	0	93	24	69	25.81%	74.19%	25.46	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
ACCN	2012	2076	62	0	62	32	30	51.61%	48.39%	33.48	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
ACCN	2013	2494	85	1	84	31	53	36.90%	63.10%	29.69	2	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
ACCN	2014				49	26		53.06%		30.98	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
MATH	2010	1256	39	0	39	22	17	56.41%	43.59%	32.21	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
MATH	2011	703	20	1	19	10	9	52.63%	47.37%	37.00	1	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
MATH	2012	2083	73	0	73	29	44	39.73%	60.27%	28.53	1	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
MATH	2013	1580	46	0	46	26	20	56.52%	43.48%	34.35	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
MATH	2014				46	28		60.87%		37.43	2	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
PHSC	2010	2918	118	1	117	31	86	26.50%	73.50%	24.94	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
PHSC	2011	2843	126	0	126	25	101	19.84%	80.16%	22.56	1	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
PHSC	2012	2356	73	0	73	38	35	52.05%	47.95%	32.27	1	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
PHSC	2013	2374	87	0	87	31	56	35.63%	64.37%	27.29	0	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
PHSC	2014				88	36		40.91%		31.10	3	0	4	1	Ordinary Secondary	Motheo	1184	46	Control	4
ACCN	2010	959	30	1	29	21	8	72.41%	27.59%	33.07	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
ACCN	2011	1224	42	0	42	15	27	35.71%	64.29%	29.14	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
ACCN	2012	509	18	0	18	7	11	38.89%	61.11%	28.28	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
ACCN	2013	833	18	0	18	17	1	94.44%	5.56%	46.28	1	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
ACCN	2014				8	7		87.50%		38.50	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
MATH	2010	1801	57	1	56	28	28	50.00%	50.00%	32.16	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
MATH	2011	985	34	0	34	11	23	32.35%	67.65%	28.97	1	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
MATH	2012	651	23	0	23	8	15	34.78%	65.22%	28.30	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
MATH	2013	1528	48	0	48	22	26	45.83%	54.17%	31.83	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
MATH	2014				39	13		33.33%		26.67	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
PHSC	2010	2104	74	1	73	28	45	38.36%	61.64%	28.82	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
PHSC	2011	1055	40	0	40	12	28	30.00%	70.00%	26.38	1	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
PHSC	2012	758	28	1	27	10	17	37.04%	62.96%	28.07	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
PHSC	2013	1273	35	0	35	24	11	68.57%	31.43%	36.37	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
PHSC	2014				29	22		75.86%		37.34	0	0	13	3	Ordinary Secondary	Motheo	1097	43	Control	13
ACCN	2010	821	27	0	27	9	18	33.33%	66.67%	30.41	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
ACCN	2011	589	16	0	16	8	8	50.00%	50.00%	36.81	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
ACCN	2012	652	18	0	18	11	7	61.11%	38.89%	36.22	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
ACCN	2013	821	25	1	24	13	11	54.17%	45.83%	34.21	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
ACCN	2014				24	16		66.67%		34.75	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
MATH	2010	1822	85	0	85	21	64	24.71%	75.29%	21.44	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
MATH	2011	906	20	0	20	20	0	100.00%	0.00%	45.30	1	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
MATH	2012	901	24	1	23	17	6	73.91%	26.09%	39.17	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
MATH	2013	1439	60	1	59	17	42	28.81%	71.19%	24.39	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
MATH	2014				78	13		16.67%		19.40	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
PHSC	2010	2077	58	0	58	33	25	56.90%	43.10%	35.81	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
PHSC	2011	1409	37	0	37	25	12	67.57%	32.43%	38.08	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
PHSC	2012	924	27	1	26	18	8	69.23%	30.77%	35.54	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
PHSC	2013	1210	35	0	35	25	10	71.43%	28.57%	34.57	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
PHSC	2014				54	4		7.41%		17.30	0	0	11	3	Ordinary Secondary	Motheo	928	35	Control	11
