What Effect does an After-school Science, Maths and English Enhancement Programme have on Grade 10 to 12 Students' Learning of Physical Science?

by

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ABSTRACT

The main purpose of this study was to determine whether a Physical Science intervention programme that has been running for three years at St John's College for selected Grade 10-12 students from under-resourced schools in inner city Johannesburg, has had any impact on the final academic results of these selected students in the National Senior Certificate examination. There is little international or local research that deals with third world academic extension and enrichment programmes, particularly with respect to South Africa. A mixed methods case study on the programme was carried out. Numerical data was collected over a period of three years to be used to determine the effectiveness of the programme. Interviews with the participants and teachers on the programme were conducted and surveys were carried out with participants on the programme as well as students who were not on the programme from the three partner schools. The three instruments used in the research provided different forms of data which produced findings that were combined to look for common trends and understandings.

The data collected from the surveys, interviews and term scores were coded, captured organised, analysed and interpreted. Among the more significant findings were: (a) Not all of the participants on the programme showed academic improvement; (b) The overall academic improvement of the two groups researched was marginally better than their peers who were not part of the programme; (c) In the view of the participants, the intervention had a greater influence on their academic achievements than the actual findings from analysis of the numerical data indicated; (d) There are a number of factors that determine the success of the programme; (e) The self-motivation is an important determinant for success of individuals on the programme. These findings could assist current programme organisers and institutions that seek to introduce similar types of intervention programmes in the future.

DECLARATION

I, Derek Bradley, declare that:

(i) The research reported in this thesis, except where otherwise indicated is my original work;

(ii) This thesis has not been submitted for any degree or examination at any other university;

(iii) This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons;

(iv) This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a) their words have been re-written but the general information attributed to them has been referenced;

b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

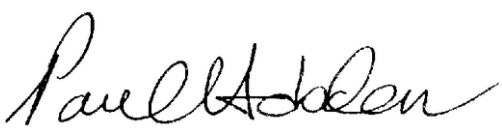
(v) The work described in this thesis was carried out in the School of Education, University of KwaZulu-Natal, from 2009 to 2012 under the supervision of Prof. Paul Hobden (Supervisor) and

(vi) Ethical clearance No. **HSS/1197/011M** was granted prior to undertaking the fieldwork.

Signed: 

Derek Bradley

As the candidate's Supervisor I, Paul Hobden, agree to the submission of this minor dissertation.

Signed: 

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ABBREVIATIONS

AFT:	American Federation of Teachers
ARC:	Afterschool Research Consortium
ASSAF:	Academy of Science of South Africa
CASE	Cognitive Acceleration through Science Education
CASME:	Centre for the Advancement of Science and Mathematics Education
CASS:	Continuous assessment
CDE:	Centre for Development and Enterprise
CEP:	Curriculum extension programme
CRESST:	Centre for Research on Evaluation, Standards, and Student Testing.
DOE:	Department of Education
GDE:	Government Department of Education
HFRP:	Harvard Family Research Project
IEB:	Independent Examinations Board
JET:	Joint Education Trust
OST:	Out-of-school time programme
SACMEQ:	The Southern Africa Consortium for Monitoring Educational Quality
SEDL:	Southwest Educational Development Laboratory
SES:	Socio Economic Status
SJC:	St John's College
STEM:	Science, Technology, Engineering and Mathematics
TASC:	The after school corporation
TIMSS:	Trends in International Mathematics and Science Study
TMP:	Teacher Mentorship Programme
TSR:	Teacher-student relationships

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I would like to thank all the Academy students who were willing to participate in this study and to the Principals of the three schools involved and to the teachers of the Academy students who have given up time to be involved in such a worthwhile programme and finally to Prof. Paul Hobden, my supervisor, without whose suggestions and guidance, this study would not have been achieved. I would also like to thank Prof. Hobden for being prepared to meet me in Johannesburg in order for me to undertake this study.

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND TO THE RESEARCH.

A number of intervention programmes have been initiated in South Africa in an attempt to improve the academic achievements of students who are involved in such programmes. The introduction of intervention programmes is in response to the poor matric results achieved by many students in the National Senior certificate (NSC) final school examination and the poor achievement by a number of students who have entered University but who have not been able to manage the academic rigour (Taylor, 2010). There have been efforts made by Government to improve the situation with little success. Lusi (1997) had the following to say:

> The goal of complex reform is specifically to improve instruction, and thereby student achievement. Bringing about this type of reform is long term work requiring additional capacity at both the state and local level. It is also work that no one to date has had much success with, particularly on a state-wide scale. No one knows exactly how to bring about complex change. (p. 170)

There is a shortage of students attempting Science based degrees and there is a shortage of Scientists, Engineers and Technologists in South Africa and many programmes have been introduced to address these shortages. According to Reddy (2006a) in her assessment of the findings of the Trends in International Mathematics and Science Study (TIMSS) the poor performance in Science by a large sector of South African students is as a direct result of poorly qualified teachers, large average class sizes of 45, poorly resourced schools and the fact that a large number of students are not being taught and tested in their mother tongue (p. 116). Grayson (2012) concurs and had this to say at the Independent Examination Board (IEB) regional Schools Conference:

> The standard of Mathematics and Science at Matric level is of great concern as statistics show that even though the ‘performance’ in the matric exit exam would indicate an improvement from 2008, the skills that first year engineering students have on entering university has shown a marked regression. A lack of depth into subject material at school level seems to be problem. (p.1)

Reddy has made reference to the poor teaching and large class sizes and unfortunately, many schools across South Africa experience these problems.

The report on the TIMSS project has highlighted the problems at Grade 6 and Grade 9 level in South Africa. Suggestions around poor teaching or teachers simply not being qualified are reasons given for the problems experienced. I believe that this is too simplistic; the problems are far more complex than this. According to Kriek and Grayson (2009), there is cause for concern about performance in Science, Technology, Engineering and Mathematics (STEM) in South Africa. When South Africa participated in the Trends in International Mathematics and Science Study (TIMSS) in 1995, 1999 and 2003, we ranked last out of the 50 countries that participated (Reddy, 2006). At university level, our graduation rates in STEM are poor. As a result, the pool of potential scientists, engineers, health practitioners and future teachers of mathematics and science is severely limited. This, in turn, limits South Africa's ability to be internationally competitive, as well as its ability to provide the infrastructure needed for the well-being of the majority of its people. Jansen (2012) concurs and had the following to say: "Our society, schools and universities have adjusted expectations downwards, especially in relation to black students, and that is dangerous in a country with so much promise for excellence" (p. 7).

It is as a consequence of all of these issues that intervention programmes of various types have been introduced in South Africa. In 2001, the Department of Education launched the National Strategy for Mathematics, Science and Technology Education (NSMSTE) in pursuit of improving the quality of teaching and learning in Mathematics and Science. A central initiative of this strategy was the identification and support of Dinaledi Schools or focus schools for mathematics and science (Taylor, Shindler, du Toit, & Mosselson,, 2010). Other initiatives mentioned by Taylor et al. are the STAR Schools is another intervention initiative that was introduced to attempt to improve the results of students from less advantaged schools and the LEAP schools which provide education to students with potential from high-need communities and they require that all students study mathematics, physical science and English. Taylor et al. (2010, p. 6) in his assessment of different intervention programmes also mentions the initiative of the Independent Schools Association of South Africa (ISASA) in providing children with talent from less advantaged backgrounds the chance of attending an Independent school via generous bursaries supplied by donors.

There has also been unease at the small number of students attempting Physical Science and Mathematics. Programmes, such as the St John's Academy, have been initiated to try and improve the results in these specific subjects**.** The introduction of this programme was as a consequence of the state of many inner city schools and the fact that the Education Department did not appear to be making the improvements necessary to place many students

in a position to be successful in the National Senior Certificate examination (NSC). The St John's Academy was initiated in 2008, with the express purpose of introducing an academic outreach programme for selected male students in grade 10 to 12 from three less advantaged inner city secondary schools. Selected boys are transported every weekday to St John's College where they are taught Physical Science, English, Mathematics and Computer skills. There are three hours allocated to the teaching of Physical Science (the main focus discipline of the study) per week. The three partner schools are under-resourced and this was one of the reasons these schools were selected. In the preliminary examination of the schools we found that class sizes are excessive (in some cases, in excess of 40), teacher absenteeism is a problem and physical facilities are not what they should be. We established the Academy in the belief that we could through sharing resources make a difference to at least some of the boys.

St John's College is an extremely well-resourced school, both in terms of physical facilities and competent and highly qualified teaching staff and we have consistently produced some of the best academic results for any school in the country. Within each discipline offered, it is our aim to provide consolidation tuition, to expose the students to more practical work particularly in Physical Science and to experience tuition through the latest technology available in teaching. We began the Academy with the firm belief that this added input would lead to an improvement in the results that the boys achieve in the final NSC examination. My intention in this study was to establish what impact this afterschool intervention programme has on the achievements of the participants. Little research has been conducted on the effectiveness of such programmes (Taylor, Muller, & Vinjevold, 2003, p. 19). Vaden-Kiernan, Lauer, Reisner and Pierce (2009) had the following to say about intervention programmes:

> Recent evaluations and research syntheses of after-school programs rated as high quality show they are associated with increases in student achievement and other positive socio-behavioural outcomes. Those examinations provide a springboard for the next much-needed area of investigation—whether after-school programs containing academic content can have positive impacts on student achievement—about which scant rigorous evidence exists. (p. 2)

1.2 RESEARCH QUESTIONS

The key question that this research initiative addressed was: What is the effect of the after school intervention programme in Physical Science? The following sub-questions guided my investigation:

1 Do the students' academic achievements improve significantly more than their peers who do not receive the intervention?
2 What effect does the intervention programme have on students' attitudes to school, science and learning?
3 What are the participant's views on the instructional emphasis on practical work?
4 What factors do the participants consider to be most influential in determining the success or failure of the intervention from their perspective?

Taken together, these questions guided the collection of data that was used to answer the main question.

1.3 THE RESEARCH METHOD

The study of the Academy programme has involved two different groups of participants. The first group started in grade 10 in 2008 and wrote the National Senior Certificate examination at the end of 2010. The second group started in 2009 and finished in 2011. Each group was therefore studied over a three year period. I was looking for the impact that such an intervention has on the academic progress of participants specifically in Physical Science during the three years. I believed that there were a number of factors that have an influence on the success of participating students. I therefore decided to approach this research from a pragmatic perspective. According to McMillan and Schumacher (2010):

> In the pragmatic paradigm, there is a belief that the scientific method is, by itself, insufficient. Rather, common sense and practical thinking are used to determine the best approach (e.g. quantitative and qualitative), depending on the purpose of the study and the contextual factors. This method provides the theoretical basis for conducting mixed-method studies. (p. 6)

I decided that only studying their marks and results would not provide sufficient evidence or information about the success of the programme. I therefore decided that implementing a mixed method approach (Johnson, Onwuegbuzie, & Turner, 2007), would best suit this study. According to Creswell (2009) "Collecting diverse types of data best provides an understanding of a research problem" (p. 18).

My research questions were best answered by gathering a variety of data through interviews, surveys and the compilation of test results. As a consequence, my approach was to employ a variety of methods and techniques of data collection and analysis. The type of mixed method design strategy that I used was a concurrent embedded approach (Creswell, 2009). The quantitative method was 'embedded' in the qualitative method because a smaller portion of the data collected was summative (assessment marks) with interviews and surveys used as a source of information about individual experiences, Essentially, the intention of the qualitative aspect was for the students primarily to tell their 'own stories' about what effect the programme has had on them. Creswell (2009) has the following to say: "The concurrent embedded model may be used to serve a variety of purposes. Often, this model is used so that a researcher can gain broader perspectives as a result of using different methods as opposed to using the predominant method alone" (p. 215). Thus, information obtained from the two methods was then integrated to gain a more comprehensive view. There were three different groups of participants in the research. Firstly, all the academy students formed one group. Secondly, the second group were the peers of the selected group who were not selected, that is, their classmates in their own schools and the final group were the tutors and teachers. Given that I was working at St John's College, it was decided to use this as the case due to the convenience and access to data from the school programme.

A case study was chosen as it fitted the types of questions that needed to be answered with the Academy after-school enhancement programme being the subject of interest. According to Yin (2009) a central tendency of case studies is to illuminate decisions that have been made. In this case a decision was made to have an enhancement programme. The case study would indicate what the result of this decision was. In addition the case study would be investigating a phenomenon in its real life context as it was a complex phenomenon in which the boundaries were not clearly defined. For example it is not clear that the act of teaching the science would be the only determinant of improvement in results. Finally case studies rely on many sources of data and in this case a mixed method approach seemed to be suitable. Given that it was proposed to carry out a case study it was envisaged that the focus of some of the questions could be influenced as data was collected. The questions listed above were considered guiding questions open to change.

1.4 AN OVERVIEW OF THE DISSERTATION

This dissertation consists of six chapters. This first chapter is an introduction. It sets out the overview of the study and of the background which provided the motivation to embark on the study. The second chapter is a review of the literature which includes relevant theories and findings about after-school programmes and sets out the theoretical analysis of the effectiveness of the programme with a specific focus on factors that enhance and inhibit learning and progress in such programmes. The third chapter describes and accounts for the research methods and the tools or instruments used that enabled the researcher to gather the required data and the techniques of analysis and interpretation used and to achieve the purpose of this study. Chapter four deals with the analysis and discussion of the numerical data and chapter five describes and explains the data accumulated through the use of surveys and explains the findings from the interviews. The findings from both instruments were compared in this chapter. The setting of the study is described and the meanings that the participants had formed whilst on the programme are given which provides insight to reasons for success and failures. Chapter 6 provides summaries, limitations, conclusions and possible implications for further study in the field. This was constructed through careful analysis of the actual results obtained by the participants on the programme and comparing these findings with research carried out on similar programmes both locally and internationally.

CHAPTER 2
LITERATURE REVIEW

For the purpose of this study, I have divided this literature review into five main focus areas, all of which are relevant to intervention programmes. These focus areas are: (a) The description of intervention programmes; (b) The reasons for the introduction of intervention programmes; (c) The conceptual framework for this study; (d) Research findings in studies on intervention programmes; (e) The instructional emphasis on practical work and the impact that this may have on learning and; (f) Summary.

2.1 INTERVENTION PROGRAMMES.

A definition according to Chung, Gannett and de Kanter La Perla (2000) of after-school programmes is:

> Quality community-driven, expanded learning opportunities that support developmentally appropriate cognitive, social, physical, and emotional outcomes. In addition, these programmes offer a balanced program of academic support, arts and cultural enrichment, recreation, and nutrition. After-school programs can run directly after school, or during evenings, weekends, summer vacations, and holidays. (p. 2)

Chung et al. expand their description by saying that there are different forms of after-school programmes that are designed to fulfill specific needs. Broadly, they can be split into three types “youth development," "school-age child care," and "extended day programmes" or "expanded learning programmes." Providers of afterschool programmes tend to be schools or community-based and faith-based organisations. Programmes can be accommodated in various settings where students feel safe. There are different programmes which are accessible to different age groups, starting at elementary school level and continuing through to post-school (p. 3).

In South Africa, according to Taylor and Vinjevold (1999), intervention programmes can take various forms but the majority of such programmes are created to improve the academic results of participants or as has been defined by Chung et al. "expanded learning programs.” In my experience, parents in various centres across the country are beginning to recognise the benefits a quality afterschool program can provide. Because they offer a range

of subjects not always properly taught which would include the core subjects of English, Mathematics and Physical Science during the traditional school day, these programmes give students many opportunities for growth and learning they might not find elsewhere. For example, at a time when many schools have had to cut or reduce spending on teaching staff and facilities Taylor (2008) had the following to say: “After-school programs can offer students the opportunity to spend time in small groups with highly competent staff” (p. 12). Feldman (2000), president of the American Federation of Teachers wrote a holiday wish list in which she asked for more learning time for children who need it.

> There is accumulating research that after-school programs, summer school, and extended days enable children who are behind to catch up. Simply focusing on academics is not enough. Poor children need the kind of extras that advantaged children take for granted but that too many poor children don't get: sports and cultural activities -- like singing in choirs, dancing, visiting museums -- and going on organised excursions." (p. 7)

2.2 THE NEED FOR INTERVENTION PROGRAMMES

Research shows that there are various after-school programmes that are developed to target specific needs of a particular community. Measured success rates have also been shown to vary dramatically from one programme to the next. I will specifically focus on the academic progress made within programmes that attempt to improve the understanding and performance in Mathematics, English and most importantly, Science. Crewe (2009) had the following to say about the state of Science and Mathematics in South Africa:

> The state of Science and Mathematics in South African schools has frequently been termed a national crisis. South African students have fared poorly in comparative tests of Science and Mathematics at both international and regional levels and in local benchmark texts. As a result, the pool of potential scientists, engineers, health practitioners and future teachers of mathematics and science is severely limited. This, in turn, limits South Africa’s ability to be internationally competitive, as well as its ability to provide the infrastructure needed for the well-being of the majority of its people. (p. 7)

Jansen concurs (2012) and argues that although the matric exam results are getting stronger, the preparedness of students for University is getting weaker. – resulting in high dropout rates and a poor quality of graduates' skills. He quotes Professor Yeld, Dean of Higher Education Development at the University of Cape Town who stated that new students 'flounder and fail or scrape through with marginal passes' because of failures by their schools to adequately prepare them for university (p. 5).

According to Spaull (2012), teacher absenteeism in South Africa is twice as high as that of Namibia and Botswana, and three times higher than Mozambique's. This state of education in South Africa has resulted in organisations looking to 'fill the gap' or simply to provide some form of intervention so that pupils will be in a position to succeed in the national Senior Certificate and have the skills to enter and be successful at tertiary institutions. Science and Mathematics are two of the subjects that require time, energy and resources to improve both the teaching and learning in these areas. Intervention programmes such as the St John's Academy have been initiated for precisely this reason. Overseas where similar situations prevail, after school interventions have also been initiated:

> The After School Corporation (TASC) is a non-profit organisation established through a challenge grant from the Open Society Institute in 1998. Its mission is to enhance the quality, availability and sustainability of After-school programmes in New York City and beyond. With the goal of making after-school programmes a public responsibility. TASC funds, supports, monitors and evaluates after-school programmes in New York City. It works with local and national partners to build high quality, sustainable after-school systems in New York and beyond (Mahler, 1998, p. 2).

The TASC programmes were initially introduced in order to address the perceived low achievement in many subjects such as Mathematics, Science, English and the other Humanities by pupils in the greater New York area. According to its Department of Education 68% of Americans who start high school graduate four years later. In the State of New York fewer than 60% of students and only 55% of young males do so, just 47% of black students, 45% of Hispanic students finish high school on time (Mahler, 1998). There is therefore a need to involve more young people in academic support programmes. High quality after-school programmes have arisen to address these challenges.

Vaden-Kiernan, Hughes, Jones, Rudo, Fitzgerald and Hartry (2009) under the auspices of Southwest Educational Development Laboratory (SEDL) and more specifically**,** the Centre for Evaluation and Education Policy (CEEP) at the University of Indiana researched the

impact of a number of after-school programmes. The programmes were introduced to both enhance and support the learning taking place in the schools in the area. The programme researchers collected data from multiple sources using a variety of methods to assess study implementation and reliability of programme implementation. Observation rating scales were used during site visits. Information about teachers' use of the instructional components of the programs was collected using these rating scales during the scheduled structured observations. Focus groups and interviews with principals, afterschool program directors, and instructors also were conducted during the site visits; these sessions provided descriptive information about teachers' experience with the intervention in their after-school classrooms. The programme organisers emphasised the following outcomes:

> Academic programming in afterschool settings remains a potentially rewarding and important endeavour. Gaining a better understanding of the relative effectiveness of the types of academic assistance offered in afterschool settings (i.e., unstructured and structured academic enrichment, tutoring, and homework assistance) and the target groups, in afterschool settings are inherently bewildered by programme reliability, quantity and duration challenges. Namely, many structured academically focused afterschool programming or curricula, like the ones in these trials, are adapted from curricula modelled in day-school settings and therefore have inherent challenges to reliability when placed in an afterschool setting. Many programs operate only 4 days a week for 2–3 hours per day with about 45–60 minutes per day focused on academic enrichment, limiting the program treatment or quantity. (p. 14)

Huang and Cho (2009), who has spent nearly a decade evaluating after-school programs recently led a group of researchers under the umbrella of the Centre for Research on Evaluation, Standards (CRESST) in a study in which they examined the effects of the Los Angeles' Better Educated Students for Tomorrow (LA's BEST) after-school program based on programme dosage (the amount of time spent on the programme). The researchers analysed achievement using the following after-school attendance doses: less than 20 days, 21 to 50 days, 51 to 100 days, and more than 100. Their findings indicated that there was a strong link between the achievement and attendance. Generally those students that attended for more than 100 days showed a greater improvement than those who attended for less than 100 days.

There has also been some attention placed on student intervention programmes in developing countries such as South Africa. According to a report by Gresser and Ross-Larson (2003), achieving universal primary education and eliminating gender disparities in primary

and secondary education require addressing efficiency, equity and resources levels as related problems must become a priority. The report continues by setting out a number of goals; providing quality education ranks second on the list of 8 main goals. The following statement appeared in the report, which highlights the importance of education in developing countries:

> Lack of education robs an individual of a full life. It also robs a society of a foundation for sustainable development because education is critical to improving health, nutrition and productivity. The education goal is thus central to the other goals. (p. 9)

To this end, it is vital that answers are found to providing quality education. Academic intervention programmes such as the Academy programme may have an important role to play in this regard.

2.2.1 Local research into the need for intervention programmes.

According to Taylor et al. (2010, p. 3) in a recent review of projects, there are currently a number of different secondary school intervention programmes running in South Africa. There are programmes that take place after school, on weekends and during school vacations operating out of universities and other higher education institutions. These programmes are in place as a result of the desperate state that many of South African Schools are in, in terms of the delivery of even basic education (Crouch, 1999). While all of these programmes studied seem to provide a valuable service to the students selected, most of them have not been externally evaluated. The report found that the common thread through all programmes is that the academic enrichment involves at least Mathematics, Physical Science and English and that it would appear from most programmes that teachers have to deal with backlogs in these subjects.

There are a number of after-school programmes currently in operation across South Africa. A few of them target pupils at the Matric level only, offering ‘cram’ courses in various subjects whilst others offer more extensive programmes spanning a few years. There is diversity in how these programmes operate, some are exclusively offered on Saturday mornings whilst others are offered in afternoons during the week. Many Independent Schools are involved in, or run their own extension programmes, targeting pupils from previously disadvantaged communities. Taylor et al. (2010) in a report for the Centre for Development and Enterprise (CDE) highlighted ten such programmes. He made it clear that at the time of

writing the report, very little research had been carried out on the effectiveness of these, or in fact, any other out-of-school programmes in South Africa (p. 19).