ACCN	2010	1631	56	3	53	27	26	50.94%	49.06%	30.77	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
ACCN	2011	1433	50	0	50	20	30	40.00%	60.00%	28.66	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
ACCN	2012	1231	40	0	40	17	23	42.50%	57.50%	30.78	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
ACCN	2013	1285	39	0	39	21	18	53.85%	46.15%	32.95	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
ACCN	2014				17	11		64.71%		43.53	1	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
MATH	2010	1590	42	0	42	29	13	69.05%	30.95%	37.86	1	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
MATH	2011	1504	52	0	52	21	31	40.38%	59.62%	28.92	1	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
MATH	2012	1004	36	0	36	14	22	38.89%	61.11%	27.89	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
MATH	2013	1219	41	0	41	19	22	46.34%	53.66%	29.73	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
MATH	2014				17	15		88.24%		47.18	2	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
PHSC	2010	1654	42	0	42	28	14	66.67%	33.33%	39.38	1	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
PHSC	2011	1886	52	0	52	37	15	71.15%	28.85%	36.27	1	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
PHSC	2012	1259	36	0	36	22	14	61.11%	38.89%	34.97	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
PHSC	2013	1163	41	0	41	15	26	36.59%	63.41%	28.37	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
PHSC	2014				29	14		48.28%		32.07	0	0	5	2	Ordinary Secondary	Motheo	961	35	Control	5
ACCN	2010	679	21	0	21	11	10	52.38%	47.62%	32.33	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
ACCN	2011	628	13	0	13	12	1	92.31%	7.69%	48.31	1	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
ACCN	2012	518	12	0	12	10	2	83.33%	16.67%	43.17	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
ACCN	2013	642	14	0	14	11	3	78.57%	21.43%	45.86	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
ACCN	2014				19	15		78.95%		37.84	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
MATH	2010	108	3	0	3	2	1	66.67%	33.33%	36.00	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
MATH	2011	282	10	0	10	4	6	40.00%	60.00%	28.20	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
MATH	2012	218	8	0	8	2	6	25.00%	75.00%	27.25	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
MATH	2013	708	19	0	19	15	4	78.95%	21.05%	37.26	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
MATH	2014				25	19		76.00%		39.28	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
PHSC	2010	433	20	0	20	4	16	20.00%	80.00%	21.65	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
PHSC	2011	363	10	0	10	6	4	60.00%	40.00%	36.30	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
PHSC	2012	340	8	0	8	5	3	62.50%	37.50%	42.50	1	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
PHSC	2013	547	14	1	13	11	2	84.62%	15.38%	42.08	1	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
PHSC	2014				23	15		65.22%		33.83	0	0	17	4	Ordinary Secondary	Motheo	1333	42	Control	17
ACCN	2010	1439	45	0	45	21	24	46.67%	53.33%	31.98	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
ACCN	2011	1192	53	1	52	12	40	23.08%	76.92%	22.92	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
ACCN	2012	1252	47	0	47	13	34	27.66%	72.34%	26.64	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
ACCN	2013	1496	48	2	46	25	21	54.35%	45.65%	32.52	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
ACCN	2014				28	26		92.86%		50.64	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
MATH	2010	796	21	0	21	13	8	61.90%	38.10%	37.90	2	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
MATH	2011	856	26	0	26	11	15	42.31%	57.69%	32.92	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
MATH	2012	798	19	0	19	12	7	63.16%	36.84%	42.00	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
MATH	2013	1099	27	0	27	20	7	74.07%	25.93%	40.70	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
MATH	2014				18	13		72.22%		38.61	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
PHSC	2010	1034	33	0	33	13	20	39.39%	60.61%	31.33	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
PHSC	2011	1237	44	0	44	10	34	22.73%	77.27%	28.11	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
PHSC	2012	740	19	0	19	12	7	63.16%	36.84%	38.95	1	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
PHSC	2013	1603	47	1	46	26	20	56.52%	43.48%	34.85	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8
PHSC	2014				30	12		40.00%		27.77	0	0	8	3	Ordinary Secondary	Motheo	718	27	Control	8