Taylor's report simply provided information about the type of programme and a brief description for each of the programmes. He identified two main types: Enrichment and placement programmes. The enrichment programmes leave their children in their current schools and provide extra classes after school hours. Such programmes could be offered on the premises of the host school or some other venue. Placement programmes on the other hand take capable pupils from deprived backgrounds and place them into better resourced schools. In his concluding remarks, Taylor made mention of the high costs of the various programmes but available information to this point suggests that the various programmes are effective in achieving their goals (p. 10).

.....Two examples of these programmes are the LEAP and the ISASA programmes. A number of headmasters and parents within better resourced schools in South Africa have identified the inequality that exists in terms of facilities and teaching staff and have attempted to make some kind of a contribution by providing such programmes to students from 'less-advantaged' schools. For example, the LEAP programme, which focuses on Mathematics, Physical Science and English, is an example. This programme provides extra tuition to students as preparation for entry into tertiary institutions. Another programme (ISASA M&E Project), organised through 19 Independent schools, accommodates 338 students from disadvantaged backgrounds within the schools as extra students with the emphasis being the improvement of achievement in Mathematics and English.

There have also been large scale interventions. The Joint Education Trust (JET) was commissioned by the National Department of Education to manage school development programmes involving more than 1600 schools. This work involved programme design, project management and all associated activities, service provider management, training of managers, teachers and district officials and offering technical advice on school improvement. The Monitoring and evaluation formed a critical component of school development projects managed by JET. The organisation's Evaluation and Research Division (ERD) is therefore involved in most of the projects that JET is contracted to manage, primarily to provide a measure of how students are benefiting. Assessment of student performance is a key element, helping to ascertain which factors make a difference in improving the quality of schooling. ERD's work revolves around the distinct activities of evaluation and research. Research is conducted with the idea that if the findings from the investigations of the impact of programmes were positive then could they be used in a wider

context. Evaluation focuses on assessing the value of particular projects. However, evaluation has its greatest value when designed to answer important research questions, in addition to providing both foundational and collective feedback to project participants. JET's project evaluations are therefore designed to answer essentially two questions: 'Did the project have its intended impact?' and 'Is this an appropriate model for improving schools under similar conditions?'

ERD's research designs are based on the collection of empirical evidence that demonstrates and supports viable impact. The knowledge derived from this work ultimately shapes JET's own programmes, and at the same time, directs funders and donors in the design of their education development projects. The division's activities are planned to maximise lessons for future work and to have a positive impact on the education system. Taylor (2008) under the auspices of JET investigated various programmes.

The Centre for the Advancement of Science and Mathematics Education (CASME) is an outreach and teacher professional development unit of the School of Science, Mathematics and Technology Education at the University of KwaZulu-Natal. CASME aims to address historical, universal imbalances characteristic in the South African education system by improving and sustaining the quality and accessibility of mathematics and science education. This initiative was initially aimed at providing focused support to selected educators and schools in order to double the number of students passing Mathematics and Science at Grade 12 level. There is a shortage of qualified Scientists and Technologists in South Africa and in order to be able to compete on an equal footing in the international arena this shortage needs to be addressed immediately. Young, passionate individuals need to be trained so as to fill this gap. However, some schools in South Africa do not have well-trained science teachers, nor do they have resources or laboratories. Also, teacher to student ratios in a class is often so high that the teacher only conducts practical demonstrations, where possible, in Science. Taylor (2008) says that this together with other factors such as lack of funds has had a significant negative impact on the number of students entering the Science field. To help alleviate this problem it is believed that teachers need to place more emphasis on STEM (Science, Technology, Engineering and mathematics) careers and encourage students to choose STEM careers. For this to be achieved the teachers themselves need to be properly qualified and assertive in the teaching of science and in so doing preparing students for tertiary education in these fields.

Teachers need support through in-service training as well as developing their content knowledge and their pedagogic skills. The intervention programmes have also been

developed to help provide at least some pupils with the skills to be confident when entering a science based field (World Science Forum, 2007). There is a direct correlation between a nation's wealth and its scientific and technological capacity. In South Africa we need to make a concerted national effort to promote science and technology as a means of improving living standards. The most effective way of taking our country forward is to engender in our young people an enthusiasm for science and technology. One of the purposes of introducing intervention programmes has been to address this shortage of students entering science fields**.** At university level, our graduation rates in STEM are poor. As a result, the pool of potential scientists, engineers, health practitioners and future teachers of mathematics and science is severely limited. This, in turn, limits South Africa's ability to be internationally competitive, as well as its ability to provide the infrastructure needed for the well-being of the majority of its people. After-school programmes have been initiated in an attempt to provide pupils with the skills needed to succeed in science fields.

Another form of intervention is that is being instituted in South Africa is support programmes to up-grade teachers. Fricke, Horak, Meyer and van Lingen (2008) looked at a Mathematics and Science Intervention Programme in Tshwane Township Schools. The Teacher Mentorship Programme (TMP) based at the Department of Civil and Bio systems Engineering of the University of Pretoria was created as a result of lessons learnt from on-going outreach and awareness creation projects and recent research findings. The most cost-effective and sustainable support for Maths and Science students can be achieved by mentoring their teachers in their work environment (p. 64). The development of teachers is not part of this study however, it is important to note that teacher intervention programmes are seen as an extremely important and fundamental aspect to providing quality education in a country such as South Africa and such intervention programmes have been started in an attempt to improve the teaching and learning in schools. Research into programmes of improving teacher skills and the possible impact this would have for education could be a possible study on its own.

2.2.2 The need to develop critical thinking and problem-solving skills.

One of the key factors in the design of the Academy programme was the development of both critical thinking and problem solving skills. A conscious decision was made in this regard as we believed that many schools are not providing sufficient opportunities to improve these

vital skills. The St John's Science curriculum covers the prescribed content set out by the GDE as well as providing much greater depth in selected key areas so as to provide the students with necessary skills to follow a science based degree. Our intention was to provide the Academy students with as much of the St John's science material as possible, thus providing them with these problem-solving abilities. Research would appear to indicate that breadth as opposed to depth in a subject area would necessarily lead to a lack of development of critical thinking skills. Reddy (2006) in her analysis of Trends in International Mathematics and Science Study (TIMMS), supports this line of thought.

Unfortunately, when the boys arrive onto the Academy programme at the beginning of Grade 10, most of them have serious misconceptions and a general lack of basic knowledge in Science. The programme design has had to address this issue as well as promoting problem-solving and critical thinking skills. Taylor in his assessment of out-of-school programmes, 2008, makes mention of the fact that intervention programmes that target pupils towards the end of their schooling would appear to have less impact than those that are instituted at a younger age (p. 26).

Our intention during the grade 10 year was to address these problems and attempt to have them all at the same level of understanding in Science by the end of that year. From grade 11 to the end of their matric year their teachers in the Academy have concentrated on completing the curriculum, exposing them to extensive practical laboratory work and providing them with opportunities to improve their problem-solving and critical-thinking skills. I believe that the students on the programme will show an improvement over the three year period when measured against their peers and against themselves.

2.3 **THE INTERPRETIVE FRAMEWORK**

The aim of this section is to provide the interpretive framework which forms the basis of this study. An interpretive framework according to Smyth (2004) is an instrument that assists the researcher to review relevant literature for the study. It also helps in designing appropriate methodological and data analysis procedures. In other words, it determines the literature, methods of data collection and data analysis. In support of this argument McMillan and Schumacher (2011) point out that the framework highlights the intellectual or scholarly perspective in which the problem is embedded and described. The framework is also used to justify the selection of the subjects, variables and design (p. 74).

In order to inform the study a preliminary literature search has been undertaken in the broad area of teaching and learning physical science (Redish, 2003). The intervention programme has as its focus the teaching and learning of physical science with the goal of improving students understanding and through this their achievement in the NSC. Consequently theories and concepts dealing with teaching and learning, student success, student conceptual understanding, attitudes to learning and school will all inform this study and play a role in interpreting and understanding the findings. Consequently work from this area of the literature will form the basis of my theoretical and conceptual framework. In addition it was felt that there was a need to consider as many of the other factors that could have a positive or negative impact on achieving this outcome such as motivation and student resources for studying. What follows is the start of the development of my framework or lens through which the study will be viewed (Gallagher, 1991). As I reflect on my own philosophies in relation to the study and inform myself through further reading this framework will be more fully developed.

Firstly, the idea of what constitutes quality teaching and learning is core to the intervention and consequently understanding this case study. The intervention programme has as its fundamental assumption that these students are not receiving quality teaching and consequently their learning is not optimal. It has been clear from my own experience that the students on the programme have been exposed to teaching in their own schools that has expected them to sit, listen and accept. It would appear that they are not encouraged to question and in my discussion with them they confirmed that this was the case. Only a small minority of students are prepared to answer questions. This general method of instruction has resulted in most students engaging in rote like learning when preparing for tests and exams (Hobden, 2005). Unfortunately, this will only enable them to achieve a low pass as exams are designed with only a limited amount of questions answerable through rote learning (Schuster, 1993). Consequently the students ideas and understanding of what it means to learn will need to be interpreted and understood both in relation to traditional rote learning and the new methods based on constructivist ideas (Driver, 1995) encouraged by the after-school intervention.

In the Academy, even with encouragement to question and not to simply accept all that is taught them, many of the students are reluctant to engage and it has taken a long time for them to feel comfortable to do this. Our intention is for the students to develop skills and to make meaning of their experiences through effective teaching and positive interaction with the different staff members. In this study it will be important to understand how the students

respond to this form of teaching and if they do see these teachers as different to their normal classroom science teacher. Consequently the teachers' strategies will need to be interpreted and understood in terms of what it means to be a good teacher and use of effective instructional strategies (Kirschner, Sweller & Clark, 2006). For example there is a belief that the use of practical work will help in the development of students' conceptual understanding and this will in turn lead to improved results. The current literature (Miller, 2007) on this is ambivalent and exactly how the participants view the role of the practical work will need to be questioned. It is our purpose to provide them with skills, the ability to think critically and to be able to problem solve. According to Taylor and Vinjevold (1999) "schooling should equip students to exhibit independence and initiative in directing their own learning" (p. 110). Students would be guided to acquire higher order thinking skills such as problem solving. This would necessarily assume that the teaching would be of an appropriate standard to be able to achieve this. Taylor et al. had the following to say:

> While the unequal distribution of material resources and quality teachers makes an enormous difference to student learning, the greatest obstacle to equity in any schooling system is the differential access to formal knowledge open to children of different social classes. (p.112)

This lack of access to 'formal knowledge' that Taylor refers to is addressed within the Academy programme and I believe it has had a positive impact on the results of the majority of students on the programme.

Roblyer, Edwards, and Havriluk (1997) reported that teachers have found that discovery learning is successful only when students have prerequisite knowledge and undergo some prior structured experiences. It is clear that when the boys arrive on the programme at the beginning of grade 10 the 'prerequisite knowledge' that Roblyer et al. speak about is somewhat limited. The limited amount of essential background knowledge that some of the students display may prove to have a negative impact on their performance in the NSC examination.

Howie, Scherman and Venter, (2008) had the following to say on their assessment of the outcomes of the TIMMS results. They specifically looked at the gap between advantaged and disadvantaged students in science achievement:

> One dominant factor emerged in these models and that was the students' performance in the locally developed English test that provided a measure of students' proficiency in English, the language in which more than 70% of the students wrote the science

> tests. Students who had a higher score on the English test also performed better in the science test, despite their backgrounds. (p. 6)

In their study three categories of students were ultimately identified: advantaged, semi-advantaged, and disadvantaged groups. The Academy students could be classified into the category of either semi-disadvantaged or disadvantaged and all of them have English as either their second or even their third language.

The second concept that will form part of the framework is what constitutes success. Whenever sponsors and the general public consider programmes such as this the first thing they want to know is how successful is the programme. The question that arises is what constitutes success for the different participants in the programme. With all of these interventions in place, there needs to be an assessment of the progress of the students and a measurement of how successful the learning has been. Normally, the National Senior Certificate has been used as the main predictor of effective learning by the media and department of education. There are high hopes expressed by all of the students to be able to enter university and it would appear that their parents and communities also have high expectations for them. What does success mean for these students and other participants in the study? In previous studies success has simply been that the students remain in school and finish grade 12 while others only consider a success if the student achieves over 60% in the target discipline. Such programmes are not unique, but some of the issues and factors around the acquisition of knowledge and understanding within a South African context may be unique and therefore “success” may be different to what is expected.

The third part of the framework deals with affective factors that influence learner achievement. There are a number of factors that may impact both on the attitudes displayed by the participants and on their learning both in their own schools and whilst on the programme. If the students arrive on the programme with the attitude that they want to learn and gain as much from the programme as possible then I believe they will achieve this goal and display the improved performance that is expected of them. There is evidence of certain participants on the programme who have regularly been absent and I suspect that they lack the motivation to fully utilise the opportunities that have presented themselves. I believe that these students will not make the projected academic improvements. Svinicki (2003) had the following to say about motivation and achievement:

> If I had to summarize what the research and theory on learning and motivation have to say to teachers at the turn of the twenty-first century, it would be that more than ever we believe that students are at the centre of the teaching and learning process. As

> teachers, we can filter, highlight, guide, give feedback, and encourage, but the biggest variable in what determines final performance is what the students bring to the table. The students' prior knowledge and its structure, their learning strategies, goals, beliefs, self-efficacy, and motivations all contribute to their learning. (p. 23)

There appears to be evidence that motivation is one of the key components of academic success. There are also a number of factors which encourage or promote academic motivation. In my experience, those students who display self-motivation and self-efficacy have shown improvement in their academic performance. I believe that the performance of the Academy students would be consistent with these observations. Both Gonzalez (2002) and Fan and Williams (2009) looked at the effects of parental contribution to students' academic self- efficacy, engagement and intrinsic motivation. In Fan and Williams study they investigated the effect of eight different aspects of parental involvement in the adolescent's school life on engagement and intrinsic motivation in Mathematics and English. They say that it is inadequate to look at only one aspect. They took a closer look at how different dimensions of parental involvement impacts on commitment and motivation and they explored how the various dimensions could be related to intrinsic motivation. The main findings and recommendations from the Fan and Williams study was that they found that the different dimensions of parental involvement had differing impact. For example they found that parent-school communication concerning students' poor performance and behavioural problems had a negative impact on motivation.

Another key finding in Fan and Williams study was that parents' aspirations for the children stood out as a strong predictor of the child's self-efficacy. It is interesting that parental advice at home was positively associated with motivation in English but no significant links in this regard were found for Mathematics (p. 68). In Mathematics it was further found that parents' participation with their children in extracurricular activities had a positive relation to their motivation. Excessive participation could be seen as controlling which impacts negatively on intrinsic motivation. When parents are involved in school functions it also seems to strengthen the bond between school and home which relates positively to motivation. When parents obtain information from teachers and other parents it impacts negatively on motivation (p. 69). The child feels excluded from the discourse which would necessarily undermine his or her autonomy. The key feature of school-parent contact is the content of the communication. They found that parent-school communication concerning students' poor performance and behavioural problems had a negative impact on motivation. Contact regarding more benign content had a strong positive association with motivation.

Chouinard and Roy (2008, p. 36) were concerned that there was a significant decrease in students' attitudes toward and motivation in mathematics and science in high school. Their study aims were to examine the changes in competence beliefs, utility value and achievement goals in mathematics during high school. They took gender and the time of the year into account they found that motivation in mathematics declined as the students grew older. They also found that factors such as value of mathematics in everyday life, mastery goals, and attitude towards learning and boys' competence beliefs all steadily declined over the period. They therefore concluded that a gradual drop in motivation was evident. They suggest that the value of the subject beyond the classroom should not be neglected and the teacher would therefore play a crucial role in making the subject more interesting by showing why certain methods are used (p. 45).

Academic motivation by participants on the programme may be linked to good teaching. If there is a perception that the teachers are both effective and caring, students may show improved performance. According to Ursano., Kartheiser, and Ursano, (2008):

> The reactions of teacher and student to each other and to the learning context can become barriers to the development of the teaching alliance. For the "good teacher", teaching is not a display of knowledge. Rather it is a process which includes identifying an area for learning and deciding on the interventions that will foster learning. (p. 187)

They continue:

> The teaching alliance is an essential component of the teacher–student relationship and consists of setting the context for learning, communicating with a particular student, and making an educational diagnosis. The educational diagnosis is essential to a student's active learning. The identification of the impediments to learning determines the method of educational intervention. Teaching is not a display of knowledge. It is a process of setting a context for learning, diagnosing learning problems, and deciding on the educational interventions that will be most helpful in fostering the learning of a student. (p. 192)

A summary of their findings appear in Table 2.1. (Adapted from the original table Ursano., Kartheiser, & Ursano, 2008 p. 193)

Table 2.1 *Summary of findings: The good teacher and therapeutic alliance.*

Good Teacher and Effective Learning	Therapeutic Alliance and Psychotherapy
Provides feedback to the student	Able to speak the language of the student's
Active, specific and engaged	Actively present at all times
Relevant learning	Listens closely to the student's position
Mentor	Guide
Able to take the student's perspective	Able to identify with student's emotions
Let's student identify what is to be learned	Follows the student's lead

White, Barnes, Lawson and Lawson (2009) asked students open ended questions around the idea of what helped them learn in a classroom environment, including what advice would they give to their teachers and what their teachers did that helped them to learn in class. Of the twenty one aspects that the students had initially identified, two were clearly considered by the majority of students as the most important; teacher explanations and teachers engaging students (p. 11).

Dewey (1916) had made similar findings as White et.al but suggested that teachers should inspire their students and had the following to say:

> Informal curriculum manifests itself through such intangibles as atmosphere and dispositional attitudes toward learning. It is suggested that there needs to be a shift in focus beyond the content to include individual students. The goal of the professional educator is to transform his or her students, to inspire them to think, to feel, and to experience citizenship as active members in a democratic society. (p. 45)

There are a number of other factors that should augment the progress of the participants and taken together create the context within which this intervention takes place. There are for example factors that I believe will, to some extent, inhibit the expected increase in performance of the students. For example, Bernstein, (2008) refers to 'visible' and 'invisible' pedagogy as main contributing factors to effective learning. Essentially, the visible would involve the teacher teaching in a classroom with all the necessary tools and facilities. The invisible would be the transferring of knowledge within the home, normally, by parents, but not necessarily (p. 99). Unfortunately, in South Africa, most families are not first language English speakers and therefore, much of this 'invisible pedagogy' is not taking place. Both visible and invisible pedagogy is more often than not taking place in many classrooms because, teachers themselves, are not English first language speakers. This could be a major

factor in stifling the academic progress in not only Mathematics and Science, but in other subject areas as well. None of the students on the programme have English as their mother tongue and they may very well not be receiving the benefits of 'invisible' pedagogy.

I believe that if the students on the programme are motivated and display self-determination they will improve as expected. However, if these attributes are not apparent I believe that they will show little progress. Svinicki, (2003) highlights motivation as one of the key factors that leads to academic success. The explanations that have been provided for each of the different concepts have clarified the parameters of this study and these concepts will also be useful to the researcher as a guide during the data interpretation process.

2.4 RESEARCH FINDINGS IN STUDIES ON INTERVENTION PROGRAMMES

2.4.1 Local research findings.

There are a number of intervention programmes in operation throughout South Africa and the success of these programmes has been studied by a few individuals and funders of the programmes. Most of these studies have shown that the interventions have had limited to moderate success rates. I will discuss the findings of studies that have been conducted in South Africa which could have an influence on the performance of students attending such intervention programmes.

The findings from the study done by Reddy (2006) on the TIMMS suggest that there are serious deficiencies in the teaching and learning in most South African classrooms (p. 116). What is disturbing is that even though South Africa has amongst the highest percentage of school attendance rates at primary school and early secondary school level on the Continent (more than 90%), according to the United Nations Human Development Report (2003), the performance of our students is amongst the worst in Africa. The TIMSS report (Howie, 2003) indicates that the performance by South African students at grade 7 and 8 level in Mathematics and Physical Science ranks at the bottom of all countries involved, including all the other African countries. A number of reasons are cited, the most significant being the lack of properly qualified teachers and inadequate teaching and learning methodologies. One of the responses has been to initiate out-of-school extension projects. In the recent review of intervention programmes by Taylor, Shindler, du Toit, and Mosselson (2010) there appears to

be no doubt that these programmes have led to some measurable success, but the evidence is limited. Taylor et al., (2010) make the point that intervention programmes that target pupils in primary school or at the start of high school careers would appear to show greater success than if programmes are designed for pupils at grade 10, grade 11 and/or grade 12 levels.

In the study of the impact of afternoon tutoring of talented young black pupils by Lewy and Hobden (1992), their findings suggested that the school drop-out rate of pupils on the programme was reduced and that the average coded matriculation scores of the group on the programme were slightly higher than those of the control group. This would suggest that such programmes not only have a positive impact directly on the academic achievement of the participants but also result in unexpected benefits as cited above.

The LEAP Schools programme was introduced in Cape Town by John Gilmour in 2007. He had the following to say as to why the programme was initiated:

> Our country's history is littered with the consequences of low expectations. Apartheid deeply divided black and white South Africans and engineered a two-stream economy: one qualified, modern and rich and the other low-skilled, poor and dependent on aid for survival. The effect of this has been a critical shortage of skills with severe implications for South Africa's development in an increasingly technological world. (2012, p. 1)

The LEAP schools were started to address some of the backlogs and serious educational issues that Gilmour has alluded to. It is an integrated system that provides both normal morning schooling followed by after-school sessions in the afternoons. This programme is significantly different to other intervention programmes in that, the same teachers teach the same students. Gilmour had the following to say about why the Leap schools have been academically successful. (2012)

> Collaborations are a vital part of the transformation process too. Partnerships between schools, institutions and international organisations have become a LEAP priority so that we can begin addressing the huge quality gap embedded in our education system. While we are always looking inwards at our own practice and leadership, we also look outwards to share and learn and sometimes to challenge. Ultimately, our approach succeeds because we place the child at the centre of the learning process. We devote our full attention to nurturing the whole person – integrating the emotional with the academic – and enabling the development of engaged, caring and responsible citizens. (p. 2)

It would appear from the results alluded to by Gilmour that the Leap schools are showing success. It is important to note that the Leap schools are a full-school intervention initiative and thus the education the students receive starts at a younger age and the contact time on a daily basis is greater than most other intervention programmes.

Taylor et al. (2010) in his analysis of various programmes across South Africa briefly described the STAR schools initiative. It was introduced to aid students in various subjects only at the matric level. There have been changes to the programme since 1994 to become more inclusive and now involve students from grade 10 and grade 11. The programme has further evolved and is essentially an outreach programme providing support for mainly students from poorly resourced schools. There are STAR school centres across the country. The programme has proved to be successful as a number of the students attending the programme achieve good results in the final NSC examinations. Interestingly, the students have to find their own transport to the venues and most of the tuition takes place on a Saturday morning. The students have been described as being generally motivated and this factor has been cited as one of the key reasons for the success enjoyed by the students. (p. 8)

Prinsloo (2008) under the auspices of the Shuttleworth Foundation carried out local research on Mathematics and English intervention programme at grade 8 level. The central hypothesis was that enhancing the contact-time that students had for Mathematics and English would improve student's performance. He conducted a study on a Mathematics, Science and English intervention programme in the Western Cape. He had the following to say: "The main observation has to be that no consistent link was found between students receiving tuition and improving their performance over time." However, according to Prinsloo, there appeared to be many factors that had to be considered when analysing the success of the programme for example, he made the following observations; "student performance improvements varied depending on demographic characteristics and contextual factors pertaining to students, their parents, teachers/tutors, and schools" (p. 61). A further finding was that higher student attendance at mathematics tuition sessions was always related to greater mathematics performance improvements, and the inverse. Prinsloo suggests that the intervention that students have experienced currently may show further academic benefits at a later stage in their academic careers.

The change to an Outcomes based education system (OBE) has had far reaching consequences. Hobden (2005) had the following to say during the introduction of outcomes based education and further Education and training (FET):

> The South African educational system is in a phase of fundamental reform, moving from curricula with highly specified content for each discipline in the curriculum to new outcomes-based curricula in which the development of skills and attitudes has been given equal prominence to discipline content. (p. 302)

Hobden (2005) suggests that given the shift towards continuous assessment, the influence that high-stakes examinations exert on classroom practices should lessen. One hopes this will lead to an increase in other classroom activities such as students carrying out more practical investigations, which will need to occur if the first outcome with its focus on 'the doing aspects and the process skills required for scientific inquiry' is implemented. Unfortunately, it is apparent that such skills Hobden refers to are limited amongst the participants entering the Academy programme, perhaps due to the way OBE is implemented or not implemented in schools. This is rather disturbing if projections are made. These skills are vital for young people entering any science field. Our intention in after-school programmes is to provide the participants with such skills and the hope is that with the acquisition of these abilities there would be a consequential improvement in their grades and ultimately we would provide them with the skills necessary to cope in tertiary institutions.

2.4.2 International research.

Welsh, Russell, Williams, Reisner and White (2002) conducted a study on the success of The After School Corporation (TASC). They looked at various factors that impacted on the achievement of individuals and groups involved in the different programmes . Some of their findings are discussed here. Students who attended the programme on a consistent basis and who spent a long time on the programme were seen to perform better in Mathematics than their peers not on the programme. Essentially, those students who were committed to the programme out-performed those not attending. "After-school dose was the key to improved achievement" (p. 62).

Frankel and Daley (2007) concur in their evaluation of the Beyond the Bells Partner Agencies after-school program. They found a link between after-school attendance and scores in Mathematics and language arts, as well as regular school attendance. After-school attendance needed to reach a relatively high level to produce a significant effect.
According to Frankel and Daley in referring to After-school programmes had the following to say:

> So far, results are mixed. Some evaluations have found small or even moderate effects attributed to after-school programs. Others have found few, none, or non-significant effects. Could there be a problem with how evaluator's measure and report the amount of time that students actually spend in their after-school program, sometimes called "the dose"? (p. 62)

Huang, Leon, La Torre and Mostafavi (2008), conducted a study on the effectiveness of an intervention programme in Los Angeles - LA's BEST program. In her evaluation of the link between attendance and performance Huang et al. had the following to say:

> As with any intervention project, students need to attend regularly in order to reap the program benefits. The current study suggests that 100 or more days of annual attendance is necessary. Implications from this study also highlight that simple indicators of program participation are inadequate to capture program effects fully. For a program to have impact on students' achievement, the students need to receive sufficient exposure. (p. 12)

The Huang study provides evidence that regular attendance in the LA's BEST program (over 100 days per year) leads to positive math achievement growth when compared to students with low attendance in the program (1–20) days per year.

In another study, Lauer, Akiba, Wilkerson, Apthorp, Snow and Martin-Glenn, (2006) carried out research on the effects of Out-of-School Time Programs for 'At-Risk' Students under the auspices of the Harvard family research project of the Harvard graduate school of education. Their findings are summarised as follows:

a. Studies showed that programmes had significant and positive effects on reading.
b. Programme duration of 44 to 84 hours showed the most positive and significant improvement in results achieved by the participants.
c. One-on-one tutoring programmes had the greatest impact.
d. Study quality with medium and high quality studies had significant influence on the performance of the participants.
e. Studies showed that the programmes had significant and positive effects on the achievement in Mathematics and Science by the participants.
f. Programmes of moderate duration showed the most positive and significant effect on the achievement of students.
g. Programmes combining an academic and social focus had a greater impact on achievement than a strictly academic programme.

h. Group size: Smaller groups that used mixed groupings had a significant impact on performance.

Studies on such programmes also showed that these programs had significant and positive effects on achievement in Mathematics and Science. In order to be included in the analysis by Lauer et al. (2006), studies had to: (a) concern an OST program for K–12 students; (b) be published or reported in or after 1985 and implemented in the United States; (c) include some type of direct assessment of students' academic achievement in reading, mathematics, or both (e.g., standardised tests or classroom assessments (d) examine the effectiveness for students at risk of failing (e) include a control or comparison group (i.e., a group of pupils who did not participate in the OST program under examination, whose achievement results were compared with those for pupils who did participate. It would appear from both the TASC programme and the OST programme run by the Harvard graduate school of education that the length of time or the number of sessions per week had a direct influence on the academic outcomes of the programme. The findings for both programmes would suggest that intervention should not be provided every afternoon to derive greatest benefit.

Unlike the Frankel-Daley study, neither Welsh et al. (2002) nor Huang et al. (2008) found significant improvements in language arts. Similarly, evaluations of other after-school programs have found dosage effects on some outcomes, but not others. In a study of the Cooke Middle School After School Recreation Program, for example, Lauver (2002) of the University of Pennsylvania did not find a significant relationship between students randomly assigned to an after-school program and a matched control group on grade point average, standardised test scores in Mathematics, Science or the humanities, or in-school behaviour. But Lauver did find that students with high after-school attendance were more likely to attend school and spend more time on homework. Again, high dosage was important.

According to Manny (1987), extension programmes often provide the intervention for a limited period of time and therefore can only offer a somewhat restricted package. He also made the comment that often, unrealistic expectations are made on the providers and more is expected of them than was intended. Findings from Vaden-Kiernan et al. (2009) in their study of the impact of a number of after-school programmes showed that there was a marked improvement in reading and writing as well as moderate improvement in Mathematics and Science. Programmes were most effective when groups were smaller and varied activities seemed to have a positive influence on the success of the programme. However in the case of

Scott-Little, Hamann and Jurs (2002) found that the average achievement across English and the humanities was slightly elevated and was only marginally improved in Mathematics and Science.

The Harvard Family Research Project, an agency that devotes considerable resources to the study of after-school programs, recommends three categories for measuring dosage: *intensity*, *duration*, and *breadth*. "Intensity," write Simpkins-Chaput, Little, and Weiss (2004), "is the amount of time youth attend a program during a given period (p. 2)," similar to the Welsh study. Duration is the history of attendance, often expressed as the number of total years in an after-school program. "Breadth of attendance," say the researchers, "refers to the variety of activities that youth attend within and across programs." The findings of the Huang study are consistent with the findings of Simpkins-Chaput et al.

To date, far fewer studies have measured breadth of activities. Baker and Witt (1996) found that students with higher after-school activity, usually three to five activities or more, had significantly higher Mathematics, Science, and reading grades than non-participants and that "participants in five or more activities had higher Texas Assessment of Academic Skills (TAAS) Mathematics scores than both non-participants and those who only participated in one or two activities.

2.5 THE IMPORTANCE OF PRACTICAL WORK IN THE LEARNING OF SCIENCE.

One of the core features of the design of the science teaching plan within the Academy was the inclusion of extensive practical work. The thinking was that most of the participants will have had little experience of practical work and that providing them with the opportunity would positively impact on their understanding of the theory. The interviews and questionnaires will provide me with their personal responses about practical work. Research on the impact of practical work on learning may provide insight as to what I could expect to find in my research.

It would appear from the research carried out by Abrahams and Millar (2009) that practical work was generally effective in getting students to do what is intended with physical objects, but much less effective in getting them to use the intended scientific ideas to guide their actions and reflect upon the data they collect. Abrahams and Millar had the following to say:

> There was little evidence that the cognitive challenge of linking observables to ideas is recognized by those who design practical activities for Science lessons. Tasks rarely incorporated explicit strategies to help students to make such links, or were presented in class in ways that reflected the size of the learning demand.
> It would appear that questions have been raised by some educators about its effectiveness as a teaching and learning strategy. (p. 1945)

Ogborn, Kress, Martins, and McGillicuddy, (1996) and Lunetta (1998) concur and argue that:

> Laboratory inquiry alone is not sufficient to enable students to construct the complex conceptual understandings of the contemporary scientific community. If students' understandings are to be changed towards those of accepted science, then intervention and negotiation with an authority, usually a teacher, is essential. (p. 252)

Driver (1975) had similar findings and had the following to say: "Our study suggests that practical work in science could be significantly improved if Teachers recognized that explanatory ideas do not 'emerge' from observations, no matter how carefully these are guided and constrained" (p. 32).

Abrahams and Millar (2009) propose that practical work is essential to the teaching of science but question the methods often used by teachers. They believe that many within the science education community and beyond see practical work carried out by students as an essential feature of science education. Questions have, however, been raised by some science educators about its effectiveness as a teaching and learning strategy. They had the following to say which agrees with what others are proposing: "Tasks rarely incorporated explicit strategies to help students to make such links, or were presented in class in ways that reflected the size of the learning demand" (p. 1945).

Solomon (1999) discusses the critical role of 'envisionment' in practical work, of helping students to imagine what might be going on 'beneath the observable surface' as they manipulate the objects and materials and make their observations. This gives purpose to the manipulations made—setting the students' actions within a particular perspective on the event. It would appear from a number of researchers that the impact of practical work on both the understanding of the theory and the expected improvement in the results of students as a result of doing practical work may not be as significant as was thought.

2.6 SUMMARY

Academic Intervention programs can have an impact on the success of students. Improved marks are reported in evaluations of The After-School Corporation (TASC) programs in New York City (Reisner, White, Birmingham & Welsh, 2001; White, Reisner, Welsh, & Russell, 2001) and in Foundations elementary school programs (Klein & Bolus, 2002). A later study of at-risk youth found that out-of-school time programs had a positive impact on reading and Mathematics (Lauer, Akiba, Wilkerson, Apthorp, Snow, & Martin-Glenn, 2006). A further study revealed substantial improvements in Mathematics results for elementary junior-high school students who participated in excellent after-school programs (Vandell, Reisner, & Pierce, 2007). The Harvard Family Research Project has through a number of studies revealed the importance of children acquiring new skills through hands-on experiential learning. (Espino, Fabiano, & Pearson, 2004). These Academic programmes appeared to be more effective if other enrichment activities were included as part of the entire programme (Huang et al., 2007).

The input and feedback by the participants is crucial to establishing factors that impact on the success of the programme. Research has revealed that there are numerous factors that could influence the progress of the participants. Welsh et al., (2002) suggest that length of time on the programme was one determining factor for success. Fan and Williams (2009) propose that parental support is important and that intrinsic motivation and self-efficacy play an important role in the success experienced by individuals. Bernstein proposes that the invisible pedagogy would be the transferring of knowledge within the home, normally, by parents, but not necessarily. The impact that the tutors or teaching staff on the programme have the learning could be significant. White et al. (2009) refers to the importance of teacher explanations and teachers engaging students. Brown suggests that there would be an improvement in teaching and learning if teachers were prepared to listen to what researchers are saying and were they prepared to become involved in research.

The research on after-school programmes has produced findings that indicate there are many factors which determine success. Attitude and motivation displayed by the students, teacher ability, group size, length of time on the programme, variety of activities all have an impact on the designated goals. There was also conflicting evidence on just how successful such programmes are in achieving their goals. The local research on such programmes is extremely limited and international research provides mixed findings. This study will provide further insight into intervention programmes. To this end, it is vital that answers are found to

providing quality education. Academic intervention programmes such as the Academy programme may have an important role to play in this regard.

CHAPTER 3
RESEARCH METHODOLOGY

Having set out the research questions and reviewed the relevant literature, this chapter will focus on how the research questions were answered. I decided to use a mixed-method approach as I believed that drawing from both quantitative and qualitative data would provide the most suitable answers to the research problem. Both the qualitative and quantitative data used in the study was gathered simultaneously thus making this a concurrent mixed-methods design. I approached this study from a pragmatic viewpoint where success was judged by improvement in marks of students and understanding the intervention and the reasons for success or failure could be determined by obtaining information from the participants. The research design that was employed was determined by looking at the intended outcomes of the programme and the research questions. Certain assumptions were made about the hope for improvement in performance of the students which constitutes the logic framework of the intervention (Babbie, & Mouton, 2001). The following 'if and then' statements link the actions to the intended outcomes and provided a guide to the research questions that were asked:

Basic logic framework of the intervention programme:

- If the boys attend the academy and have good teachers and good resources then their Physical Science knowledge will improve resulting in improved NSC results.

Improving their academic achievement depends on

- Use of excellent teachers with a proven track record in a resource rich environment
- A focus on more practical work which will lead to an improvement of their understanding of scientific concepts and problem solving skills.
- Creating a positive attitude to learning and motivation to learn.

Arising out of this logic framework the key question that this research initiative addressed was: What is the effect of the after school intervention programme in Physical science?

The following sub-questions guided my investigation:

1 Do the students' academic achievements improve significantly more than their peers who do not receive the intervention?

2 What effect does the intervention programme have on students' attitudes to school, science and learning?.

3 What are the participant's views on the instructional emphasis on practical work?

4 What factors do the participants consider to be most influential in determining the success or failure of the intervention from their perspective?

Taken together, these questions guided the collection of data that was used to answer the main question.

3.1 DESIGN OF THE STUDY

According to Kane and O'Reilly-Brun (2001) "A problem or an issue that a researcher is studying should determine not only the research design but more importantly research techniques used, not the other way around" (p. 107). They consider each research technique as a specific tool matched to a research problem. In the design of my research I believed that the research questions dealing with achievement would best be answered by using the marks obtained by participants on the programme and then making comparisons with a group of their peers not on the programme. In order to look for other consequences of the intervention and possible reasons for success or failure I believed that eliciting responses through interviews and surveys would be appropriate to provide supporting or perhaps conflicting evidence for what was found from the analysis of the marks. For my research it means I required both quantitative and qualitative data which suited a mixed method approach. Creswell (2009) suggests that:

> The researcher bases the enquiry on the assumption that collecting diverse types of data best provides an understanding of a research problem. The study begins with a broad survey in order to generalize results to a population and then, in a second phase, focuses on qualitative, open-ended interviews to collect detailed views from participants. (p. 18)

The numerical data collected was analysed and used to verify findings from the data collected from the interviews and surveys. Performance of the students was measured against baseline marks that they themselves achieved as well as against their peers who were not on the programme. I believed that using and comparing marks would be the most reliable method. For this, I used descriptive statistics and looked for relationships in the data between these marks, the school marks and their peers' marks. The framework of collecting and recording of marks was tabulated and appropriate graphs were drawn.

My research questions were best answered by gathering a variety of data through interviews, surveys and the compilation of test results. As a consequence, my approach was to employ a variety of methods and techniques of data collection and analysis. The type of

mixed method design strategy that I used was a concurrent embedded approach (Creswell, 2009). The quantitative method was 'embedded' in the qualitative method because the data collected was assessment marks with interviews and surveys used as a source of information about participants experiences. Essentially, the intention of the qualitative aspect was for the students primarily to tell their 'own stories' about what effect the programme has had on them.

According to Kane et al. (2001, p. 108) it is recognised that using more than one technique of collecting data about an issue is stronger than using only one method thus; information obtained from the two methods was then integrated to gain a more comprehensive view. Internal validity seeks to demonstrate that the explanation of a particular event, issue or set of data, which a piece of research provides can actually be sustained by the data. In the case of this study, pilot interviews were used to guide the researcher in designing the interview schedule and a pre-survey was given to a small group of the participants so that survey questions could be refined, so as to be appropriate for the research context and intended respondents. These instruments were developed during a rigorous filtering process.

The marks that were recorded for each boy were obtained from their respective schools and the final mark was the NSC exam mark. Reliability and validity could therefore have been in question however the statistical analysis of these marks reduced the chance of this posing a problem and I believe the results of such analysis has provided sufficient answers to specific research questions that were posed. External validity refers to the degree to which the results of the research can be generalised to the wider population, case or situation (Cohen, Manion & Morrison, 2007). The results of this research concur with specific findings on similar programmes in the United States but due to the variety of features and dynamics that are inherent in, and unique to this programme, I would be hesitant to suggest that all the findings could be generalised. However, in saying that I do believe that certain findings could be universal and these will be highlighted when the results are analysed.

Given my pragmatic approach and the questions I was interested in investigating, the research approach I followed was a case study using a mixed method approach (Tashakkori & Teddlie, 1998). A case study was chosen as it fits the types of questions that needed to be answered with the Academy after-school enhancement programme being the subject of interest. According to Yin (2009) a central tendency of case studies is to illuminate decisions that have been made. In this case a decision was made to have an enhancement programme. The case study can indicate what the result of this decision was. In addition a case study

investigates a phenomenon in its real life context especially where it is a complex phenomenon in which the boundaries are not clearly defined. For example it is not clear that the act of teaching the science will be the only determinant of improvement in results. This programme has similarities with other intervention programmes however, certain aspects are unique. For example, the programme is designed for young black, male Africans specifically placed into a monastic environment learning Mathematics English, Science and Computer skills. Finally the case studies rely on many sources of data and in this case a mixed method approach appeared to be the most appropriate technique.

3.2 METHOD OF DATA COLLECTION

3.2.1 Participants

The participants in this study were taken from three groups;

a. Two consecutive year groups of participants on the Academy programme
b. A group of students from the three partner schools who were not part of the programme
c. Teachers/tutors who teach on the programme.

Using a survey method in collecting data requires a representative sample from a wider population and due to the very specific and unique situation of the Academy programme the wider population had to be drawn from a group that at least had some knowledge of the programme. Thus, students from the three schools who are the peers to those involved in the programme were selected to be surveyed.

The St John's Academy consists of three year groups at any given time, grades 10, 11 and 12.The students on the programme are selected from three inner-city Johannesburg schools. The marks that were collected and the surveys and interviews that were conducted involved two consecutive matric year groups, namely the matric groups of 2010 and 2011. The 2010 group involved 19 students and the 2011 group involved 20 students. Data in the form of surveys was also collected from students not on the programme and interviews were conducted with science teachers who teach on the programme.

3.2.2 Numerical data captured

In order to collect the data required to answer the research questions, school reports were collected from every participant over a period of three years. The science marks for every

student for each quarter (Term) from the beginning of grade 10 to the end of matric (grade 12) were collected and recorded. The second last mark reflects the results attained in the preliminary examinations and the final mark reflects the results attained in the National Senior Certificate (NSC) examination. The group average in Science for each term was recorded so that the necessary comparisons could be made. I specifically compared the Science marks to the groups not on the programme. Scatter diagrams were used to make the comparisons and the averages (mean scores) and the standard deviation for each set of results was calculated in order measure the reliability of the results. A low standard deviation indicates that the data points tend to be very close to the mean whereas high standard deviation indicates that the data points are spread out over a large range of values. In addition to conveying the inconsistency of a population, standard deviation was used to measure confidence in statistical conclusions (McMillan & Schumacher, 2011).

I wanted to know if students achieved as a result of the intervention. According to Creswell (2009). “The problems studied by post-positivists reflect the need to identify and assess the causes that influences the outcomes” (p. 71). I utilised a mixed method described by Creswell which involves the use of varied types of data. Creswell (2009) had the following to say about the use of data: “the researcher bases the inquiry on the assumption that collecting diverse types of data best provides an understanding of the research problem” (p.19). The twelve sets of academic results were collected and these were analysed and compared to the responses to interviews and surveys that were conducted with the participants thus making this a mixed-method approach. Creswell and Plano (2007) defines mixed method research as:

> An approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches and the mixing of both approaches in the study. Thus, it is more than simply collecting and analysing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of the study is greater than either qualitative or quantitative research. (p. 4)

3.2.3 Surveys

The three surveys that appear in Table 3.1 below were carried out to gather specific information from participants and the peers of the participants who were not on the programme:

Table 3.1 *Surveys used to gather data from participants and peers not on the programme*

Survey	appendix	Respondents	Information gathered
Pilot survey contained 12 questions that required an 'agree' or 'disagree' response	1	Randomly selected matric students on the programme.	General information about the programme
1 On-line survey 55 respondents Academy students	2	Academy survey #2 Information gathered from students on the programme.	General academic information and information about the programme such as concerns , likes and dislikes and operational apprehensions
2 On-line survey Non-participants 39 respondents	3	Academy survey #1 Information gathered from students who were not on the programme but who were peers in the schools of the participants..	General academic information and information about the programme seen from the perspective of the non-participants.
3 Written responses to four questions.(peers) 30 respondents	4	Second survey	Questions target improvements by participants- From a peer perspective.

A pilot survey (appendix 1) was conducted with a group of matric Academy students from the first cohort (2010).This pilot survey was analysed and a final survey for participants was designed (appendix 2). The survey contained 30 responses and was given to all Academy students on the programme in 2011 which involved all three year groups. Some of the students opted not to fill in the survey form which was conducted on-line and some of the forms were invalid as more than one response was recorded for each question. A total of 55 survey forms were collected and analysed.

The instruments used in the surveys employed categorical scales: Strongly agree: agree disagree: strongly disagree. The two choices, namely, agree and strongly agree were grouped

and the two choices, disagree and strongly disagree were grouped to establish only two sets of responses that were either ‘agree’ or ‘disagree’ which led to clear interpretation of data.

An online survey was given to pupils from each school who were not on the programme but were peers to those who were participants. 39 pupils were surveyed and each survey contained 17 responses (appendix 3). The same categorical scales were used as in the survey for participants. A second survey questionnaire was given to a different group of students from the three schools who were not participants on the programme (appendix 4). This survey contained 4 questions that required written responses. These responses were then transcribed by the researcher so that analysis could be carried out. The responses were grouped according to the research questions and appropriate bar graphs and response percentages were documented. It is important for any researcher to assure respondents or interviewees of confidentiality throughout the research. I assured them that all information gathered would be treated in a confidential manner and that at no stage would any respondent be identified by name or by school.