ACCN	2010	539	21	0	21	3	18	14.29%	85.71%	25.67	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
ACCN	2011	482	19	0	19	7	12	36.84%	63.16%	25.37	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
ACCN	2012	845	27	0	27	15	12	55.56%	44.44%	31.30	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
ACCN	2013	1000	26	0	26	22	4	84.62%	15.38%	38.46	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
ACCN	2014				41	23		56.10%		33.41	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
MATH	2010	979	44	0	44	11	33	25.00%	75.00%	22.25	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
MATH	2011	822	52	0	52	7	45	13.46%	86.54%	15.81	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
MATH	2012	322	33	2	31	1	30	3.23%	96.77%	10.39	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
MATH	2013	792	27	0	27	12	15	44.44%	55.56%	29.33	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
MATH	2014				29	13		44.83%		26.28	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
PHSC	2010	707	23	0	23	9	14	39.13%	60.87%	30.74	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
PHSC	2011	876	33	0	33	10	23	30.30%	69.70%	26.55	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
PHSC	2012	414	18	1	17	5	12	29.41%	70.59%	24.35	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
PHSC	2013	655	18	0	18	11	7	61.11%	38.89%	36.39	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
PHSC	2014				29	15		51.72%		29.72	0	0	2	1	Ordinary Secondary	Motheo	430	18	Control	2
ACCN	2010	2634	80	2	78	53	25	67.95%	32.05%	33.77	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
ACCN	2011	2167	60	0	60	46	14	76.67%	23.33%	36.12	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
ACCN	2012	4848	150	0	150	74	76	49.33%	50.67%	32.32	1	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
ACCN	2013	4085	112	1	111	67	44	60.36%	39.64%	36.80	3	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
ACCN	2014				112	57		50.89%		30.75	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
MATH	2010	3722	123	0	123	48	75	39.02%	60.98%	30.26	2	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
MATH	2011	2319	81	1	80	34	46	42.50%	57.50%	28.99	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
MATH	2012	2902	89	0	89	42	47	47.19%	52.81%	32.61	1	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
MATH	2013	3139	71	1	70	56	14	80.00%	20.00%	44.84	3	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
MATH	2014				153	50		32.68%		24.46	1	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
PHSC	2010	4406	112	0	112	77	35	68.75%	31.25%	39.34	2	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
PHSC	2011	2365	76	2	74	39	35	52.70%	47.30%	31.96	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
PHSC	2012	2723	77	1	76	45	31	59.21%	40.79%	35.83	0	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
PHSC	2013	2624	61	1	60	52	8	86.67%	13.33%	43.73	4	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
PHSC	2014				113	60		53.10%		32.47	2	0	6	2	Ordinary Secondary	Motheo	1360	50	Control	6
ACCN	2010	867	28	1	27	14	13	51.85%	48.15%	32.11	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
ACCN	2011	824	31	0	31	11	20	35.48%	64.52%	26.58	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
ACCN	2012	704	24	0	24	7	17	29.17%	70.83%	29.33	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
ACCN	2013	493	16	0	16	10	6	62.50%	37.50%	30.81	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
ACCN	2014				24	11		45.83%		29.83	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
MATH	2010	382	14	0	14	4	10	28.57%	71.43%	27.29	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
MATH	2011	617	24	0	24	9	15	37.50%	62.50%	25.71	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
MATH	2012	1011	41	0	41	12	29	29.27%	70.73%	24.66	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
MATH	2013	1283	47	1	46	16	30	34.78%	65.22%	27.89	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
MATH	2014				32	16		50.00%		28.69	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
PHSC	2010	558	29	0	29	2	27	6.90%	93.10%	19.24	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
PHSC	2011	842	40	0	40	5	35	12.50%	87.50%	21.05	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
PHSC	2012	638	17	0	17	11	6	64.71%	35.29%	37.53	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
PHSC	2013	1398	42	1	41	21	20	51.22%	48.78%	34.10	1	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