3.2.4 Interviews

The three sets of interviews shown in Table 3.2 were carried out to gather specific information from participants and teachers involved in the programme:

Table 3.2 *Interviews used to gather data from participants and teachers*

1	Pilot interview- conducted with 3 matric students on the programme. This was used to develop questions for the final interview (Appendix 5)	A set of 6 questions were asked. The responses were analysed and used to design the final interview.
2	Final interview. This was conducted with 3 matric students on the programme. (Appendix 6)	A set of 12 questions were posed to all respondents
3	Teacher interviews. 4 teachers were interviewed. (Appendix 7)	A set of 12 questions were asked.

Pilot interview was conducted with three of the top performing matric Academy students, one from each of the three participating schools and the responses were analysed and used to design a final interview schedule. Three different, academically strong matric students who were on the programme were interviewed using this final interview schedule. High achievers

were chosen as it was felt that they would provide the most feedback about the programme. If the interviews were conducted to compare high achievers with low achievers then a different purposive sampling would have taken place. The final interview schedules and surveys were developed during a careful sifting process. For example, during the pilot interview two of the respondents mentioned certain experiences that had impacted both positively and negatively on them during their time on the programme so I included questions into the final interview schedule that would address these issues. All three of the respondents mentioned teachers both in the Academy and in their own schools who have had an influence on them so I decided to include a question about teachers who have somehow had an effect on them. Both Henning (2007) and Cohen et al. (2007) highlight the importance of using interviews as instruments of data collection. It provides the researcher the opportunity to clarify concepts and avoid confusion and it allows the researcher to gain accurate, first-hand information. They make the point that it allows for greater depth than any other method of data collection.

The responses to the interviews were recorded and grouped to link given answers to the specific questions asked. The interviews that were conducted with teachers on the programme were more informal and I encouraged the teachers/tutors to express exactly how they felt about the programme. The time I had set aside for these interviews was 20 minutes but in all cases, the interviews lasted for a significantly longer period of time than was allocated. The responses to each question for the four respondents were recorded. There were six science teachers teaching on the programme including the Researcher. One of the teachers indicated that they would prefer not to be interviewed, which meant that all remaining teachers were interviewed.

3.3 **VALIDITY AND RELIABILITY.**

A mixed methods approach was adopted in this study and it was therefore appropriate to deal with issues of validity for the qualitative element from a qualitative perspective while those of the quantitative component were addressed from a quantitative perspective. According to Creswell (2003) researchers using mixed methods deal with this issue by checking the validity of the quantitative procedures and the accuracy of the findings from the qualitative phase. Yin (2009) concurs and suggests that the use of multiple sources of data with triangulation and collaborative methods of research ensures that information is verified and enables one to view a phenomenon from alternative viewpoint. He also argues that it

strengthens the reliability of the results (p. 75). Therefore I adopted a mixed-method approach which enabled me to use multiple sources of data with triangulation for validation. The different sources of data in this study were the surveys given to participants, surveys given to peers not on the programme, individual interviews of participants and interviews of teachers teaching on the programme. In the current study therefore, I have attempted to provide all the steps followed and the, reasons behind choices made and actions taken and I have referred to the literature that supports them in order for the conclusions to be plausible. I have also tried to provide a detailed account of the context to allow for transferability to similar intervention programmes.

According to Creswell (2009), there are several threats to validity of the findings in research. He highlights two, namely external validity threats, where inferences are made by researchers about other settings or future or past situations and internal validity threats, where experimental procedures, treatments or experiences of participants threaten the researchers ability to draw the correct inferences from the data.

Macmillan and Schumacher (2011) suggest that selection of the participants could pose a threat to the validity of the findings and is described as an external threat. The participants selected for the St John's Academy programme were from three different schools and therefore there may have been a difference in the quality of teaching and learning that the students were exposed to in their own schools. It would possible that certain participants could have performed better as a result of the combination of good teaching in their own schools as well the intervention that they had received whilst others may have received poorer teaching in their schools and therefore were at a disadvantage. Macmillan et al. (2011) and Creswell (2009) refer to selection threats which are related to the manner in which the participants have been selected for the sample. The academic performance of the participants was analysed and measured however, the strongest pupils were chosen from the three participating schools and therefore it would have been expected that the selected group would have out-performed their peers in their own schools. To validate the numerical findings it was decided to investigate the improvement made by participants measured against their peers not receiving the intervention rather than simply looking at individual improvements.

Macmillan and Schumacher (2011) refer to 'demand characteristics' as being an internal validity threat and had the following to say: "subjects in most studies will want to present themselves in the most positive manner and there may be a belief that certain responses are expected" (p. 114). It was possible that participants who were interviewed may have given responses that they believed the researcher wanted to hear. To avoid this, I encouraged the

respondents to answer the questions honestly and I reminded them firstly of the confidentiality of the responses and secondly, the importance of being able to use the responses to draw appropriate conclusions in the research.

According to Creswell (2009), a possible internal validity threat is setting and he had the following to say:" because of the characteristics of the setting of participants in an experiment, a researcher cannot generalize to individuals in other settings" (p. 165). Creswell continued by suggesting that the researcher conduct additional experiments in new settings to ascertain if the same results would be found. I decided that looking at two different cohorts or year groups may avoid such a validity threat. In order to minimise the threats to the reliability and validity of the findings triangulation of the results was carried out by the researcher. For example according to Creswell (2009) the possible limitations to the use of interviews are that not all of the respondents are equally articulate and the researcher's presence may bias the responses (p. 129). Surveys were designed that provided similar questions to those posed in the interviews and thus it was possible for the researcher to compare results from the interviews and the surveys, thus limiting the threat to the validity of the findings.

3.3.1 Pilot survey

A pilot survey was conducted in order to determine what important questions could be included in a final survey and if certain questions should be omitted. The pilot survey (Appendix 1) contained 12 questions which required the respondents to agree or disagree to what was asked or stated. There was also opportunity provided for the participants to make any comments they wanted to. The survey was completed as a hard copy and the responses and comments were analysed to produce a final survey which was completed on-line. For example, the following questions were included in the final interview schedule as comments around these issues were included by some of the respondents in the pilot survey.

"It is good to mix with boys from other schools"

"My friends at my school are resentful of my attendance at the Academy

"I am enjoying my subjects because of the consolidation that the academy provides."

"My marks would be just as good if I did not attend the Academy".

3.3.2 Pilot Interview

A group of Matric participants from the three schools were interviewed as part of the pilot interview and their responses were used to design the final interview schedule that would best answer the research questions. (Appendix 5). Cohen et al. (2007) recognise that "pre-testing a questionnaire is crucial for its success" (p.260). Pre-testing a questionnaire is done through a pilot study. It is recognised that a pilot study should not only improve the validity and reliability but also the practicability. The pilot interviews and questionnaires enabled the researcher to (a) Have a good idea of the time it would take to complete the interviews and questionnaires (b) Ensure the clarity of the questions (c) Identify misunderstandings. The interview schedule was then designed and I decided that a standard open-ended interview would be appropriate. According to Cohen, Manion and Morrison (2007).

> The benefits of using open-ended interviews are that all respondents answer the same questions thus increasing the comparability of the responses. This allows the researcher to see and review the instrumentation used and facilitates the organisation and analysis of the data, however, it does restrict the flexibility in relating the interview to specific personalities. It may also constrain and limit the naturalness and relevance of questions and answers. (p.271)

The interview schedule was designed and adjusted once a pilot interview was carried out with participants. The pilot interview (Appendix 5) had six questions and once the interviews had been conducted I believed that there were too few questions so the final interview schedule (Appendix 6) was designed and contained twelve questions. Question 5 in the pilot interview did not elicit enough information so the question was expanded. The following question in the pilot interview: Question 5**.** *How do you think practical work in the Academy has helped you in Science?* This was expanded to: Question 5**.** *What skills do you think you have gained from doing practical work in the Academy? How do believe practical work can help you?* This appeared in the final interview.

In discussions with one of the interviewees in the pilot interview, it was revealed that some of the participants were experiencing difficulties in attending the programme so it was decided to include a question that would address this issue thus, the following question was asked: Question 7. *Have you experienced any difficulties in attending the Academy?*
It was also decided to include the following question, as attitude to work and to the programme was seen as an important aspect in the success of participants involved in the

intervention. Question 11. *Has your attitude to learning and to your school changed since you started on the Academy?* I believe that the final interview schedule provided sufficient valid data that was used in conjunction with the data from both the surveys and numerical data to provide answers to the research questions.

3.4 ETHICAL ISSUES.

There is an obligation by the researcher to treat the participants in their study with respect and sincerity. According to Macmillan and Schumacher (2011) "the researcher is ethically responsible for protecting the rights and welfare of the subjects who participate in the study" (p. 15). Kimmel (1988) and Greig, Mackay & Taylor (2007) concur and by stating that it is the duty of the researcher to make sure that the welfare of the participants is protected. This means avoiding activities that could have any negative impacts on the child either physically, emotionally or psychologically. According to Cohen, Manion and Morrison (2007); it is advisable that participants are well informed about the research. This means the participants have to know the purpose of the research, their role in the research and how the data or results will be used. Creswell (2010) suggest that the participants should be made aware of their rights. This is done in order to enable the participant to make an informed decision as to whether he or she wants to participate or not and to be aware that he or she can withdraw at any stage during the duration of the research. Creswell continues by suggesting that it is critical to seek permission from the people who are responsible for protection the interests of others and who can give formal or informal permission for the research to take place. In this study, this permission was provided by school Principals who had in turn received permission from guardians. Ethical clearance was requested and granted from the University of KwaZulu-Natal (Appendix 11) and written consent was granted by the Principals from the participating schools. The exact nature of the study was explained to all participants and it was made clear to them that they could withdraw at any stage.

3.5 CONCLUSION.

This chapter has described the stages through which I went in order to answer the research questions. The need for determining the research design has been shown and that this design is appropriate for successfully answering the questions. The target group was pre-selected before the research was undertaken. The sampling procedure was explained. The rigorous procedure, including piloting, through which the interview schedules and surveys, was

clarified. The capturing and analysing of data was outlined. The results of the numerical data will be compared to and ‘embedded’ (Creswell, 2009) in the qualitative data retrieved from the interviews and surveys. In the following chapters, the interview, survey and numerical data will be presented, analysed and explained.

CHAPTER 4
ANALYSIS OF ACHIEVEMENT SCORES

The previous chapter dealt with the way that data was generated in this study. I used a mixed method approach which involved the use of both the qualitative and quantitative approaches in the gathering of data. This chapter will highlight the analysis of the numerical data gathered and used in the study. The table 4.1 provides a summary the data collected.

Table 4.1 *Numerical data collected from the three participating schools over a three year period*

Cohort	**2008**	**2009**	**2010**	**NSC**
First group of participants 2008	Reports collected from three schools with Science marks for 4 Terms(2008)	Reports collected from three schools with Science marks for 4 Terms(2009)	First Term results and Preliminary examination results (2010)	Final matric NSC marks (2010)
Second group of participants 2009	Reports collected from three schools with Science marks for 4 Terms(2009)	Reports collected from three schools with Science marks for 4 Terms(2010)	First Term results and Preliminary examination results (2011)	Final matric NSC marks (2011)

A set of 12 marks was collected for each participant and this included their final Matric National Senior Certificate mark. The group average in each school in Science for each term was recorded so that the necessary comparisons could be made. The tables 4.2 to 4.13 contain the school results obtained in Physical Science by all of the participants. The three partner schools appear in the tables as School 1, school 2 and school 3 for confidentiality purposes. The participants all wrote tests and exams within their own schools so comparisons between the averages from the three different schools would not provide meaningful data. A comparison between how individuals have improved or regressed measured against the group average for that specific school was done. It is important to note that the school average would include the Academy participants. Thus, the school averages would be either higher or lower if the marks of the participants were not included in the calculation of the school average.

The marks attained by the participants in the first term of their grade 10 year were used as a baseline from which variations could be measured. The Science marks over a three year period obtained by two consecutive Matric groups on the Academy have been recorded in tables. The average for the entire Science group in each school over the period of research has been recorded and the standard deviation for the group and then each individual has been

calculated and recorded. The marks for each of the 12 Terms for the participants has been plotted graphically against the Science groups within each school and then for the entire group against all three schools. Correlation dot charts were plotted to look for relationships. The inaugural group that started the programme in 2008 will be discussed first.

4.1 ANALYSIS OF THE INAUGURAL GROUP OF STUDENTS - (2008-2010)

Table 4.2 below comprises the academy marks over the three years. Students wrote school tests each term and these were recorded together with the class average i.e. all students in the school from the particular grade including those attending the academy.

Table 4.2 *Achievement of individual students from School 1 over duration of programme compared to the school class average.*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2008 T 1	2008 T2	2008 T 3	2008 T 4	2009 T 1	2009 T2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	Prelims	Matric	Change
School(1) Average	53	53	48	49	56	59	63	52	54	44	36	34	-19
Academy Average	48.3	49.7	46.7	46.7	50.2	53.8	46.5	44.5	45.8	44.8	35.3	35.1	-13.3
Students													
1	60	51	52	45	58	56	51	45	48	58	49	59	-1
2	45	44	41	32	41	42	44	35	31	32	24	21	-24
3	55	50	41	49	50	59	43	44	50	45	38	41	-14
4	54	56	50	45	46	56	40	41	44	40	32	30	-24
5	54	46	52	64	56	59	49	67	61	58	41	39	-15
6	42	51	44	45	50	51	52	35	41	36	28	22	-20

The column “terms” on the table displays the coded names of each of the participants from a particular school involved in the Academy programme. This specific school has been coded as school 1 and the number 1denotes the first student from that school. The first column displays the year 2008 and the first term of the year, i.e. 2008 T1 and the marks achieved by each of the students in science for that term. The row “school (1) average” on the table provided the group average for Science at that school. The third row of the table “Academy average” provides the average for the Academy participants only. The column “Prelims” displays the marks obtained by the Academy participants in the Preliminary or mock examinations within their own school and the second last column “matric”12 display the marks obtained by participants in the external National Senior Certificate examination. The

last column provides the change obtained by each student from the first mark in 2008 to the result obtained in the NSC.

It is clear from the school average displayed in table 4.2 that there was a marked decline in the average of the students in school 1 from the start of the programme in 2008 to the NSC examination in 2010. Participants 2 and 6 showed a steady decline over the 3 year period. Participant 1 started the programme 7% higher than his school average and finished the programme achieving an average 25% higher than his peers in the NSC exam.
The Academy group started the programme with an average 4.7% below the school average and ended the programme 1.1% higher than their peers in their school. This difference indicates a real improvement of 5.8% over the duration of the programme.

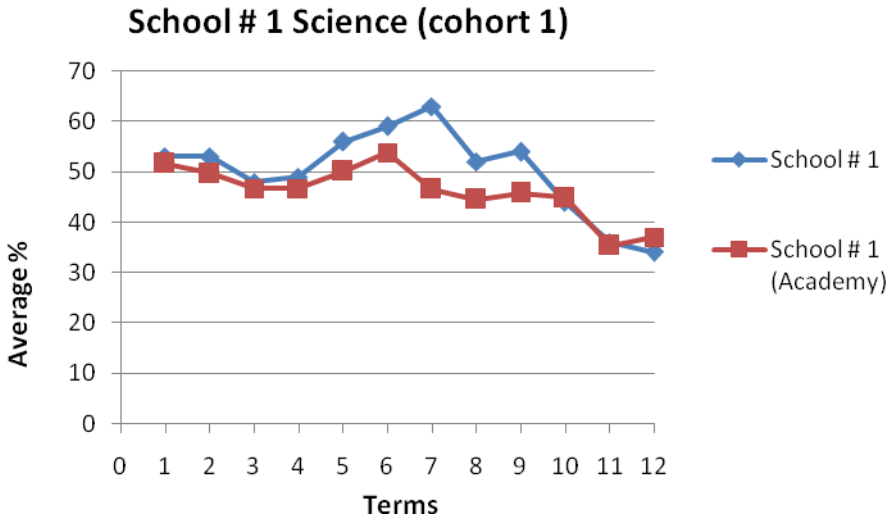

Figure 4.1: Comparison of academy students with School 1 class average per term over the three years (1st group 2008-2010)

The graph of the values provided in Table 4.2 are displayed in Figure 4.1 The vertical axis of the graph displays the average percentage achieved in Science by the Academy group shown in red and the average achieved by the school shown in blue for each term (1-12) from the start of 2008 (grade10) to the final NSC examination in 2010 shown on the horizontal axis. The graph illustrates that the selected Academy students consistently produced an average in Science which was below the average for their peers in their own school. There is however, a marked improvement by the Academy group in this school from the preliminary examination to the final NSC examination. This would indicate that some positive impact has been made even though it is only apparent late in the programme.

Table 4.3 below comprises the academy marks over the three years for the inaugural group of the second school and the group average for the science students in that school.

Table 4.3 *Achievement of individual students from School 2 over duration of programme compared to the school class average.(1st Cohort)*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2008 T 1	2008 T2	2008 T 3	2008 T 4	2009 T 1	2009 T2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	Prelims	Matric	Change
School(2) Average	62	35	54	34	32	29	31	30	25	45	41	36	-26
Academy Average	60.1	49.5	59.6	49.1	50.3	48.3	48.7	47.2	42.4	57.6	54.7	49.9	-10
students													
1	43	29	48	31	34	30	30	29	19	35	30	26	-17
2	70	68	73	69	58	60	41	59	60	72	70	69	-1
3	65	67	74	68	60	55	63	62	64	67	73	64	-1
4	51	32	50	30	44	38	44	34	19	38	34	29	-22
5	64	55	58	48	48	50	58	57	55	68	64	60	-4
6	82	66	79	65	64	61	50	48	43	65	61	54	-28
7	57	40	55	40	47	39	56	49	50	59	55	48	-9
8	60	48	55	47	55	54	45	45	32	57	55	58	-2
9	55	58	61	61	63	60	68	58	60	78	71	61	+6
10	54	32	43	32	30	36	32	31	22	37	34	30	-24

Figure 4.2 is a graph that displays the marks attained by participants from school 1 compared to their peers.

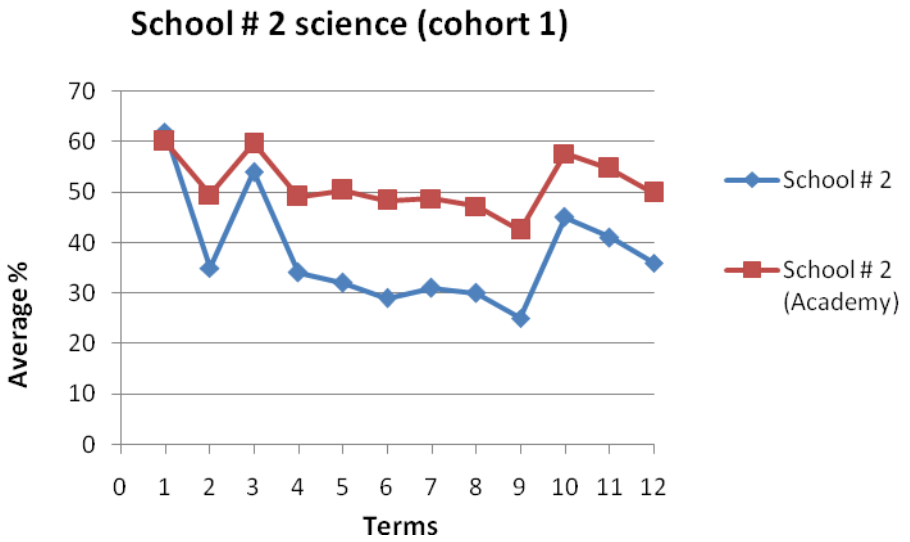

Figure 4.2: Comparison of academy students with School 2 class average per term over the three years (1st group 2008-2010)

The graph of the values provided in Table 4.3 is displayed in Fig 4.2 and show the marks for school 2 of the inaugural group over a three year period. Participant 9 began the programme having an average 7% below the school average but at the end of the three year period had improved by 25% compared to the school group. Participant 8 showed and improvement of 24%. He started at 2% below his peers and completed the programme 22% above. The Academy group began the programme with an average 0.9% below the school average and completed the programme with an average 13.9% above the school average, an improvement of 14.8%.

Table 4.4 below comprises the academy marks over the three years for the inaugural group of the third school and the group average for the science students in that school.

Table 4.4 *Achievement of individual students from School 3 over duration of programme compared to the school class average.(1st Cohort)*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2008 T 1	2008 T2	2008 T 3	2008 T 4	2009 T 1	2009 T2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	Prelims	Matric	Change
School(3) Average	58	51	47	42	44	50	51	56	42	48	43	44	-14
Academy Average	59.3	45.7	44.0	45.3	44.0	49.0	52.0	56.3	47.7	54.7	48.7	59.0	-0.3
Students													
1	61	44	48	47	51	55	58	61	56	61	59	66	+5
2	60	51	45	44	40	56	58	57	50	56	52	62	+2
3	57	42	39	45	41	36	40	51	37	47	35	49	-8

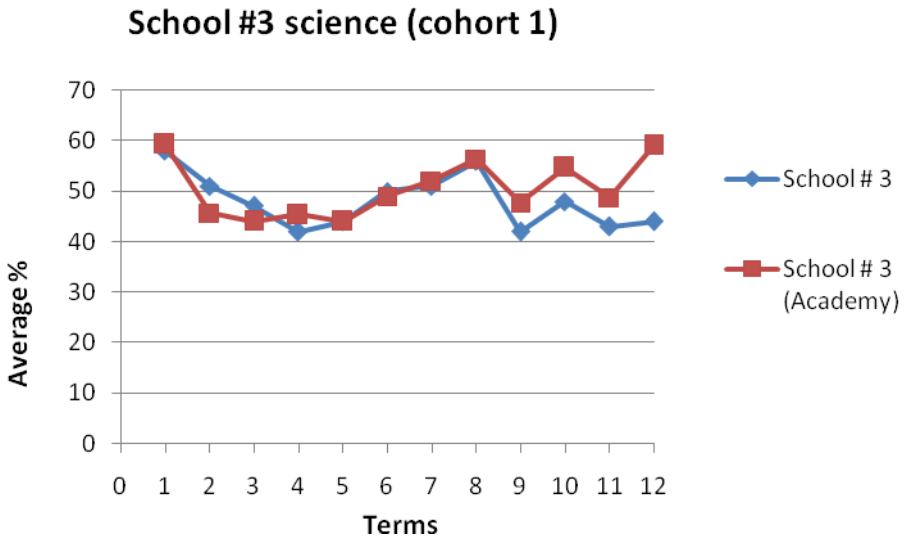

Figure 4.3: Comparison of academy students with School 3 class average per term over the three years (1st group 2008-2010)

The graph of the values provided in Table 4.4 are displayed in Figure 4.3 and show the marks for school 3 of the inaugural group over a three year period. Table 4.4 shows the marks obtained by school 3 over the duration of the programme from 2008 to 2010. All three participants showed an improvement in their average compared to the school average.