PHSC	2014				27	22		81.48%		38.85	0	0	9	3	Ordinary Secondary	Motheo	802	30	Control	9
ACCN	2010	975	28	0	28	22	6	78.57%	21.43%	34.82	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
ACCN	2011	873	28	2	26	15	11	57.69%	42.31%	33.58	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
ACCN	2012	1598	45	0	45	26	19	57.78%	42.22%	35.51	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
ACCN	2013	1865	61	0	61	30	31	49.18%	50.82%	30.57	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
ACCN	2014				27	17		62.96%		34.74	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
MATH	2010	359	9	0	9	9	0	100.00%	0.00%	39.89	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
MATH	2011	548	14	0	14	11	3	78.57%	21.43%	39.14	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
MATH	2012	1006	25	1	24	21	3	87.50%	12.50%	41.92	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
MATH	2013	1287	33	0	33	23	10	69.70%	30.30%	39.00	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
MATH	2014				34	20		58.82%		37.12	1	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
PHSC	2010	765	28	0	28	9	19	32.14%	67.86%	27.32	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
PHSC	2011	1051	35	1	34	15	19	44.12%	55.88%	30.91	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
PHSC	2012	1265	37	2	35	25	10	71.43%	28.57%	36.14	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
PHSC	2013	1436	35	0	35	29	6	82.86%	17.14%	41.03	1	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
PHSC	2014				48	30		62.50%		34.85	0	0	1	2	Ordinary Secondary	Motheo	867	32	Control	1
ACCN	2010	597	17	0	17	11	6	64.71%	35.29%	35.12	0	0	15	4	Combined	Motheo	478	23	Control	15
ACCN	2011	634	20	0	20	8	12	40.00%	60.00%	31.70	1	0	15	4	Combined	Motheo	478	23	Control	15
ACCN	2012	552	14	0	14	11	3	78.57%	21.43%	39.43	0	0	15	4	Combined	Motheo	478	23	Control	15
ACCN	2013	578	15	0	15	10	5	66.67%	33.33%	38.53	0	0	15	4	Combined	Motheo	478	23	Control	15
ACCN	2014				21	19		90.48%		41.43	0	0	15	4	Combined	Motheo	478	23	Control	15
MATH	2010	737	30	0	30	7	23	23.33%	76.67%	24.57	0	0	15	4	Combined	Motheo	478	23	Control	15
MATH	2011	471	13	0	13	8	5	61.54%	38.46%	36.23	0	0	15	4	Combined	Motheo	478	23	Control	15
MATH	2012	589	18	0	18	9	9	50.00%	50.00%	32.72	0	0	15	4	Combined	Motheo	478	23	Control	15
MATH	2013	479	12	0	12	7	5	58.33%	41.67%	39.92	0	0	15	4	Combined	Motheo	478	23	Control	15
MATH	2014				11	6		54.55%		28.55	0	0	15	4	Combined	Motheo	478	23	Control	15
PHSC	2010	1122	38	0	38	14	24	36.84%	63.16%	29.53	0	0	15	4	Combined	Motheo	478	23	Control	15
PHSC	2011	693	20	0	20	11	9	55.00%	45.00%	34.65	0	0	15	4	Combined	Motheo	478	23	Control	15
PHSC	2012	681	24	0	24	8	16	33.33%	66.67%	28.38	0	0	15	4	Combined	Motheo	478	23	Control	15
PHSC	2013	472	12	0	12	10	2	83.33%	16.67%	39.33	0	0	15	4	Combined	Motheo	478	23	Control	15
PHSC	2014				10	8		80.00%		33.20	0	0	15	4	Combined	Motheo	478	23	Control	15
ACCN	2010	442	12	0	12	9	3	75.00%	25.00%	36.83	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
ACCN	2011	1367	35	0	35	24	11	68.57%	31.43%	39.06	2	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
ACCN	2012	1110	26	0	26	19	7	73.08%	26.92%	42.69	1	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
ACCN	2013	596	14	0	14	11	3	78.57%	21.43%	42.57	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
ACCN	2014				15	14		93.33%		45.07	1	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
MATH	2010	595	20	0	20	9	11	45.00%	55.00%	29.75	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
MATH	2011	1176	30	0	30	20	10	66.67%	33.33%	39.20	2	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
MATH	2012	1222	35	0	35	18	17	51.43%	48.57%	34.91	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
MATH	2013	1293	35	0	35	22	13	62.86%	37.14%	36.94	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
MATH	2014				33	31		93.94%	51.61	51.61	2	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
PHSC	2010	619	18	0	18	9	9	50.00%	50.00%	34.39	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
PHSC	2011	1146	30	0	30	20	10	66.67%	33.33%	38.20	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
PHSC	2012	888	26	0	26	12	14	46.15%	53.85%	34.15	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
PHSC	2013	1180	32	0	32	19	13	59.38%	40.63%	36.88	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18
PHSC	2014				41	29		70.73%		38.15	0	0	18	4	Agricultural Secondary	Motheo	681	29	Control	18