The Academy average was 1.3% higher than the school average at the start of the programme in 2008 and was on average 15% higher in the NSC exam at the completion of the intervention. From the data analysed it can be concluded that there was an improvement by certain individuals on the programme but there were participants who either made no improvement or regressed.

Looking at the complete group, it can be seen from the graphs in Figure.4.4 that the Academy group began the programme with an average in science that was marginally higher than their peers in their own school. (They were chosen because they were supposed to be the best learners.) The average of the Academy students on completion of the intervention was about 10% higher than their peers. The values from tables 4.1-4.3 were used to draw the graphs displayed in figure 4.4 which are the combined results from the three participating schools.

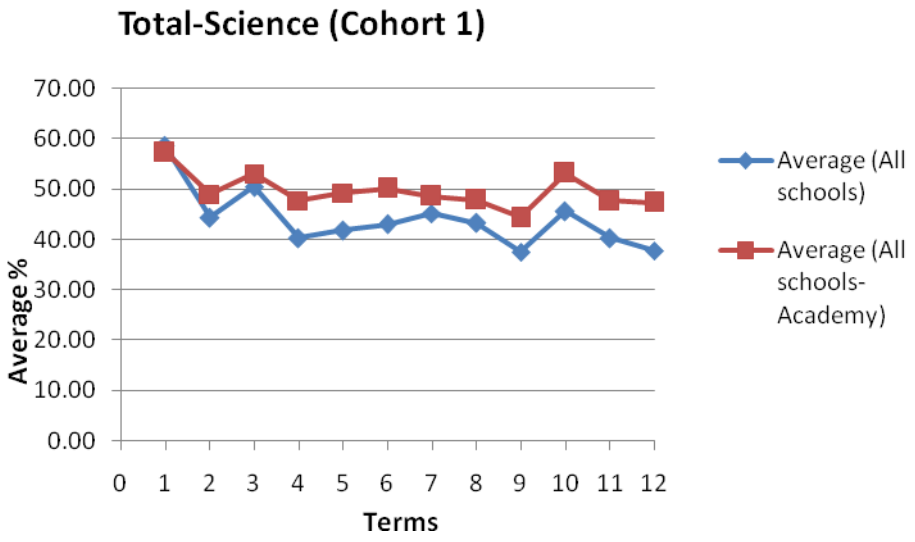

Figure 4.4: Comparison of academy students with all schools class average per term over the three years (1st group 2008-2010)

It can be seen from figure 4.4; the average attained by the participants and by their peers differed by 1% at the initiation of the programme but at the conclusion of the programme, the average of the participant's was10% higher than their peers not on the programme. This indicates that a fairly substantial improvement was experienced as a result of the intervention.

Looking at individual students, Table 4.5 indicates the number of participating students with marks that are above, below or equal to the starting average of the science pupils from the three schools.

Table 4.5 *The number of pupils above, below or equal to the class average at the start of the programme. (First group 2008)*

Term 1 2008	Students above group average	Students below group average	Students equal to group average
Total-school 1 n=6	4	2	0
Total school 2 n=8	4	6	0
Total school 3 n=3	2	1	0
Total number of students N=19	10	9	0

Tables 4.5 and 4.6 display the number of students who have achieved results that are above, below and equal to the average mark in Science achieved by their peers in their own schools for the inaugural group (2008-2010). Table 4.5 highlights the numbers at the initiation of the programme whilst table 4.6 provides the numbers at the conclusion of the programme. It is clear from the results displayed that there were a greater number of participants who achieved above the group average at the end of the programme than at the start. All three schools showed an improvement. The total number of students above the average at the beginning was intervention was 10 and at the end was 13. Table 4.7 displays the results of the entire first cohort of students from the three schools.

Table 4.6 *The number of pupils above, below or equal to the class average at the end of the programme. (First group 2008)*

NSC 2010	Students above group average	Students below group average	Students equal to group average
Total-school 1 n=6	3	3	0
Total school 2 n=10	7	3	0
Total school 3 n=3	2	1	0
Total number of students N=19	13	6	0

Table 4.7 Measurement of Improvement of first cohort from 2008-2010.

School	Student	First mark 2008 T1	Last mark NSC	Diff. first and last	Start: diff to average	End: diff to average	Net improvement over class average
1	S1_1	60	59	-1	7	25	18
1	S1_2	45	21	-24	-8	-13	-5
1	S1_3	55	41	-14	2	7	5
1	S1_4	54	30	-24	1	-4	-5
1	S1_5	54	39	-15	1	5	4
1	S1_6	42	22	-20	-11	-12	-1
2	S2_1	43	26	-17	-19	-10	9
2	S2_2	70	69	-1	8	33	25
2	S2_3	65	64	-1	3	28	25
2	S2_4	51	29	-22	-11	-7	4
2	S2_5	64	60	-4	2	24	22
2	S2_6	82	54	-28	20	18	-2
2	S2_7	57	48	-9	-5	12	17
2	S2_8	60	58	-2	-2	22	24
2	S2_9	55	61	6	-7	25	32
2	S2_10	54	30	-24	-8	-6	2
3	S3_1	61	66	5	3	22	19
3	S3_2	60	62	2	2	18	16
3	S3_3	57	49	-8	-1	5	6
1	Av_S1	53	34	-19			
2	Av_S2	62	36	-26			
3	Av_S3	58	44	-14			
1	Av_S1AL	48	35	-13	-5	1	6
2	Av_S2AL	60	50	-10	-2	14	16
3	AV_S3AL	59	59	0	1	15	14

The column heading “Student” displays the participating students in coded format for example, S1_1 is the first student from school 1. Av_S1 is the average obtained by the participants from school 1 whilst Av_ S1AL is the average obtained by the peer group at school 1. The set of results shown in column “1st Mark 2008 T1” 4 are the first set of results obtained by the students and the second set is the results obtained by them in the NSC are displayed in column “Last mark NSC”. The final column displays either a positive or a negative gain by students over the three year period compared to what they started with in 2008. Column “Start diff to average” displays the student mark compared to the school science average at the start of the intervention; column “End diff to average” shows the comparison at the end. The final column displays the net increase or decrease of each student

over the period. Of the 19 students, 4 students performed worse at the completion of the intervention, 3 students showed no improvement and 12 students improved. Nine of those students improved by more than 15% over the duration of intervention. If the results in the column “Diff first and last” is considered, the impression could be created that the programme has made no impact, however, if the change is compared to the class average, column “net improvement over class average” it is clear that there has been an improvement. Figure 4.5 is the bar chart of net improvement that has been plotted using the movement against the class averages given in table 4.7.

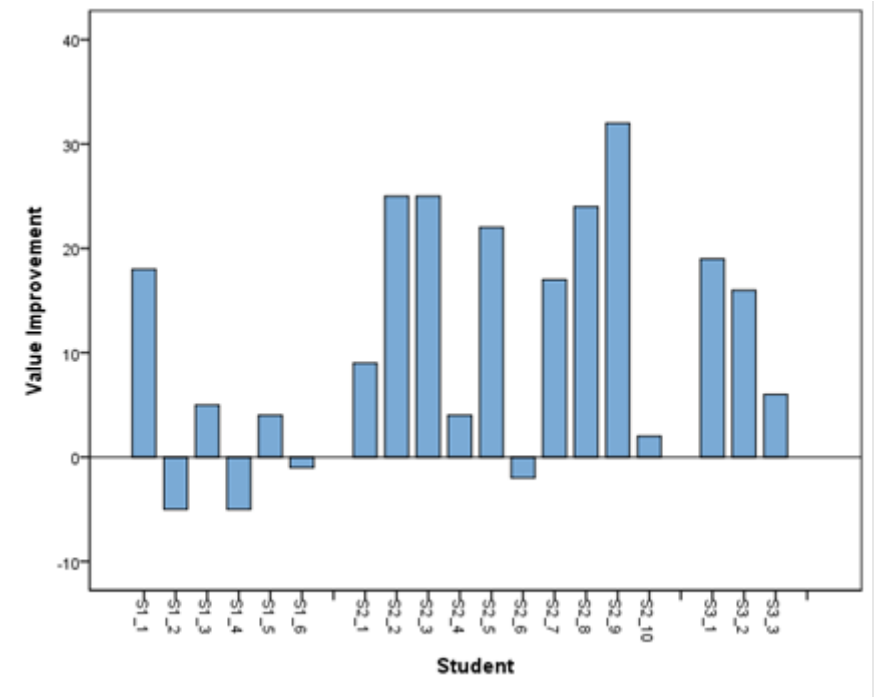

Figure 4.5 Displays the improvement of the students over the duration of intervention measured against their peers for Cohort 1.

The graph shows improvement or decline of individual students over the duration of intervention for the first group of participants. It is apparent that when the academy students’ scores are compared to their classmates, the majority showed some improvement compared to classmates, hopefully as a result of attending the academy. This was despite some of the participants producing a lower average at the end of the intervention; however their peers generally showed a greater decrease in their results thus indicating that programme has had some positive impact especially in schools 2 and 3 where the gains are consistent. Students from School 1 were not as good as the other two schools.

4.2 ANALYSIS OF THE SECOND GROUP OF STUDENTS - (2009-2011)

Tables 4.8-4.10 comprise the academy marks over the three years, 2009-2011. Students wrote school tests each term and these were recorded together with the class average i.e. all students in the school from the particular grade including those attending the academy. Table 4.8 displays the results of school 1 for the second group of Academy students who began their intervention in 2009.

Table 4.8 *Achievement of individual students from School 1 over duration of programme compared to the school class average.(2nd Cohort)*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2009 T 1	2009 T 2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	2010 T 3	2010 T 4	2011 T 1	2011 T 2	2011 prelims	Matric	Change
School(1) average	50	41	57	46	50	47	51	54	47	49	43	46	-4
Academy Average	53.9	44.9	58.9	56.3	56.4	50.3	52.7	58.4	56.7	55.7	56.3	64.9	+11
Students													
1	38	30	54	47	50	35	37	42	42	44	47	48	+10
2	57	44	56	61	53	45	48	55	49	51	44	51	-6
3	58	61	70	67	78	76	80	80	75	78	74	85	+27
4	48	39	58	60	50	52	53	63	70	59	60	70	+22
5	66	55	58	61	64	58	54	62	69	55	61	68	+2
6	55	50	51	59	58	55	64	69	55	60	64	81	+26
7	55	35	65	39	42	31	33	38	37	43	44	51	-4

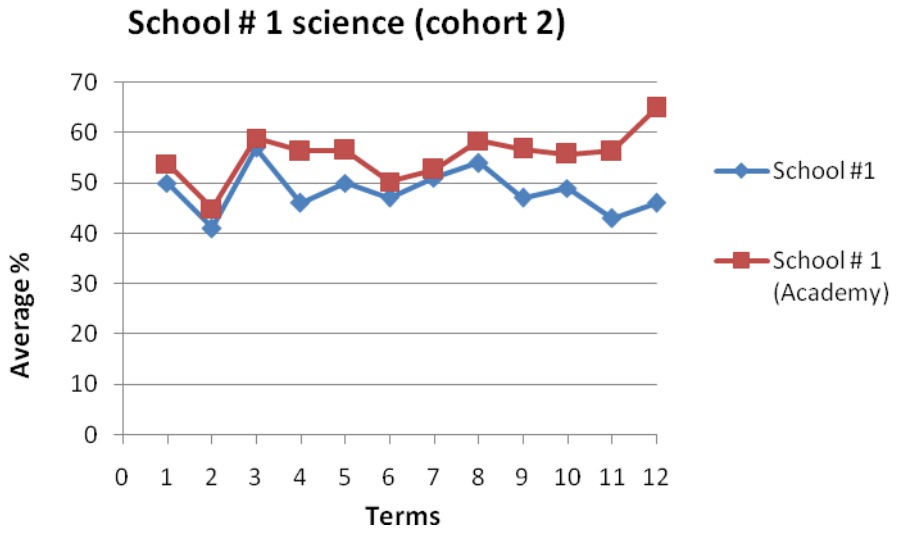

Figure 4.6: Comparison of academy students with School 1 class average per term over the three years (2nd group 2009-2011)

The Academy students showed a significant improvement from the start of intervention to the end as shown by the graphs in Fig. 4.6, the average of the school group remained fairly constant. The average of the school group fell by 4% whereas the Academy average rose by 11%. Thus, the Academy students had a 15% improvement compared to their peer group. Only one student showed a fall in average compared to the school group, Student 2 had a decline of 2% more than the school group whereas, student 3 showed a 27% improvement and student 6 an improvement of 26% measured against the school average. The second group from this school performed significantly better than the inaugural group.

Table 4.9 displays the results of school 2 for the second group of Academy students who began their intervention in 2009. The graph of the values provided in Table 4.9 are displayed in Figure 4.7 and show the marks for school 2 of the second group over a three year period. Only one student, student 2 improved when measured against his peers from their school. Student 4 showed a decline of 39% where there was no change in the school average.

Table 4.9 *Achievement of individual students from School 2 over duration of programme compared to the school class average.(2nd Cohort)*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2009 T 1	2009 T 2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	2010 T 3	2010 T 4	2011 T 1	2011 T 2	2011 prelims	Matric	Change
School(2) Average	32	27	54	29	22	22	39	29	49	38	36	32	0
Academy Average	53.7	42.8	59.8	43.7	40.3	37.6	47.2	39.2	48.6	45.3	43.4	44.6	-9
Students													
1	43	40	67	28	48	21	41	31	47	40	36	41	-2
2	64	65	70	50	48	49	58	57	72	66	65	71	+7
3	44	33	50	34	21	31	40	32	32	34	37	38	-6
4	79	42	70	50	38	38	44	40	49	45	42	40	-39
5	57	36	58	71	55	40	49	45	53	48	40	45	-12
6	54	42	46	46	46	33	38	31	52	54	47	54	0
7	43	33	62	30	40	47	57	35	38	40	37	31	-12
8	42	48	61	48	21	35	48	34	38	36	37	34	-8
9	57	46	54	36	46	44	50	48	56	45	50	47	-10

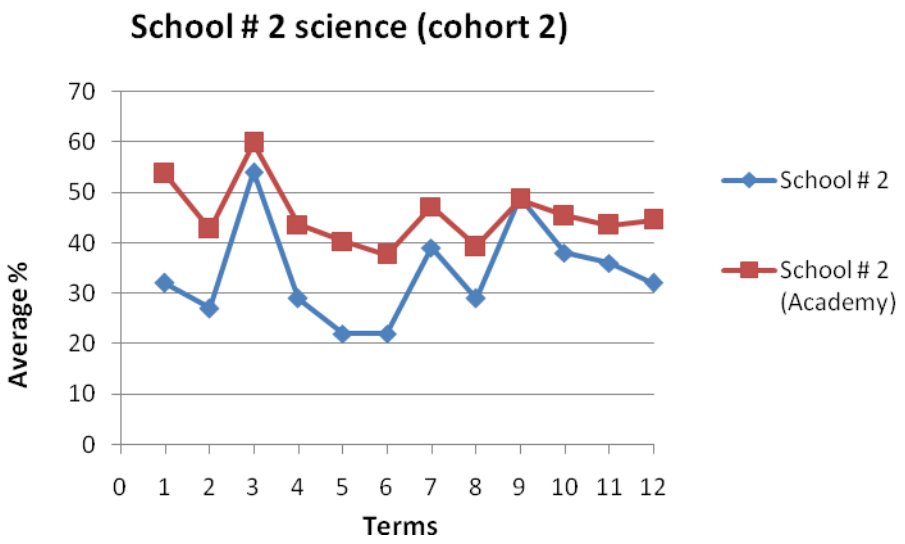

Figure 4.7: Comparison of academy students with School 2 class average per term over the three years (2nd group 2009-2011)

The Academy group for this school showed a 9 % drop compared to their school classmates group over the three year intervention. The gap did widen in the NSC examination where the Academy students improved slightly from their preliminary examination to their final examination whereas the school group showed a decline.

Table 4.10 *Achievement of individual students from School 3 over duration of programme compared to the school class average.(2nd Cohort)*

Terms	1	2	3	4	5	6	7	8	9	10	11	12	
	2009 T 1	2009 T 2	2009 T 3	2009 T 4	2010 T 1	2010 T 2	2010 T 3	2010 T 4	2011 T 1	2011 T 2	2011 prelims	Matric	Change
School(3) Average	36	36	39	43	35	39	44	35	46	41	42	47	+11
Academy Average	52.5	43.8	42.8	40.3	44.3	46.3	45.3	45.5	50.8	48.8	48.8	54.8	+2.3
Students													
1	57	58	56	59	51	56	52	54	59	55	59	66	+9
2	56	30	37	32	34	38	40	36	45	42	37	42	-14
3	34	32	37	26	40	35	31	32	40	38	34	34	0
4	63	55	41	44	52	56	58	60	59	60	65	77	+14

The graph of the values provided in Table 4.10 are displayed in Fig 4.8 and show the marks for school 3 of the second group over a three year period. Student 4 improved by 14% from the start of the programme to the end whereas student 2 dropped by 14%. The improvement made by the Academy students was 9% less than was made by the school.

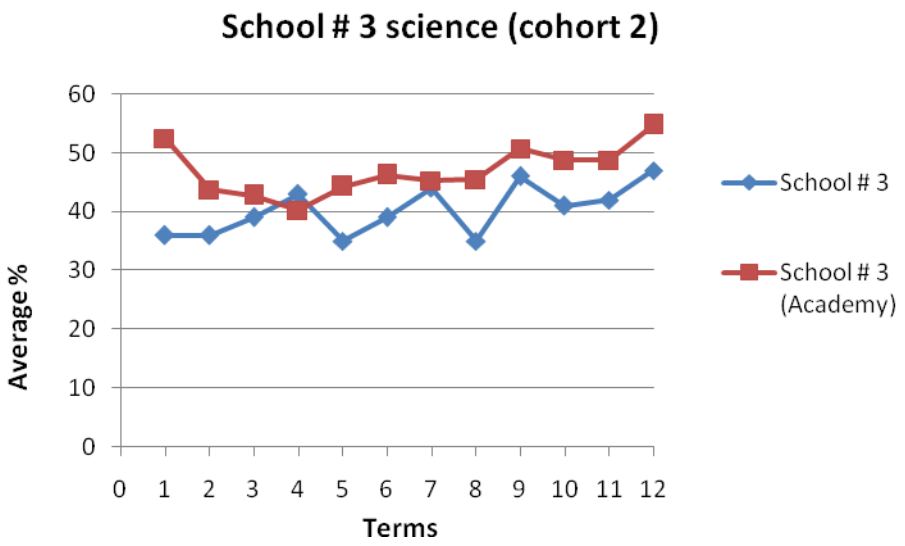

Figure 4.8: Comparison of academy students with School 3 class average per term over the three years (2nd group 2009-2011)

Figure 4.9 displays the combined results for both Academy and participating schools for the second group (2009-2011). The significant difference from Figure 4.4 (Combined schools inaugural group) to the combined schools for the second group was that the Academy average was significantly higher than the school average at the start of the programme in the second group and the difference remained constant throughout the duration of the intervention, whereas, the Academy group in the inaugural group, a significant improvement was apparent.

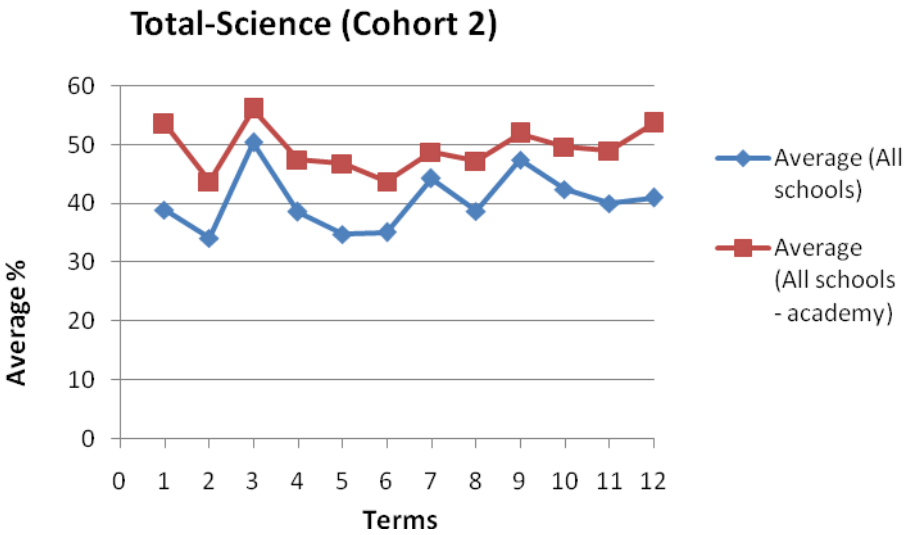

Figure 4.9: Comparison of academy students with all schools class average per term over the three years (2nd group 2009-2011)

There was a significant improvement by the Academy group from the preliminary examination to the final NSC examination whereas, the school group showed almost no improvement.

Tables 4.11 and 4.12 display the number of students who have achieved results that are above, below and equal to the average mark in Science achieved by their peers in their own schools for the second group (2009-2011). Table 4.11 highlights the numbers at the initiation of the programme whilst table 4.12 provides the numbers at the conclusion of the programme.

Table 4.11 The *number of pupils above, below or equal to the class average at the start of the programme. (Second group 2009)*

Term 1 2009	Students above group average	Students below group average	Students equal to group average
Total-school 1 n=7	5	2	0
Total school 2 n=9	9	0	0
Total school 3 n=4	3	1	0
Total number of students N=20	17	3	0

It can be seen from the results that there was only a slight improvement in the number of participants who achieved higher than the mean from the start of the programme in 2009 to the completion in 2011.

Table 4.12 The number of pupils above, below or equal to the class average at the end of the programme. (Second group 2009) NSC.

NSC 2011	Students above group average	Students below group average	Students equal to group average
Total-school 1 n=7	7	0	0
Total school 2 n=9	8	1	0
Total school 3 n=4	3	1	0
Total number of students N=20	18	2	0

However, if the two year groups are compared there were more participants above the average in the second group at the start of the programme than in the first group. The first

group had 10/19 or 53% above the average at the start of the programme compared to 17/20 or 85% for the second group.

Table 4.13 displays the results of the entire second cohort of students from the three participating schools. The column "Net improvement over class average" displays the net increase or decrease of each student over the period.