Appendix IV

Descriptive statistics

Descriptive statistics are used to organize and describe the characteristics of a collection of data. The collection is sometimes called a data set or just data.

The mean is a measure of central tendency. It is simply the sum of all the values in a group, divided by the number of values in that group. The sample mean is the measure of central tendency that most accurately reflects the population mean. It is the centremost point where all the values on one side of the mean are equal in weight to all the values on the other side of the mean. The mean is very sensitive to extreme scores. An extreme score can pull the mean in one or the other direction and make it less representative of the set of scores and less useful as a measure of central tendency. There may be situations (as in this analysis) where one value occur more than once and a weighted mean must be calculated. A weighted mean is computed by multiplying the value by the frequency of its occurrence, adding the total of all the products, and then dividing by the total number of occurrences (Salkind 2014).

The median is defined as the midpoint of a set of scores. It is the point at which one half, or 50%, of the scores fall above and one half, or 50%, fall below. Percentile points are used to define the percentage of cases equal to or below a certain point in a distribution or set of scores. The median, often called Q_2, is also known as the 50^{th} percentile, because it is the point below which 50% of the cases in the distribution fall. Other percentiles such as the 25^{th} percentile, often called Q_1, and the 75^{th} percentile, called Q_3, are often used in describing the characteristics of a distribution. The median is insensitive to extreme scores. For a set of scores in which some of the scores are extreme, the median better represents the centremost value of that set of scores than the mean (Salkind 2014).

When it comes to describing the characteristics of a distribution, averages are only one half of the story. The other half is measures of variability. Variability (also called spread or dispersion) reflects how scores differ from one another. It is a measure of how each score in a group of scores differs from the mean. The range is the most general measure of variability. The range is computed by subtracting the lowest score, or minimum value, from the highest score, or maximum value, in the distribution. The range shows how much spread there is from the lowest to the highest point in a distribution (Salkind 2014).

The most frequently used measure of variability is the standard deviation. The standard deviation represents the average amount of variability in a set of scores. In practical terms, it is the average distance from the mean. The larger the standard deviation, the larger the average distance each data point is from the mean of the distribution. The standard deviation is calculated by finding the difference between each individual score and the mean, squaring each difference, and then sums them all together. Then, this sum is divided by the size of the sample minus 1 and the square root of the result is determined. The sum of the square is divided by the sample size minus 1, because standard deviation is an unbiased estimate of the population standard deviation. The standard deviation can be used to compare scores from different distributions, even when the means and standard deviations are different (Salkind 2014).

There are four different ways in which distributions can differ: mean value, variability, skewness, and kurtosis (Salkind 2014).

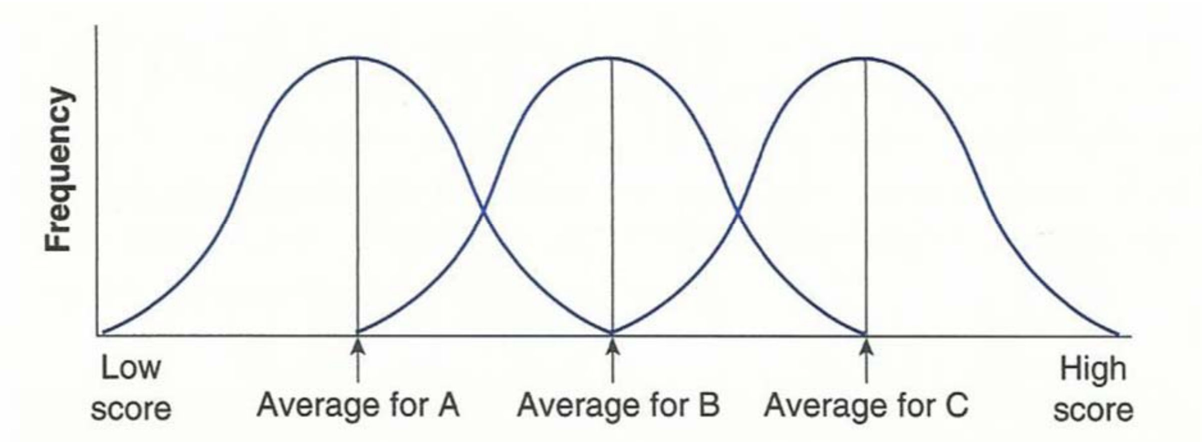

Figure 1. How distributions can differ in their mean score (Salkind 2014).

The mean of distribution C is more than that of distribution B, which in turn, is more than that of distribution A (Salkind 2014).

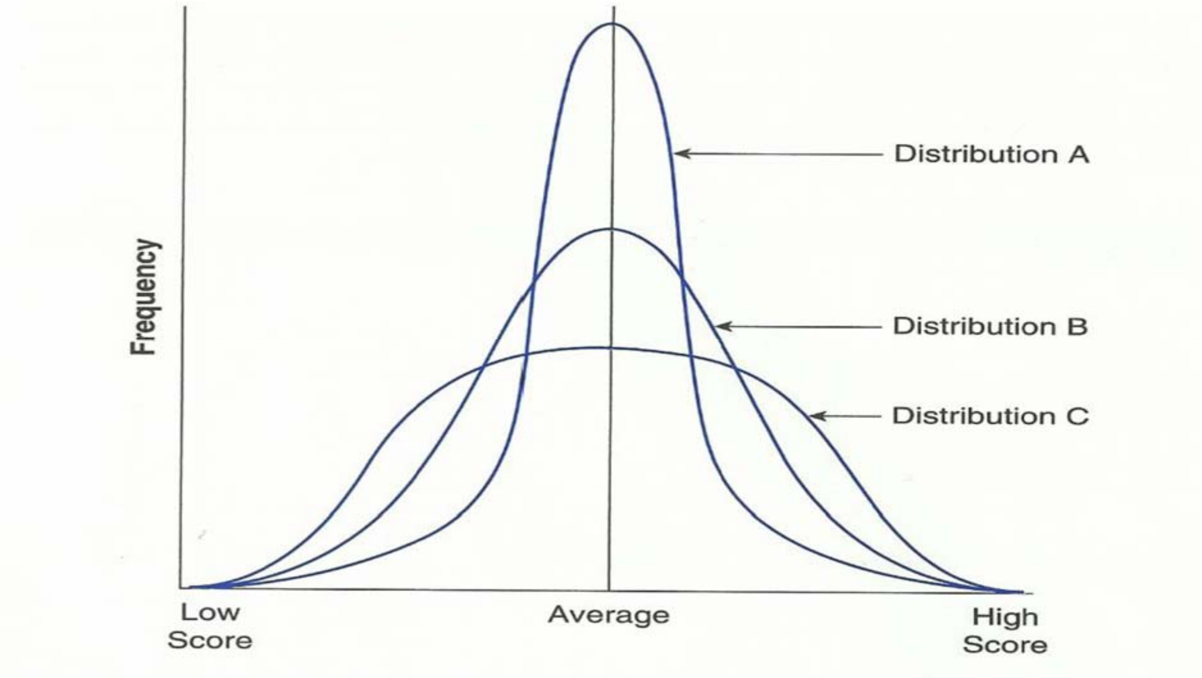

Figure 2. How distributions can differ in variability (Salkind 2014).

The distributions in figure 9 all have the same mean value but they differ in variability. The variability in distribution A is less than that in distribution B and, in turn, less than found in C (Salkind 2014).