Table 4.13 *Measurement of Improvement of second cohort from 2009-2011.*

School	Student	First mark 2009 T1	Last mark NSC	Diff. first and last	Start: diff to average	End: diff to average	Net improvement over class average
1	S1_1	38	48	10	-12	2	14
1	S1_2	57	51	-6	7	5	-2
1	S1_3	58	85	27	8	39	31
1	S1_4	48	39	22	-2	24	26
1	S1_5	66	55	2	16	22	6
1	S1_6	55	50	26	5	35	30
1	S1_7	55	35	-4	5	5	0
2	S2_1	43	41	-2	11	9	-2
2	S2_2	64	71	7	32	39	7
2	S2_3	44	38	-6	12	6	-6
2	S2_4	79	40	-39	47	8	-39
2	S2_5	57	45	-12	25	13	-12
2	S2_6	54	54	0	22	22	0
2	S2_7	43	31	-12	11	-1	-12
2	S2_8	42	34	-8	10	2	-8
2	S2_9	57	47	-10	25	15	-10
3	S3_1	57	66	9	21	19	-2
3	S3_2	56	42	-14	20	-5	-25
3	S3_3	34	34	0	-2	-13	-11
3	S3_4	63	77	14	27	30	3
1	Av_S1	50	46	-4			
2	Av_S2	32	32	0			
3	Av_S3	36	47	11			
1	Av_S1AL	54	65	11	4	19	15
2	Av_S2AL	54	45	-12	22	13	-9
3	AV_S3AL	53	55	2	17	8	-9

Of the 20, 12 performed worse at the completion of the intervention, 2 showed no improvement and 8 improved. School 1 showed the greatest improvement with 4 students improving by more than 15% from the start of the intervention to completion. School 2 however, had only 1 student who managed to maintain their performance over the intervention, all the other students performed worse at the end. This particular school wrote the Independent Examination Board (IEB) Examinations as opposed to the other two schools

who wrote Government Department of Education (GDE) Examinations. School 3 had only one student improve over the period of intervention.

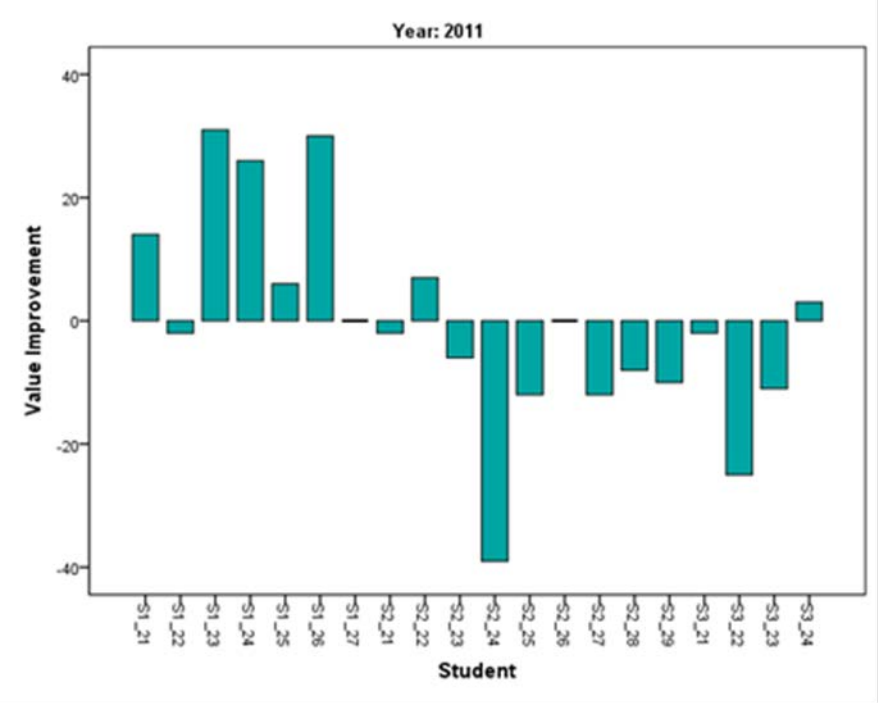

Figure 4.10 Displays the improvement of the students over the duration of intervention measured against their peers for cohort 2.

It would appear that the first cohort of students showed a greater improvement over the intervention than the second cohort. Of interest is how much better the second group from school 1 performed compared to their colleagues in the previous year group as shown in figure 4.11 below. Schools 2 and 3 were not as good as their colleagues in the previous year and in fact most of them showed a decrease in their performance measured against their peers (Appendices 7 & 8). It is important to note that the second cohort were academically stronger at the start of the intervention compared to their colleagues in the previous year group. It can be concluded that the intervention had very little academic impact on the second group whereas; the intervention had a significant positive impact on the first cohort. The reasons for the discrepancy between the two groups are not clear but I believe that attitude and motivation displayed by the two different cohorts may have had a role to play in the performance of the two groups.

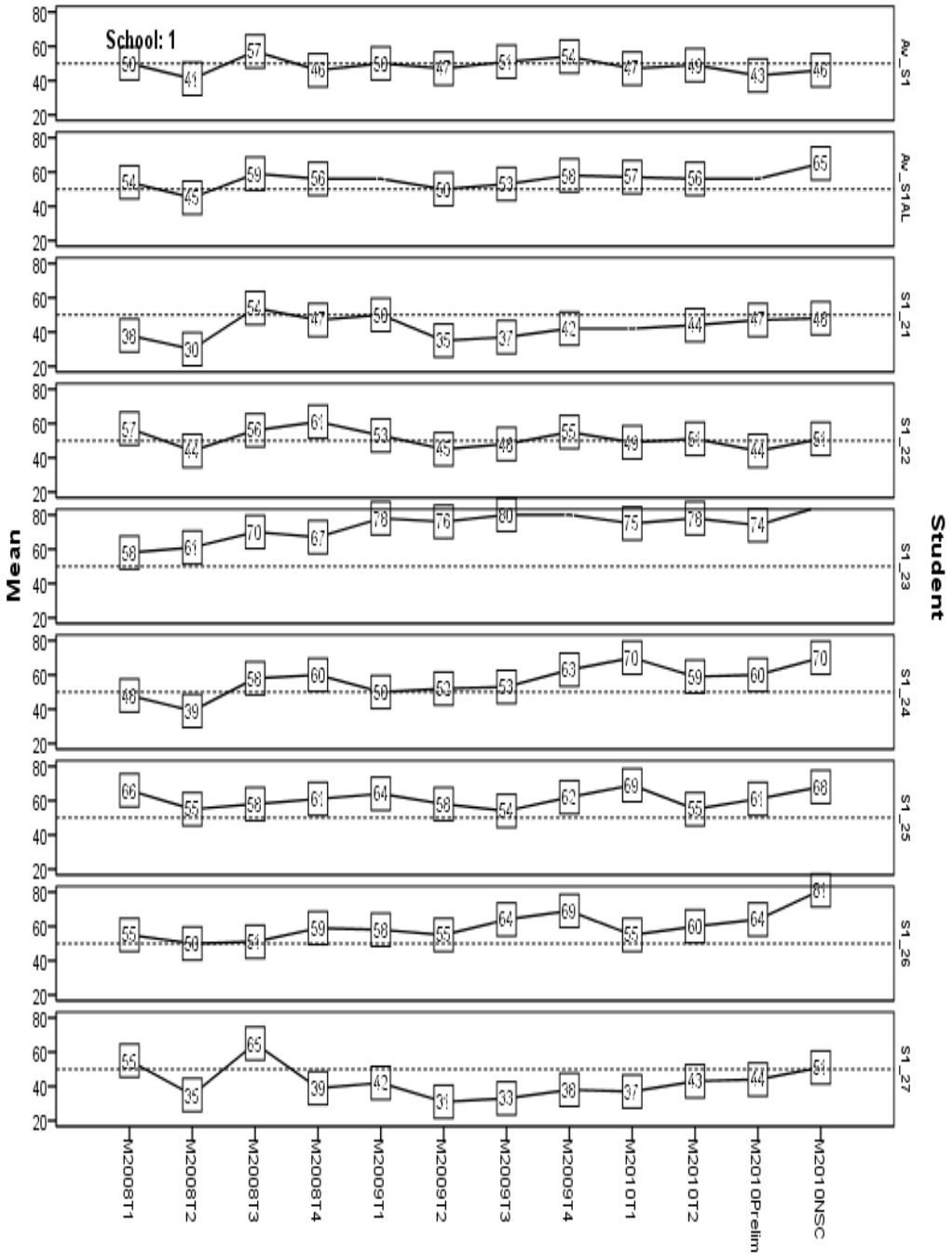

Figure 4.11 Cohort 2 school 1- Graph showing the results by term starting in 2009 and finishing with the NSC exam in 2011

4.1 CONCLUSIONS

The results from the first year that the programme was in operation indicate that the number of students improving, achieving above the average of their peers in their schools, increased over the period of intervention. It is important to note however, that it is a relative improvement compared to class average and not an actual improvement on the baseline entrance marks (The two tests were different so cannot results cannot be meaningfully compared only relative movement against classmates.). It is also important that the only common examination that all the students wrote was the final NSC and therefore comparisons of improvements across the schools would not provide reliable data. The same trend occurred in the second group who entered the Academy in 2009. A few individuals made a significant improvement in both year groups over the duration of the intervention and there were a number who performed poorly at the end of the intervention. Significantly, the students in the Academy of the inaugural group from all three participating schools produced an improvement in their average for Science compared to their peers in their own schools from the start of the intervention to the conclusion when the students wrote the NSC examinations.

Two schools in the second group (2009-2011), schools 2 and 3, showed a decline in their averages when measured against the averages attained by their peers from their own schools. They showed a relative decrease in their scores compared to their whole class averages, thus, if the class average went down, they went down further! The students in the Academy from School 1 however, showed a significant improvement when measured against their peers. There were also three individuals from this school who made substantial improvements over the intervention period. There was a significantly higher percentage of students achieving above group averages at the start of the intervention in the second group compared to the first group (85% in the second group compared to 53% in the first group). It could be construed that the second group were academically stronger at the start of the intervention than their peers when compared to the first group and their peers. From the results, the intervention has had a positive impact on the first cohort and only isolated individuals in the second cohort displayed significant improvement. It could be concluded that such an intervention has had a greater impact on the weaker group as a whole when compared to the stronger group. Considering the fact that the Academy students were selected using Academic performance as one of the criteria, the improvements are not as significant as was anticipated. However, when considering the actual achievements by the

students at the start of the programme, there was an insignificant difference between the averages of the Academy students compared to their peers in their own schools. It is important to note that the schools provided their highest performers in the grade 9 year to be considered and interviewed for the programme. On analysis of the results obtained from the first assessment at the end of term 1 it is clear that the selected students were either only marginally stronger academically or even weaker than their peers in their own schools. This could suggest that there were issues with the methods in which the selection process was conducted. Seen in this context, the improvements by some students could be considered to be substantial.

CHAPTER 5
ANALYSIS OF SURVEYS AND INTERVIEWS

The previous chapter dealt with the manner in which the student achievement scores were analysed in this study. In this chapter the analysis of the interviews and surveys will be discussed and the comparison of the findings with those from the previous chapter will be made. It was outlined that I used a mixed method approach which involved the use of both the qualitative and quantitative approaches in the gathering of data. This involved data gathering instruments such as surveys and interviews which are the focus of this chapter.

Three surveys were designed in order to seek responses that would provide data to be able to answer the research questions. A pilot survey was carried out with a group of matric students in order to design a final survey. A final survey with 30 responses was designed and the participants completed the survey on-line. The entire Academy was given the survey (appendix 2). Of the 64 boys 6 chose not to participate and 3 survey forms were either illegible or simply made no sense. Thus 86% of the Academy responded The 30 questions were recorded and the questions with the accompanying responses were grouped according to the research sub-questions. A second survey was designed for pupils not on the programme and they were given a hard copy of the survey which contained 17 responses (Survey #1, appendix 3) the questions in each of the surveys were grouped so as to provide specific answers to the research questions. A third survey(appendix 4) was given to a different group of pupils from the three schools who were not participants on the programme and this survey required written responses to four questions and they were able to offer a final comment. The first two surveys were designed using a forced response.

The purpose of the interviews was to gather information from two different groups of people. Both groups were directly involved in the programme and I was expecting to interview a third group, pupils from the three partner schools who were not participants on the programme however, the Principals of the schools' did not allow this. I did however survey these pupils from the three schools so I did collect useful data from another source and viewpoint. The reason for interviewing the different groups was to gain information from their perspectives and then to compare the data and look for answers to the research questions. The first group who were interviewed were participants on the programme. A pilot interview (appendix 6) was carried out with three Grade 12 students, one from each of the three participating schools. The responses and results of the pilot interview were analysed

studied and used to design a final interview schedule and it was decided by the researcher that there were not sufficient questions in the interviews to provide answers to the research questions. This final interview was conducted with three different matric students. Refer to (Appendices 6). The second set of interviews involved four teachers on the programme. A copy of the interviews appears under the appendix 7. The findings will be discussed in this chapter. Both sets of interviews were standardised open-ended interviews. The questions in the surveys have been grouped according to the research questions and corresponding findings from the interviews will be discussed when it is appropriate. The overarching question for the research will be considered during the discussion. The overarching question is: 'W*hat is the effect of the after school intervention programme in Physical science?'*

5.1 PARTICIPANTS VIEWS ON THE IMPACT OF THE INTERVENTION ON THEIR ACADEMIC PROGRESS

In the previous chapter the impact of the intervention was analysed from the numerical data gathered. The results from both year groups that were studied indicated that the number of students achieving above the average of their peers in their schools increased over the period of intervention. The participants had an opportunity through the survey and interviews to express their point of view on the impact the programme has had on their academic progress and performance. The survey of participants on the Academy programme, (Appendix 2) was completed on-line by the participants on the programme and (Appendix 3) is the survey completed by randomly selected pupils from the schools who were not on the programme.

Table 5.1 *Combined Survey responses- Participants on the programme* (a)

		Forced response %	
	Questions	Agree	Disagree
2	*The teaching of English has not had any significant effect on my Mathematics and Science*	**23**	**77**
4	*My marks have not improved significantly during my time in the Academy*	**28**	**72**
12	*My teachers at school have noticed an improvement in my performance in my science.*	**73**	**27**
14	*My friends have not really noticed an improvement in my ability in Maths Science and English*	**21**	**79**
15	*I have not improved my confidence in tackling Science problems during my time in the Academy.*	**31**	**69**
21	*My problem solving skills in Maths and Science have not improved during my time in the academy.*	**15**	**85**
22	*I am finding it difficult to manage my work because of the time I spend in the Academy.*	**40**	**60**
25	*My peers back at school are learning 'stuff' from me.*	**82**	**33**
26	*My marks would not be as good if I did not attend the Academy.*	**38**	**62**

The following questions in the surveys provided evidence from the participants that from their perspective, the programme has had a positive impact on their learning of science. The answers they offered were their views on the various issues and are given in Table 5.1. There were four possible responses to the questions in the table above. Strongly agree, agree, disagree and strongly disagree. For clarity and ease of interpretation, agree and strongly agree have been grouped together as "Agree" and disagree and strongly disagree have been grouped together as "Disagree". The information from this survey indicates that from their perspective there has been an improvement by most students in their academic performance in science. For example, 72% of respondents in question 4 indicated that there marks had improved during their time on the programme. 84% of respondents to question 21 indicated that their problem solving and critical-thinking skills had improved over the duration of the intervention. From these responses it can be seen that academy students report that their peers at school are learning from them, their problem solving skills have improved, their own teachers have noticed an improvement in their performance, the improvement in their use of the English language has impacted positively in their learning of mathematics and science and their own confidence has improved whilst on the programme.

A number of responses given to questions four and nine of the interviews conducted with the participants (Appendix 6) appear to support the findings from the survey. Question 4 and those comments that are linked to the first sub-question are given below: *'How do you think you have benefited in Physical science by being on the Academy programme'* .There were three students interviewed and all of them indicated that the impact that science in the Academy has been positive. The following two responses confirm the findings in the survey: *"My marks have improved." and "I am more motivated to improve."* 71% respondents in the survey indicated that they have benefitted from doing science in the Academy.

The following responses were offered to Question 9 *'Do you think your marks have improved compared to your friends in your school? And how would you say the other boys in the Academy are doing compared to their schoolmates?* :

> "Yes. I have moved up to near the top of the grade. I have noticed that some of the other boys have also improved their positions in the grade. But some have got worse"
> "Most of my marks have improved and I am doing better than most of the students in my class. Some of my friends in the Academy are doing better. Some others are really not doing better.

> "Some of my marks have improved but some of the others have not got better. Some of them have done better" **(**Some of the Academy students have out-performed their peers)

All three of the above academy students who were interviewed indicated that they had shown improvement. They also indicated that there was some improvement compared to their classmates. Once again, these responses are consistent with the findings from both the surveys and the analysis of the marks in chapter 4. Further confirmation is provided from the survey for non-participants. The following statement was made: *My teachers at school have noticed an improvement in the performance of my friends in science*. 87% of respondents agreed with the statement.

The teachers were interviewed and the following responses were given to question 5. Question 5: *'Have you noticed an improvement in the boys marks?'*

> "*I do not test the boys on a regular basis but through their questioning and my questioning I believe there is an improvement by most boys."*
>
> *"There are a few of the boys who really have shown very little progress."*
>
> *"I look at their improvement in their experimental and practical work I would say that they have made progress."*
>
> *"I don't test the boys so I can't comment. I see them only once a week."*

The teachers responses are not as definite as the participants but there is some indication, if somewhat limited, to the fact that there is an improvement by some, but not all of the participants. These responses are consistent with the findings from the analysis of the numerical data discussed in chapter 4.

White, Barnes and Lawson (2009, p. 11) highlight the impact that the teacher has on learning through his or her explanations and through the engagement they have with the students. A number of respondents have highlighted the good teachers they are experiencing in the Academy and this would suggest that student's marks may be improving as a direct result of this positive interaction. The results provide enough positive evidence to make the following assertion. **Assertion One:** In the opinion of the participants the intervention that is provided through the Academy programme in Physical Science has led to an improvement in their results.

Lewy and Hobden (1992) in their study found moderate improvement by the group of students they researched who were part of a similar programme. Welsh et al. (2002) in their research into the benefits of the TASC programme agreed with Lewy and Hobden and found

that those participants who were seldom absent and had been on the programme for an extended period of time showed the greatest improvement.

5.2 ATTITUDE TO LEARNING BY PARTICIPANTS.

Research Sub-question 2: *What effect does the intervention programme have on student's attitudes to school, science and learning?* The following questions given in Table 5.2 from the survey provided answers to this research question.

Table 5.2 *Combined Survey responses- Participants on the programme* (b)

Question	Questions	Forced response % Agree	Disagree
3	*It is more important to learn content in Maths and Science rather than developing critical thinking skills.*	**29**	**71**
6	*Content is not really important.*	**22**	**78**
10	*I am enjoying my subjects because of the consolidation that the Academy provides*	**96**	**4**
20	*I have set my goals higher because of my attendance in the Academy*	**85**	**15**
23	*I believe it is truly beneficial attending the Academy*	**100**	**0**
24	*It is better to rote learn and obtain good marks rather than trying to understand the difficult concepts.*	**49**	**51**

From the responses to the seven questions it is evident that the majority of participants have a positive attitude to school, science and learning. An example of this was the positive response to question 10 of the survey where 53 of 55 of the respondents indicated that they are enjoying their subjects because of the consolidation that the Academy provides. Of the 55 respondents 47 have set their goals higher because of their attendance in the Academy (Q20). All 55 respondents believe it is truly beneficial attending the Academy (Q 23) and 39 of the 55 respondents believe that it important to develop critical thinking skills in maths and science (Q3).

The interviews with the three selected students revealed a similar overall response to that in the surveys. For example, Question 3: *What other activities on the programme have you enjoyed? Elaborate*. The following responses are a sample of what was given by the three students interviewed: All three indicated that they were enjoying and benefitting from doing practical work. They also indicated that they are enjoying using computers. These responses indicate that through their experiences their learning is being enhanced and this probably improved their attitude to learning. Two of the responses to Question 8*: 'Give 5 highlights of*

your time on the programme.' Are: Doing practical work and having guest speakers address them on various issues. Once again, there has been a positive response to the activities that students experience and there is an indication that this has resulted in greater motivation and attitude. The responses to question 11confirm this. Question 11: *'Has your attitude to learning and to your school changed since you started on the Academy?'* All three respondents indicated that they are working harder since they joined the programme.

The following responses were given by the four teachers when interviewed: Question 2: *'Do you find the boys responsive?'*. Responses are shown below:

"Yes. They are prepared to ask questions but they do become tired."

"They are prepared to become involved in class discussion."

"They are Confident to ask questions."

"The students are really keen to learn and are willing."

"They are really disappointed when they do not perform in the short revision tests I give them."

"The boys are keen to learn and they are always attentive."

All of the above responses indicate that the students have a positive attitude to learning and to Science. The responses from the surveys and interviews with the participants agree with this finding. Question 4: *'Do you find that the boys are motivated?'*

"I must say that I am surprised by the lack of motivation displayed by many of the boys. "

"I get the feeling that they believe that because they are attending the Academy there marks will automatically improve."

"Not as motivated as we should expect them to be. Many of them find the work difficult and perhaps they almost give up in the more challenging sections of the curriculum."

"Yes they are motivated but I do have a few that do not seem to be that interested."

The responses given to this question indicate that there are some boys who are not motivated and therefore are not displaying a positive attitude to Science and learning. These responses show some disagreement between what some of the teachers have said about motivation and attitude toward learning and what the participants have stated. It is clear that most of the participants have indicated an improvement in attitude and motivation. The results of the analysis of the numerical data in chapter 4 could show a link between improved success, motivation and attitude.

Dewey mentions ‘atmosphere’ as being an important ingredient in inspiring students. A number of respondents are referred to specific teachers who have had an impact on them. These responses could indicate that these positives improve their attitude to learning. Bernstein (2008) mentions the ‘visible ‘pedagogy as a contributing factor to effective learning. This visible pedagogy would include what the teacher provides in terms of teaching and learning and once again, the respondents have cited these as positive aspects of their experience in the Academy. These affirmative features could result in students adopting a positive attitude to learning and to Science.

From the results of the surveys and interviews conducted, the second assertion, **Assertion Two** is made: The participation by students on the programme has resulted in an improvement in the attitude of most of them toward school, science and learning.

5.3 VIEWS ON PRACTICAL WORK.

There were questions in both the surveys and interviews that investigated the importance of practical work and the outlook of the students on practical work. The following research question guided the design of the questions that I included in the surveys and interviews so as to elicit the most appropriate responses to this research question. *What are the participant’s views on the instructional emphasis on practical work?* The questions and responses appear in table 5.3.