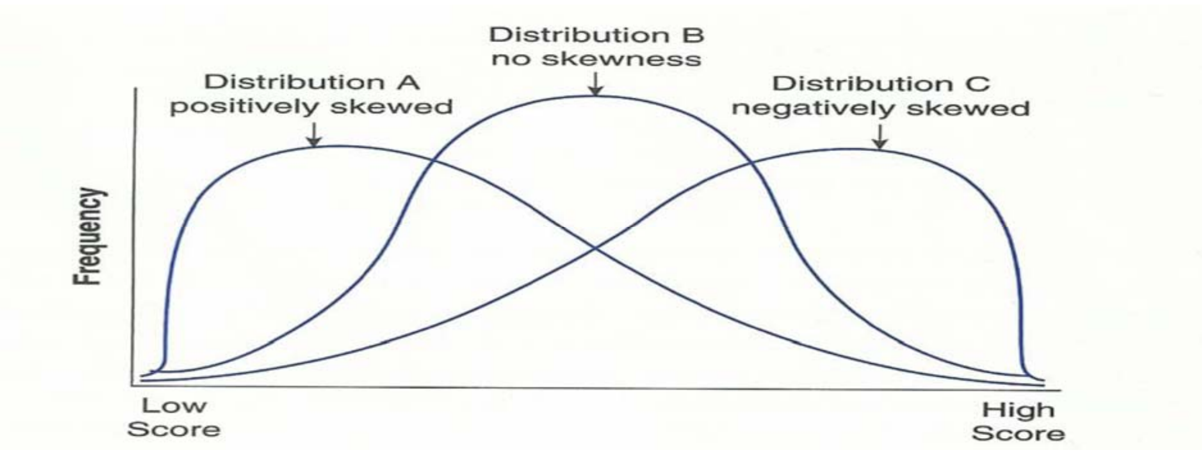

Figure 3. Degree of skewness in different distributions (Salkind 2014).

Skewness is a measure of the lack of symmetry of a distribution. In other words, the tail of the distribution is longer than another. In figure 10, the right tail of distribution A is longer than its left tail, corresponding to a smaller number of occurrences at the high end of the distribution. This is a positively skewed distribution. Distribution C's right tail is shorter than its left tail, corresponding to a larger number of occurrences at the high end of the distribution. This is a negatively skewed distribution. Distribution B have tails with equal lengths and is not skew (Salkind 2014).

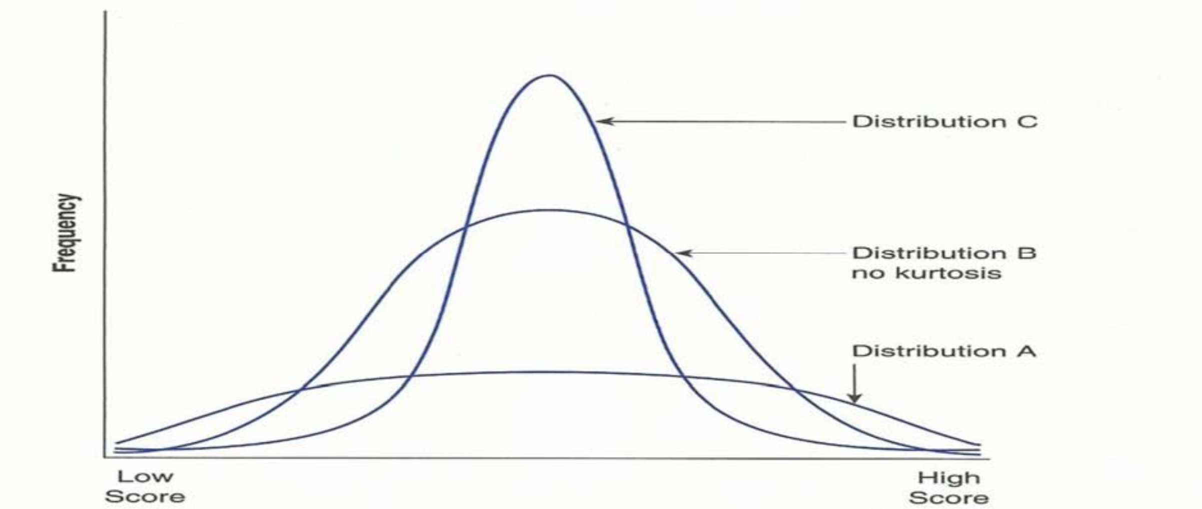

Figure 4. Degrees of kurtosis in different distributions (Salkind 2014).

Kurtosis has to do with how flat or peaked a distribution appears. Distribution B has a normal distribution and, therefore, no kurtosis. Distribution C is relatively peaked and is less variable or dispersed relative to distribution B. Distribution A is relatively flat and is more variable or dispersed relative to distribution B (Salkind 2014).

Skewness can be determined by using the following formula (Salkind 2014):

$$Sk = \frac{3(\overline{X} - M)}{s}$$

- Sk is Pearson’s measure of skewness
- X is the mean
- M is the median
- s is the standard deviation

Appendix V

Inferential statistics

Inferential statistics are used to infer something about the population based on the sample's characteristics.

Statistical significance is the degree of risk the researcher is willing to take that a null hypothesis will be rejected when it is actually true. The null hypothesis always states that there is no difference between the two sample groups. The null hypothesis can be true of false. Either there really is no difference between groups, or there really and truly is an inequality. If the level of significance is 0.05, it means that on any one test of the null hypothesis, there is a 5% chance that the researcher will reject it (and conclude that there is a group difference) when the null is true and there really is no group difference at all. The inferential method works as follows (Salkind 2014):

1. The researcher selects a sample representative of the populations from which they are drawn.

2. The mean scores for groups are computed and compared using some statistical test.

3. A conclusion is reached as to whether or not the difference or the ratio between the scores is the result of chance or the result of true and statistically significant differences between the groups.

4. An inference, based on the results of an analysis of the sample data, is made about the population from which the sample was drawn.

A confidence interval is the estimate of the range of a population value that can be determined given the sample value. It indicates how much confidence a researcher can have that the population mean will fall between two scores. A 95% confidence interval would be correct 95% of the time (Salkind 2014).

Analysis of covariance (ANCOVA) is a different kind of analysis of variance (ANOVA). With simple analysis of variance, there is one factor or one treatment variable being explored, and there are more than two groups or levels within this factor or treatment variable. The technique is called analysis of variance because the variance due to differences in performance is separated into (a) variance that is due to differences between individuals within groups and (b) variance due to differences between groups. Then, the two types of variance are compared with one another. If more than one factor or treatment variable are examined, factorial analysis of variance is used. ANCOVA allows you to equalize initial differences between groups (Salkind 2014).

Prediction is the computation of future outcomes based on knowledge of present ones. The simplest way to think about prediction is to think that you are determining the score on one variable (the criterion, dependent variable or outcome variable) based on the value of another score (the predictor or independent variable). The way to find out how well the predictor can predict the outcome variable is through the creation of a regression line. The line is created from sample data that have been collected. The equations are then used to predict scores that will apply to the population. There is also the case of regression where more than one predictor or independent variable is used to predict a particular outcome. This model is called multiple regression (Salkind 2014). In some cases, the outcome variable is dichotomous, but one or more predictors are continuous. In this case, an analysis is desired that is similar to multiple regression, but that takes into account that categorical nature of the dependant variable. Logistic regression is such a procedure; the outcome is the logit of the probability of the outcome event occurring. That is, the model is the same as a logit model, except that one or more predictors are continuous. Logit models use the logit of the probability as the outcome, where the logit is defined as the logarithm of the odds (Kaplan 2004):

$$\text{logit}(p) = \ln\{p/(1-p)\}$$

Although statistical significance is one way to measure the size of a difference between two group means, effect size is becoming a more prevalent way to express this relationship in educational program evaluation. Indeed effect size is seen as much more important than statistical significance (Cohen et al. 2007). Effect size provides an estimate of the program's impact (Thompson et al. 2004). It is a measurement of the magnitude of the treatment (Salkind 2014). A common way to express effect size is Cohen's d statistic, in which the difference of the means of the treated and control groups are standardized, by dividing that difference by the pooled standard deviation of the two groups (Cohen et al. 2007):

$$d = \frac{mean\ of\ the\ experimental\ group - mean\ of\ control\ group}{pooled\ standard\ deviation}$$

By expressing the difference of group means in terms of standard deviation units, Cohen's d statistic provides a simple metric that allows researchers to compare treatment effects from different studies even if results are reported using different units of measurement. This makes it possible to compare a range of programs and thus supports evidence-based decision-making on the part of policymakers (Thompson et al. 2004). The following guidelines can be used to determine the size of the effect (Salkind 2014):

A small effect size ranges from 0.00 to 0.20.

A medium effect size ranges from 0.20 to 0.50.

A large effect size is any value above 0.50.

It is, however, important not to interpret effect sizes with the same rigidity as statistical significance with regards to cut-off points (as indicated above), but relate the effect sizes found to those of prior studies (Cohen et al. 2007). In educational program evaluation, effect sizes of common interventions on student learning vary from below 0.10 standard deviations to 0.70 standard deviations or more (Thompson et al. 2004). Hattie (1992) found that spending a year in school has an effect size of around 0.40 on student learning. Among the national samples used to norm the Stanford Achievement Test-9th Edition (SAT-9), fifth graders scored 0.5 of a standard deviation higher than fourth graders in math and 0.3 of a standard deviation higher in reading (Granger & Kane 2004).