Table 5.3 *Combined Survey responses- Participants on the programme* (c)

Question	Questions	Forced response % Agree	Disagree
1	*The Academy has improved my practical skills in Science.*	**89**	**11**
5	*It is important that I do practical work rather than the teacher doing demonstrations.*	**81**	**19**
18	*My handling skills with apparatus have improved*	**92**	**8**
27	*Developing practical skills are important.*	**91**	**9**

The response by the participants indicates that 50 of the 55 respondents believe that their skills in practical work have improved as a result of the academy intervention as shown in table 5.3. The respondents also highlight the improved confidence that they have experienced as a result of handling apparatus. Of the 39 respondents in the survey given to peers not on the programme 36 of them indicated that in their opinion, the Academy intervention has

resulted in an improvement in the practical skills of the participants. Four teachers were interviewed and one of the questions that was asked was: 'What aspect of your subject have you noticed the most marked improvement amongst the boys?' (Appendix 7). The following responses were given:

Their skills and confidence with practical equipment has definitely improved.

Their English has also improved and this should improve their understanding of exam questions.

Their handling of apparatus has improved.

These responses indicate that the teachers believe that the inclusion of practical work for the students doing science in the Academy has had a positive impact in their learning.
The next question that was posed to the teachers was: 'What are your views on the instructional emphasis on practical work? (Q. 11)' The following responses were given:

The use of practical work develops and supports the corresponding theory.

The more practice they have in practical work at school, the more competent they will be when they enter a tertiary institution.

Practical work should supplement what we are teaching and the pupils should make the link.

It is good for the students to handle equipment as it builds confidence.

The responses are provided by the teachers so even though there are in-depth explanations around the benefits of practical work, the responses cannot be used to answer sub-question 3 as the question is directed to the students. However, the responses do provide useful information and appear to support what the students have said. For example, both groups of respondents have mentioned the link between practical work and theoretical content.

The following responses to a question asked of the participants in the interviews support the claim that greater use of practical work lead to improved skills. Some of the skills they gained are highlighted through the responses to the following question. The three students who were interviewed were asked the following question: *What skills do you think you have gained from doing practical work in the Academy? How do believe practical work can help you?*

The following responses were given:

We have learnt how to use equipment and take measurements.

I think it makes us understand the work.

I think I am not scared anymore to touch the equipment.

The experiments also help us understand the laws

It has taught me to be careful with the chemicals.

I have got better at it. I think that if I go to University I will have an advantage over many other people who have not done any practical work.

From the responses to these questions practical work is seen as being an important part of what the students are experiencing on the programme. Question 5 of the survey highlights the importance of students doing practical work themselves: '*It is important that I do practical work rather than the teacher doing demonstrations.'*

Of the 55 respondents, 80% of them indicated that it is more important for them to do the practical work rather than the teacher doing demonstrations. All 55 respondents believed that developing practical skills is important. The following response was offered by a student not on the programme. The response was given in the last section of the second survey. Comment 19 which read: *'The programme is helping my friend develop new skills in computers and in Maths and Science practical work.'* In the first survey for students not on the programme 94% of respondents to question 10: *Do you believe that the Academy has improved the science practical skills of my friends on the Academy?* believe that the Academy has resulted in an improvement.

Most of the participants have stated that they believe that practical work provides them with skills which can be used should they follow a Science based career and there are immediate benefits from doing practical work for example the understanding of the theory in Science can be enhanced by conducting experiments. In conclusion, the participants, their peers and the teachers highlight the importance of doing practical work and believe that it enhances handling skills, the understanding of the theory is improved through doing practical work and it provides the necessary skills to cope with university practical work. This is in agreement with what Lunetta (1998) has argued. Lunetta stated that interaction between the teacher and the student during practical work is crucial to the development of the link between theory and experimentation. (p. 252). Abrahams and Millar (1966) stated that it is vital that students must themselves do the practical work in Science to gain maximum benefit. The teachers and the students have also made similar comments about this connection.

From the results of the surveys and interviews conducted, the third assertion is made:

Assertion Three: Greater use of practical work and experimentation has led to improved science practical skills, motivation and attitude to science.

5.4 INFLUENTIAL FACTORS.

The participants on the programme have emphasised a few reasons for the success of the intervention programme. The reasons are highlighted below. Figure 5.1 displays the responses to the question about the importance of learning English for success in Science. The following 4 sets of graphs have been drawn from the survey (Appendix 2, p. 91) and were chosen to emphasise a few reasons cited by participants for the impact the Academy has had on their learning.

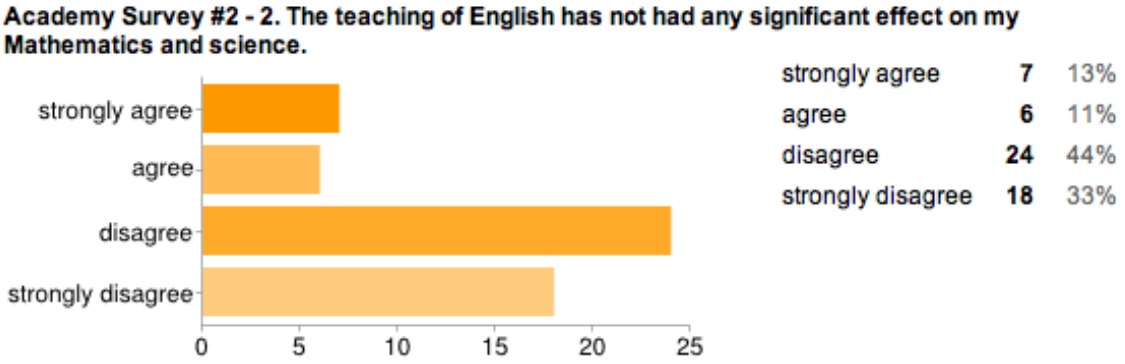

Figure 5.1 Graph displaying the responses to the question that learning English may impact on the success in Science.

77% of participants state that learning English is an important factor for success in science. 40% of the participants believe that spending time on the Academy programme has a negative impact on the management of their other work. This is shown as figure 5.2

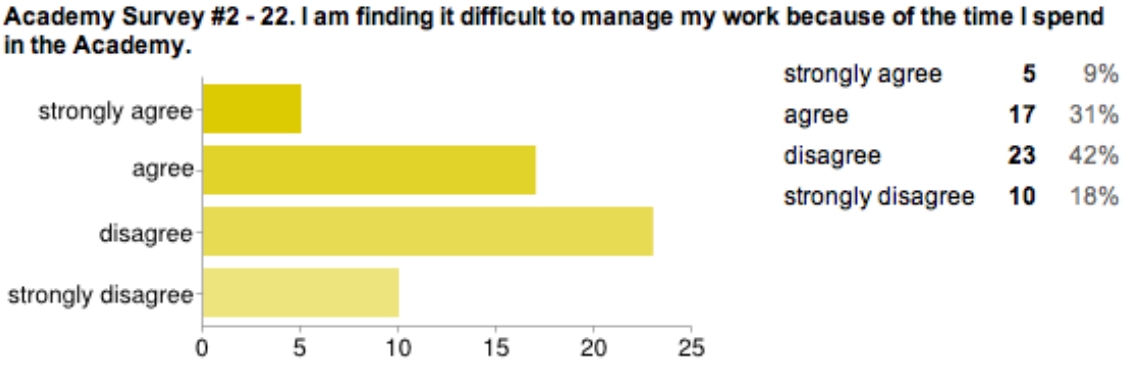

Figure 5.2 The impact of the Academy on time management of participant's.

71% of participants believe that developing critical thinking skills is more important than learning content. This is displayed in figure 29 below.

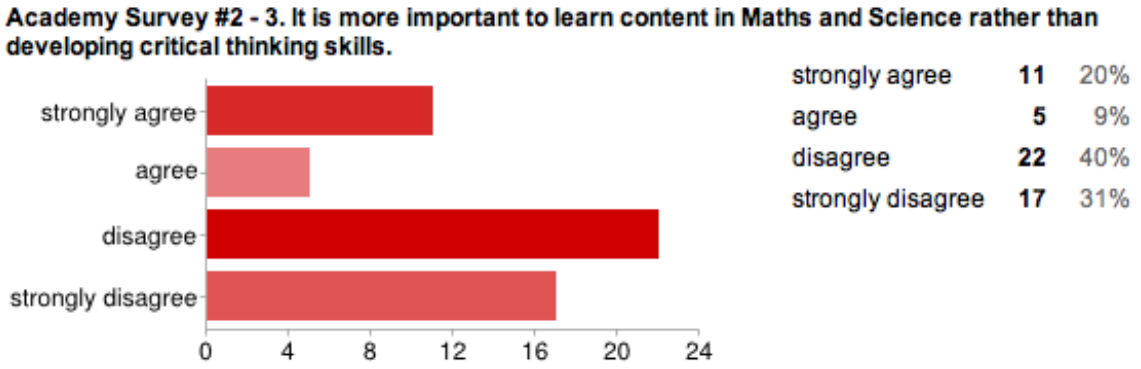

Figure 5.3 The importance of developing critical thinking skills.

91% of the participants believe that developing practical skills I extremely important to their own success. This is shown in figure 5.4.

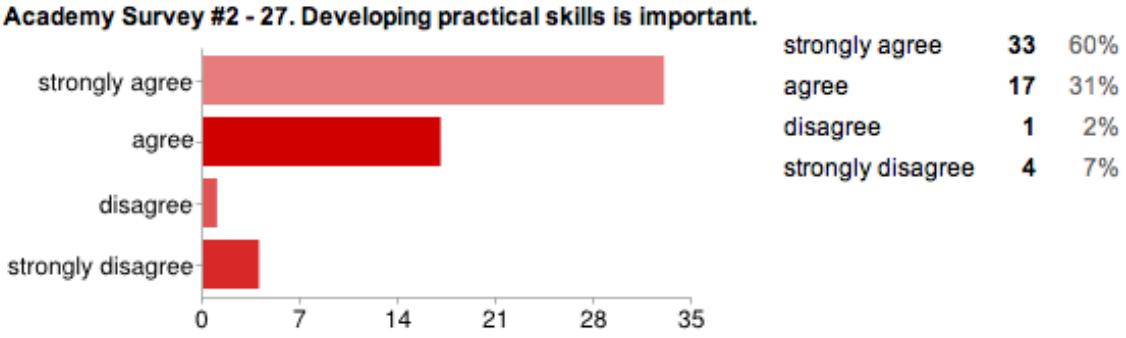

Figure 5.4 Developing practical skills.

The surveys and interviews revealed that there are factors that could both enhance as well as inhibit learning in the Academy. It was decided by the researcher to seek perspectives from various sources for both validity and reliability purposes so two surveys were given to non-participants who were peers to participants from the partner schools. One of the sub-questions of the research dealt with the issues that could both improve or hinder learning on the programme. The question asked was: *What factors do the participants consider to be most influential in determining the success or failure of the intervention from their perspective? Questions (5; 6; 11; 14) from* the survey for students not on the programme (appendix 3) will provide insight into those factors that they, as non- participants, feel positively impact on the success of the intervention on their friends who are participants on the programme. Table 5.4 provides the statements in the survey and the responses from these

non-participants. The responses were recorded as a percentage of those who agreed and those who disagreed.

Table 5.4 *Combined Survey responses- Participants not on the programme.*

		Forced response	
Number	**Questions**	**A**	**D**
5	*Learning computer skills in the Academy will help my friends improve their ability in Science and Mathematics.*	**61**	**39**
6	*Five afternoons in the Academy is better than four days.*	**64**	**36**
11	*My teachers in my school are supportive of my friends attending the Academy*	**59**	**41**
14	*My friends are finding it difficult to manage their work because of the time they spend in the Academy.*	**54**	**46**

The questions and responses in table 5.4 have been extracted from the survey (Appendix 3). Of all the respondents 54% say that the participants struggle to manage their time due to their participation. 36 % believe that a shorter week is preferable, thus indicating that the students need time for their own work. Other factors that have an impact on the success of the programme include a lack of support by some of the teachers from the participating schools. 41% of the respondents believe they do not have support from their teachers. The survey also revealed that 36% of the respondents feel that reducing the week from five days to four would have benefits for the students by allowing them to have more time for their own school work. It would appear from these results that time spent on the programme has a negative impact on some of the participants. From the responses it would seem that some students are managing the time pressures but that others are not. An important factor that could also have a negative impact on the success of the programme is the fatigue that some of the participants are experiencing. This was highlighted by a number of respondents who emphasised this as an issue.

The following responses to question 3 of the second survey (Appendix 4) of the students not on the programme are issues that have been mentioned by the respondents that could have an impact on the success of the programme. *Question 3: Do you believe that your friends are able to cope with their schoolwork and the time they spend in the Academy?* A number of respondents indicated that their friends could not cope with all the work. They also indicated that their friends are often tired and do not do their school home-work.

The interviews with the participants (extracted from Appendix 6) provided the following information. Only those questions that had a bearing on the research question have been included with the appropriate responses.

Question 6: *'what could we do to improve the efficiency of the Academy?'*

Transport was raised as an issue that could negatively impact on the success of the programme. More lessons in mathematics and science should be provided. Some of the students are constantly absent and this is disruptive. These issues could have a negative impact on the success of the programme.

Question 10: *'What factors do you think are important for the Academy to be successful?'*

Once again, transport was highlighted as a problem. Some of the respondents believe that other subjects should be taught. The issue of student's absenteeism was emphasized. These responses propose that the problem with transport needs to be resolved and a second important factor is the continued absenteeism by certain students which appears to be disruptive and thus could impact on the success of the programme.

The teachers who were interviewed were asked the following question:

Question *12* *'What factors do you consider to be most influential in determining the success or failure of the intervention on the participants?'*

The following responses were given:

More tests should be given to the students whilst on the programme.

Absenteeism is a problem. This results in a lack of continuity.

Some of the students are not motivated and this presents a problem.

Some of the students are very tired and find it difficult to concentrate. This is as a result of their long day.

Some of the students lack confidence and self-belief.

Once again, the research sub-question 4 was directed at the participants but again there, is a strong link between what the students have highlighted as issues that could impact on the success of the programme and what the teachers have said. For example, both groups indicated that absenteeism is a problem. A few of the teachers have highlighted motivation as an important factor for individual success on the programme. This belief is borne out by Svinicki and Dixon (1987) who said that the learning approaches adopted by students, their views, their self-worth and their motivation all impact on their learning.

From the surveys and interviews there are a number of factors that have an impact on the success of the programme. A few of these have been highlighted by teachers and students and need to be considered when assessing the efficiency of the programme. This leads to

Assertion 4: There were specific factors mentioned by participants that were strong determinants for the academic success of the intervention programme.
The following are some common issues emphasised by all three groups of respondents, (the students on the programme, their peers not on the programme and teachers), that influence the effectiveness of the programme: From the students perspective the learning of English is important; the amount of time the Academy is in session negatively impacts on their performance in their own schools; the emphasis on critical thinking skills is important and; the development of practical skills was viewed by the participants as a key factor for their success. The researcher found from the results of the surveys and interviews conducted with the teachers and the peers not on the programme that the data supported these findings.

5.5 SUMMARY

The responses in the surveys and the interviews have provided answers to the research questions. According to the participants, the teachers and a group of students not on the programme the Academy intervention programme is having a positive influence on the academic success of most of the participants. The effectiveness of the teachers, the notes that have been provided and the attitude and motivation shown by students are factors that ultimately determine the success of the students in Physical Science on the programme. Time and fatigue are factors that have been highlighted as issues that could negatively impact on the success of individuals. Motivation by the students has been emphasised as an important factor in the academic success of individuals on the programme (Fan & Williams, 2009).

Most of the respondents believe that practical work is valuable as it improves handling skills and prepares those who intend following a Science-based Degree or Diploma and according to some of the respondents; it also makes an important link to the theory that is taught. Many of the respondents believed that the attitude of the participants to Science, learning and to their schools has improved as a result of their inclusion in the Academy programme.

A comparison of the quantitative data captured and analysed with the qualitative data was conducted. The results of the numerical data (quantitative) indicated that the difference between the mean of the Academy participants and their peers did not show as significant an increase over the period of intervention as was expected. However, in the analysis of the results over the three year intercession it was apparent that most of the participants in the first

cohort showed improvement from the start to the conclusion of the intervention, whereas fewer participants from the second cohort showed improvement. The results are therefore consistent with the findings from the analysis of the interviews and surveys. This mixed method of data collection has an advantage over either a quantitative or a qualitative approach in that the first method of data collection that is used informs the second one, or the second one supplements the first, and this leads to a better understanding of the phenomenon being studied (Creswell, 1994, p. 24).

CHAPTER 6
SUMMARY AND CONCLUSIONS,

6.1 CONCLUSIONS

The study set out to explore what affect an after school Science, Maths and English enhancement programme have on grade 10 to 12 students' learning of physical Science. There are a number of similar programmes that in operation throughout South Africa but the success of these programmes has not been fully researched. In particular this study had as its focus four questions (a) Do the students' academic achievements improve significantly more than their peers who do not receive the intervention? (b)What effect does the intervention programme have on student's attitudes to school, science and learning**?** (c) What are the participant's views on the instructional emphasis on practical work? (d) What factors do the participants consider to be most influential in determining the success or failure of the intervention from their perspective?

To answer these questions a mixed method design was used. Two groups or cohorts of participants were studied in the research. The first group joined the programme in 2008 and finished in 1010 and the second group joined the programme in 2009 and finished in 2011. Marks from each of the two groups were collected every Term for the three years and this data was organised and analysed . Surveys and interviews were conducted with participants, teachers and students from the three partner schools who were not on the programme. These seemed to be the most appropriate data gathering instruments to achieve the research goals.

The analysis of the results of the numerical data showed that there was an improvement by the majority of participants in the first cohort from the start of the intervention to the conclusion three years later. This was not found to be the case with the second group. The results of the participants was measured against the average in Science obtained by their peers form their own particular schools who were not on the programme. This was true for both cohorts however; the second group on average did not make as significant an improvement as the first group. It was suggested that the first group were not as academically strong as the second cohort and this may have been a factor in the smaller margin of improvement. The qualitative data which included the surveys and interviews were used to triangulate the results and there was a link between the findings from the three sets of data.

6.1.1 Do the students' academic achievements improve significantly more than their peers who do receive the intervention?

Quantitative data was collected from the participants and their classmates over three years. The Analysis of the numerical results gathered from each student have yielded that the intervention has had moderate success in raising the marks of the participants. The comparison between the participants and their peers from their own schools was the method used to determine if improvements had been made over the duration of the intervention. Of the 19 participants in the inaugural cohort, 4 of them performed poorer at the end compared to their peers. The remaining 15 performed better, with 3 participants improving by 25% or more. The overall net improvement by the participants measured against their peers not on the programme was 11.3%. This improvement could be construed as significant enough to state that the programme has had a positive impact on the participant's science results.

The second cohort however, did not make the same improvement, in fact, of the 20 students, 12 regressed when measured against their peers from their own schools. School 1in the first cohort was the worst performing school and I addressed the poor results with participants, specifically with the grade 11 group moving into grade 12 at the start of 2011 and indicated to them that they needed to make the most of their participation on the programme. There was a significant improvement by this school in the final NSC examinations at the end of 2011 with an average improvement of 15% when measured against their peers from their own school. The previous cohort from this school had only shown an improvement of 2.7% when measured against their peers. Schools 2 and 3 of the second cohort both regressed when measured against their peers. School 2 regressed by 9% whereas school 3 regressed by 8.8%. Once the results of the three schools were combined, the overall regression was 0.6%. There was however, a significant improvement by the participants from the writing of their preliminary examination to the writing of the NSC examination. Their peers showed a regression from the preliminary examination to the NSC examination. The results of the second cohort showed no improvement and it would appear that the intervention has had no impact on results of the participants in science. It is not clear why the first cohort made a significant improvement over the period of intervention whilst the second cohort showed no improvement.

6.1.2 What effect does the intervention programme have on student's attitudes to school, science and learning?

The surveys and the interviews revealed that some, but not all of the participants showed an improvement in their attitude to school, Science and learning in general. The link between the change in attitude and the self-motivation by individuals was highlighted by teachers and participants in their responses in the surveys and interviews. For example, the majority of the participants who were surveyed indicated that they are enjoying the consolidation that the Academy offers and they like the subjects that are being offered. The three students who were interviewed provided similar responses, for example, they indicated they are enjoying doing practical work and using computers, they also indicated that they are all working harder since they joined the Academy. Such responses could indicate that there has been an improvement in attitude and in motivation shown by the participants. The interviews with the teachers provided similar responses. For example, it was stated that the students are willing and keen to ask and answer questions, are prepared to become involved in classroom discussions and are willing to learn. Such responses would indicate a positive attitude and motivation by participants. However, the following responses indicate that not all of the participants were as motivated or had the positive attitude that was indicated in the surveys and interviews with the participants. One of the comments made by a teacher was they were surprised by the lack of motivation displayed by many of the boys. A second comment was that some of the students believed that because they are attending the Academy there marks will automatically improve and another comment was the students were not as motivated as was expected.

6.1.3 What are the participant's views on the instructional emphasis on practical work?

All participants on the programme who responded in both the interviews and surveys indicated that doing practical work improves their understanding of the theory and it improves their handling skills and they have gained confidence in handling equipment. They also indicated that it prepared them for Science at University. Some of the respondents said that it is an aspect of Science that they enjoy which creates a positive attitude to the subject. It would appear from the interviews with teachers that they provide explanations during the practical work and that they are fully involved during these sessions. According to Driver (1975) Students need to be guided through practical work.

6.1.4 What factors do the participants consider to be most influential in determining the success or failure of the intervention from their perspective?

The participants believe that support from their own teachers is important to their success on the programme and jealousy by peers in their own schools makes it difficult for them. . Fatigue by many of the participants is an issue that could impact negatively on the success of the programme. A lack of motivation displayed by some of the participants could be as a direct result of the fatigue they have experienced. There is a perception that transport from their own schools to the Academy at St John's is not always reliable and this issue needs to be addressed for the success of the programme. A number of participants have said that absenteeism by some of their peers on the programme is disruptive as teachers often have to spend time re-reaching work. Within the literature there is evidence that time spent on the programme is a factor that needs to be carefully considered when developing such after-school interventions. Research indicates that between 60 and 80 hours per year yields the best results. The Academy is in session for about 300 hours. The results from the surveys and the interviews have indicated that the students do not have enough time to manage their own schoolwork.

6.2 LIMITATIONS

Two of the three Principals of the schools did not allow me to interview the pupils who were not on the programme nor their teachers and thus I relied on two sets of surveys that were given to a group of students in each of the schools. I was not able to elicit any response from teachers in the schools and this placed certain limitations on the spread of data I was hoping to accumulate. These same Principals had agreed to allow me access to their pupils but made it extremely difficult to do so. It was clear from the responses to the surveys that some of the teachers from the schools were not supportive of their pupils participating in the intervention programme and this may certainly have had some effect on the performance of those pupils who were directly involved with these specific teachers. This dissertation comprised 38% of the study with the remaining 62% being the course work, thus the study was limited in its breadth and depth. A better result could have been achieved if I had a carefully designed baseline entrance tests so that the actual standard of the students could be determined and such baseline test results could have been used in the selection of candidates

for the programme. In addition the number of students involved were reasonably small especially when school groups were considered. This made meaningful statistical analysis difficult and I was restricted to providing descriptive statistics supplemented by the qualitative data. Given the nature of the study which is a case study and the selection of students from the schools (not random sampling), the results apply to this specific programme and cannot be generalized across other projects. However, other projects can look at this case and where characteristics are similar they can learn from the programme.

6.3 IMPLICATIONS FOR FURTHER RESEARCH.

It is acknowledged that this study is quite specific to the type of intervention programme under research and that it is targeting a group of students from a specific environment. There is no doubt that certain findings could be generalised to most forms of interventions but certainly the findings around the numerical data may not necessarily be generalised. However, the study has made a contribution to the understanding of intervention programmes in South Africa.

The limited improvement by the participants is noted, however, there were certainly other skills and benefits that the boys acquired during their time on the programme these however did not form part of the research. Further research should be given to the “hidden curriculum” elements which are such a powerful part of the mix. Academy boys feel even if their marks are not necessarily better, they have grown academically. They see a bigger world and find that an empowering experience. Extra lessons, *cram school* or Saturday classes might drill the boys and achieve better marks in the NSC but this is a short term focus only. By working for “transcendence” in the students such programmes would be building for the long term. The introduction of intervention programmes at grade 10 level may be too late in the academic career of many of the participants, hence the argument for more strategic focus and analysis of the real blockages. The ISASA programme puts students from similar backgrounds fulltime into independent schools and their academic results appear to be disappointing. Other Mathematics and English programmes report the same challenges. The backlog is simply too great. Knowledge around this issue is important for the success of the Academy programme so further study could be warranted.

Finally, the intervention that pupils have received over a three year period may have proved to have somewhat limited immediate effects but these same students may show even greater improvements in the future. A study of how the Academy students are performing after high school may be a valuable research exercise.

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APPENDICES

Appendix 1 Pilot survey of participants

PILOT SURVEY
Participants

		Agree	Disagree
1	*The teaching of English has not had any effect on your Mathematics and Science results.*		
2	*Content in mathematics and Science is important.*		
3	*Improving my computer skills will have a positive impact on mathematics and science.*		
4	*Five afternoons in the Academy is better than four days.*		
5	*My teachers have noticed an improvement in my performance in my own school.*		
6	*I pass on some of the content I learn to my friends in my own school.*		
7	*I think my problem-solving skills have improved while I have attended the Academy*		
8	*My teachers in my own school approve of me attending the Academy.*		
9	*I have set higher goals for myself as a result of attending the Academy.*		
10	*I struggle to manage my time because I attend the Academy.*		
11	*I think I am more confident when handling Science apparatus.*		
12	*Do you believe that the Academy has improved your Science practical skills*		

Comments that you would like to make:

1.

2.

3.

4.

APPENDIX 2 Final online survey for students on the programme

Students on the programme

Academy Survey 2

	strongly agree	agree	disagree	strongly disagree
1. The academy has improved my practical skills in Science.	●	●	●	●
2. The teaching of English has not had any significant effect on my Mathematics and science.	●	●	●	●
3. It is more important to learn content in Maths and Science rather than developing critical thinking skills.	●	●	●	●
4. My marks have not improved significantly during my time in the Academy.	●	●	●	●
5. It is important that I do practical work rather than the teacher doing demonstrations.	●	●	●	●
6. Content is not really important.	●	●	●	●
7. My friends back at my school are resentful of my attendance at the Academy.	●	●	●	●
8. Learning computer skills in the academy will not help me improve my ability in Science and Maths.	●	●	●	●
9. Five afternoons in the Academy per week is better than four days.	●	●	●	●
10. I am enjoying my subjects because of the consolidation that the academy provides	●	●	●	●
11. My academy teachers are not really happy with my progress.	●	●	●	●
12. My teachers at school have noticed an improvement in my performance in my Science.	●	●	●	●
13. I share some of what I have learnt with my friends back at school.	●	●	●	●
14. My friends have not really noticed an improvement in my ability in Science, maths or English.	●	●	●	●
15. I have not improved my confidence in tackling science problems during my time in the Academy.	●	●	●	●
16. Mixing with boys from other schools in the Academy has been positive.	●	●	●	●

	strongly agree	agree	disagree	strongly disagree
17. The extra notes that we have received from the Science teacher in the academy has created confusion and made learning more difficult.	●	●	●	●
18. My handling skills with apparatus have improved.	●	●	●	●
19. My teachers in my school are supportive of me attending the Academy.	●	●	●	●
20. I have set my goals higher because of my attendance in the Academy	●	●	●	●
21. My problem solving skills in maths and Science have not improved during my time in the academy	●	●	●	●
22. I am finding it difficult to manage my work because of the time I spend in the Academy.	●	●	●	●
23. I believe it is truly beneficial attending the Academy	●	●	●	●
24. It is better to rote learn and obtain good marks rather than trying to understand the difficult concepts.	●	●	●	●
25. My peers back at school are learning 'stuff' from me.	●	●	●	●
26. My marks would be as good if I did not attend the Academy.	●	●	●	●
27. Developing practical skills is important.	●	●	●	●
28. My parents are happy that I am attending the Academy	●	●	●	●
29. I don't really see much point in attending the Academy	●	●	●	●
30. There are changes that could be made to the academy that will improve my learning.	●	●	●	●

Question Title Academy Survey #2

APPENDIX 3 Final survey for students not on the programme

Students not on the programme

Academy Survey 1

Top of Form

	Strongly agree	Agree	Disagree	Strongly disagree
1. Do you believe that the academy has improved the Science practical skills of my friends in the Academy?.	●	●	●	●
2. The teaching of English has not had any significant effect on the Mathematics and Science results of my friends on the programme.	●	●	●	●
3. Content is not really important.	●	●	●	●
4. I am very interested in what my friends are learning in the Academy.	●	●	●	●
5.Learning computer skills in the academy will help my friends improve their ability in Science and Maths.	●	●	●	●
6. Five afternoons in the Academy per week is better than four days.	●	●	●	●
7. My teachers at school have noticed an improvement in the performance of my friends in Science.	●	●	●	●
8. My friends on the programme share some of what they have learnt with me.	●	●	●	●
9. I have not really noticed an improvement in my friends' ability in Science, maths or English.	●	●	●	●
10. I have noticed that my friends are more confident when handling Science apparatus and their skills have improved.	●	●	●	●
11. My teachers in my school are supportive of my friends attending the Academy.	●	●	●	●
12 I can see that my friends have set their goals higher because of their attendance on the Academy programme.	●	●	●	●
13. I can see that problem solving skills of my friends in both Mathematics and Science has not improved during their time in the academy.	●	●	●	●

	Strongly agree	Agree	Disagree	Strongly disagree
14. My friends are finding it difficult to manage their work because of the time they spend in the Academy.	●	●	●	●
15. It is better to rote learn and obtain good marks rather than trying to understand the difficult concepts.	●	●	●	●
16. I think my friend's marks would be as good if they did not attend the Academy.	●	●	●	●
17. Developing practical skills is important.	●	●	●	●

APPENDIX 4 Questionnaire survey of students not on programme

Students not on the programme

ACADEMY SURVEY 3

Random selection of pupils from the three schools who are not participants on the programme.

Question 1. Do you think that your friends on the programme are improving their marks in Maths, Science and English by participating in the programme?

Question 2. What improvements, if any, have you noticed in your friends' academic progress?

Question 3. Do you believe that your friends are able to cope with their schoolwork and the time they spend in the Academy?

Question 4. Do your friends share what they have learnt on the programme with you?

Comments

APPENDIX 5 Pilot Interview of Academy Students

School: Name:

1. Confidentiality – assure respondent of absolute confidentiality.
2. The benefit of the study.
   a. A study to determine the effectiveness of the Academy. It will also give an insight into the strengths and weaknesses so that necessary changes can be made. (Elaborate)
   b. The funders need to have feedback on the programme.

Question 1. Talk about the schools you have attended form Grade 1.

Question 2. Have you enjoyed your High School years?

Question 3. What has your experience been of activities other than Academics in the Academy?
Probing question: Do you have the opportunity to have guest speakers at your own school?

Question 4.How do you think you have benefited in Physical science by being on the Academy programme?

Question 5. How do you think practical work in the Academy has helped you in Science?

Question 6. What could we have done in the Academy to improve it's efficiency?

Length of interview and Time of interview:_____

APPENDIX 6 Final interviews with Academy students

Interview schedule Academy School:

Name: STUDENT

Question 1. Have you enjoyed your High School years? What in particular have you enjoyed?

Question 2. Have any of your Teachers inspired you? Explain.

Question 3. What other activities on the programme have you enjoyed? Elaborate.

Question 4. How do you think you have benefited in Physical science by being on the Academy programme? Provide 3 examples.

Question 5. What skills do you think you have gained from doing practical work in the Academy? How do believe practical work can help you?

Question 6. What could we do to improve the efficiency of the Academy?

Question 7. Have you experienced any difficulties in attending the Academy?

Question 8. Give 5 highlights of your time on the programme.

Question 9. Do you think your marks have improved compared to your friends in your school? And how would you say the other boys in the Academy are doing compared to their schoolmates?

Question 10. What factors do you think are important for the Academy to be successful?

Question 11. Has your attitude to learning and to your school changed since you started on the Academy?

Question 12. What career do you wish to follow? Has the Academy had any influence on your decision?

APPENDIX 7 Teacher interview schedule

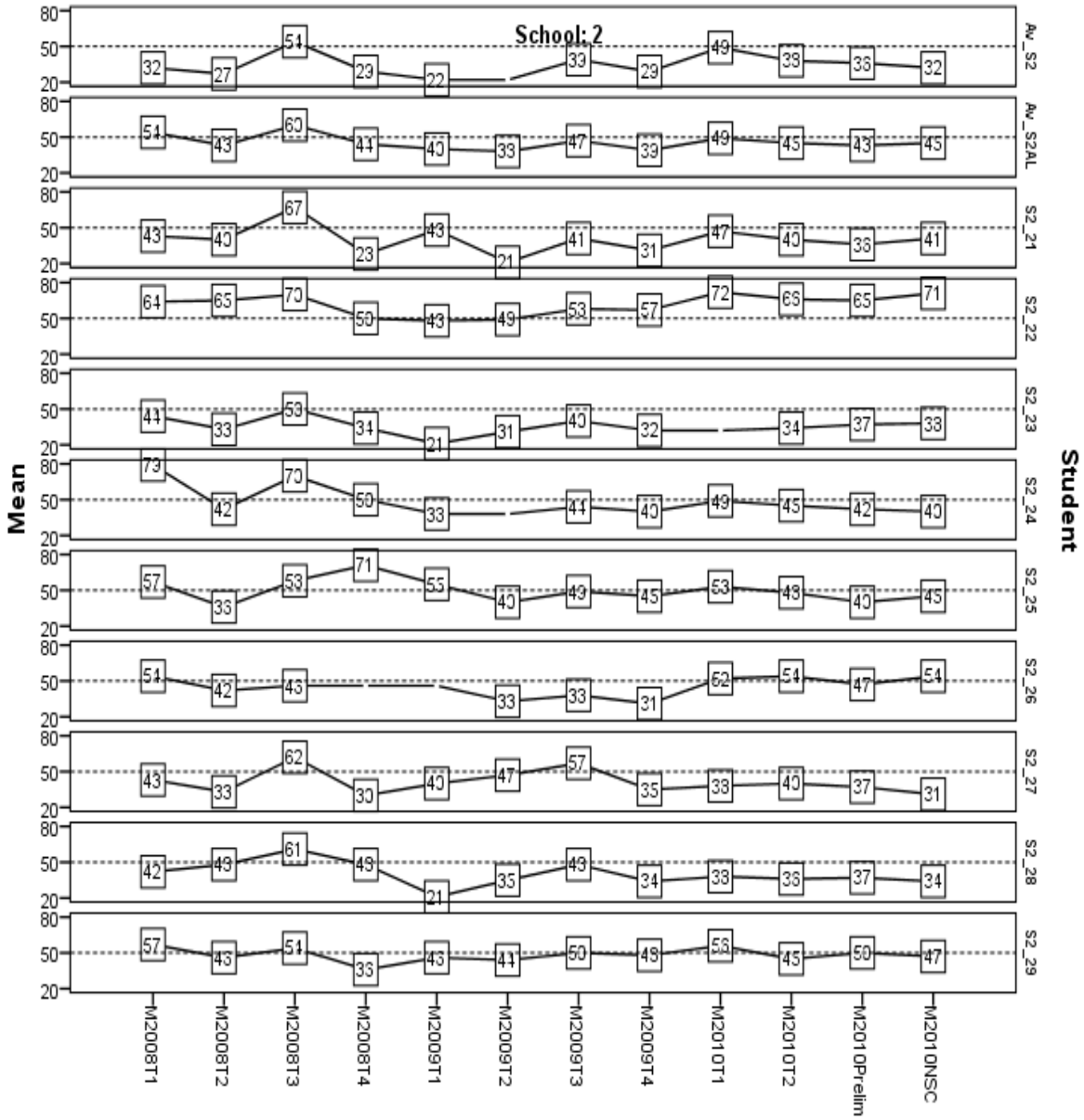
Interview schedule

Teachers on the programme

Name: Teacher
Subject and grades that are taught;

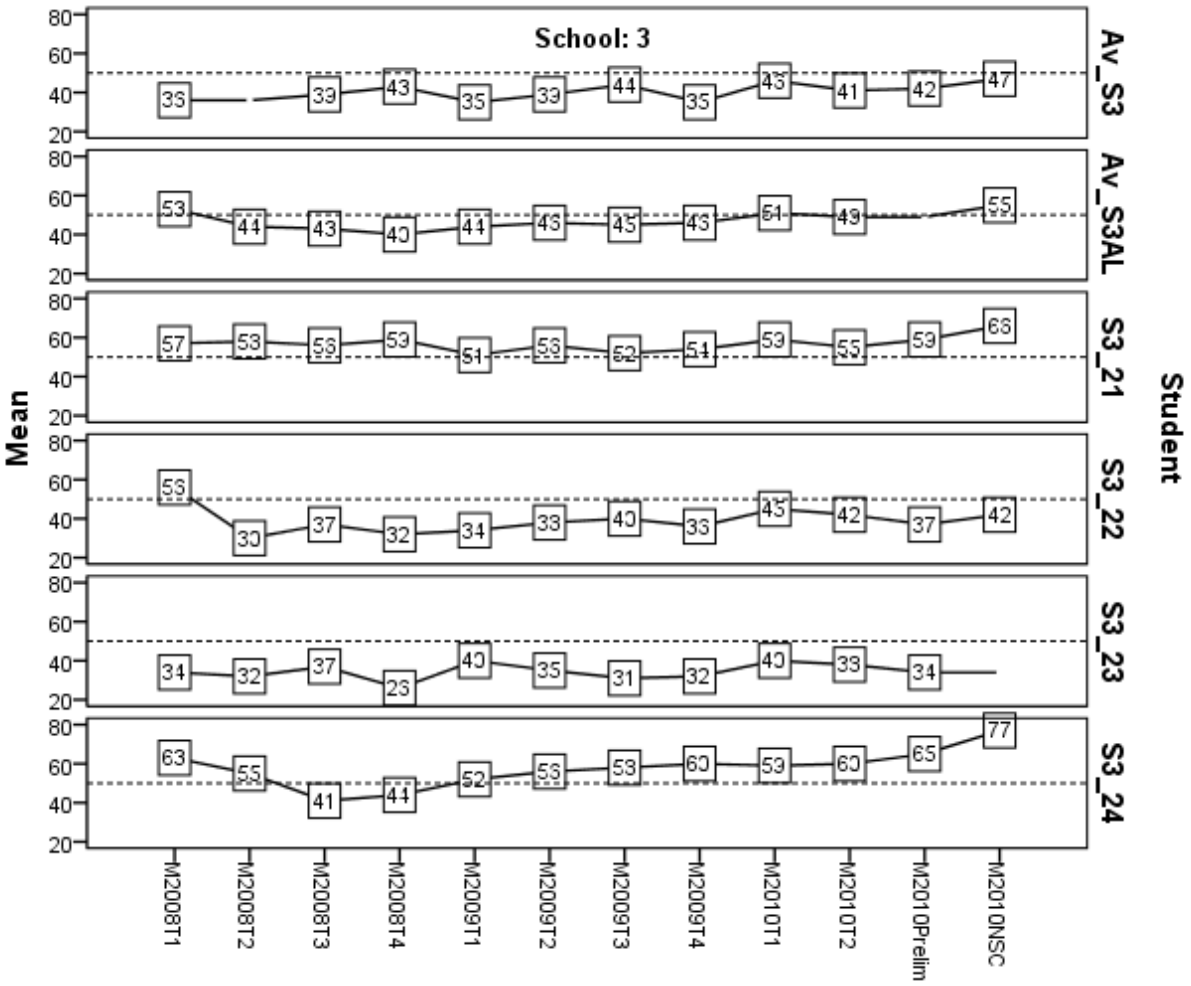
1. How many hours per week are you teaching in the Academy?
2. Do you find the boys to be responsive?
3. Do you teach differently to how you teach the St John's students?
4. Do you find that the boys are motivated?
5. Have you noticed an improvement in the boys marks?
6. What aspect of your subject have you noticed the most marked improvement amongst the boys?
7. How would you describe the atmosphere in your class?
8. What do find the boys most enjoy about your subject?
9. Do the students' academic achievements improve significantly with the intervention that we provide? Compared to their peers not on the programme?
10. What effect do you believe the intervention programme has on students attitudes to School and learning?
11. (ONLY FOR SCIENCE TEACHERS) What are your views on the instructional emphasis on practical work?
12. What factors do you consider to be most influential in determining the success or failure of the intervention on the participants?

APPENDIX 8 Cohort 2 School 2 student results by term



Cohort 2 school 2- Graph showing the results by term starting in 2009 and finishing with the NSC exam in 2011

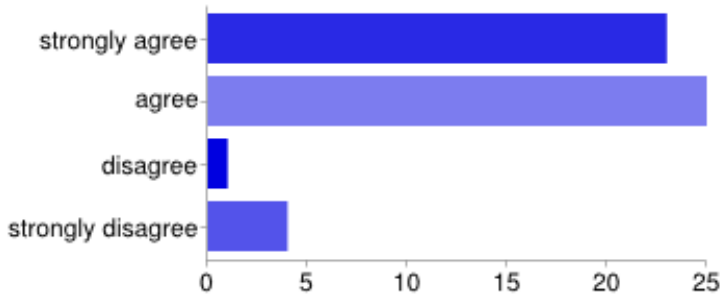
APPENDIX 9 Cohort 2 School 3student results by term



Cohort 2 school 3- Graph showing the results by term starting in 2009 and finishing with the NSC exam in 2011

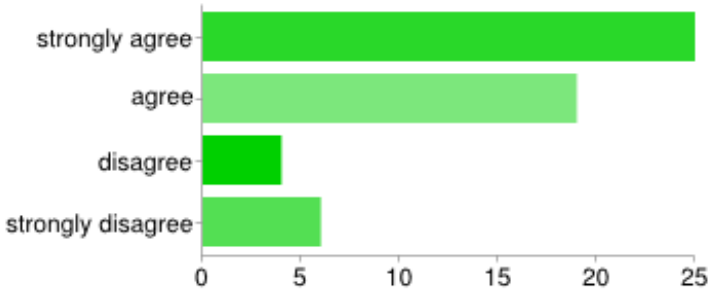
APPENDIX 10 Responses to questions on practical work

Academy Survey #2 - 1. The academy has improved my practical skills in Science.



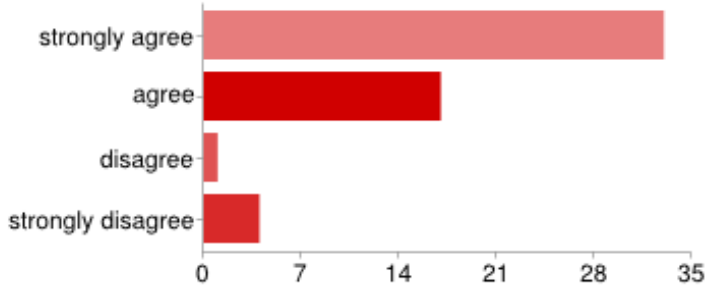
strongly agree	**23**	42%
agree	**25**	45%
disagree	**1**	2%
strongly disagree	**4**	7%

Academy Survey #2 - 5. It is important that I do practical work rather than the teacher doing demonstrations.



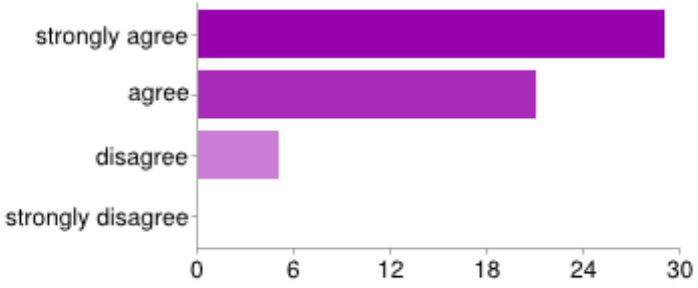
strongly agree	**25**	45%
agree	**19**	35%
disagree	**4**	7%
strongly disagree	**6**	11%

Academy Survey #2 - 27. Developing practical skills is important.



strongly agree	**33**	60%
agree	**17**	31%
disagree	**1**	2%
strongly disagree	**4**	7%

Academy Survey #2 - 18. My handling skills with apparatus have improved.



strongly agree	**29**	53%
agree	**21**	38%
disagree	**5**	9%
strongly disagree	**0**	0%

APPENDIX 11 Ethical clearance certificate from UKZN

UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

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Westville Campus
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Tel No: +27 31 260 3587
Fax No: +27 31 260 4609
ximbap@ukzn.ac.za

18 November 2011

Mr D Bradley (992241558)
SMTE

Dear Mr Bradley

PROTOCOL REFERENCE NUMBER: HSS/1197/011M
PROJECT TITLE: What effect does an after school Science, Maths and English enhancement programme have on Grade 10 to 12 students' learning of Physical Science

In response to your application dated 7 November 2011, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.
PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Professor Steven Collings (Chair)
Humanities & Social Science Research Ethics Committee

cc. Supervisor – Professor Paul Hobden
cc. Mrs S Naicker/Mr N Memela