ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

by

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DECLARATION

I declare that the dissertation, ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION, hereby handed in for the qualification of Magister Artium at the University of the Free State, is my own sovereign work and that I have not previously submitted the same work for a qualification at/in another University/faculty.

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M.M. Moleko

December 2014

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DEDICATION

This dissertation is dedicated to

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LIST OF ABBREVIATIONS

BSU	Boise State University
CDA	Critical Discourse Analysis
CER	Critical Emancipatory Research
CM	Concept Mapping
CT	Critical Theory
GPS	Group Problem-solving
HEI	Higher Education Institution
LCC	LaGuardia Community College
NMMU	Nelson Mandela Metropolitan University
SILMG	Supplemental Instruction Leader Manual Guideline
SISMG	Supplemental Instruction Supervisor Manual Guideline
NZU	New Zealand University
OBE	Outcomes Based Education
PAR	Participatory Action Research
PPS	Paired Problem-solving
RQ	Reciprocal Questioning
RSA	Republic of South Africa
RSQ	Redirecting students' Questions
SCU	South Carolina University
SI	Supplemental Instruction
SIC	Supplemental Instruction Coordinator
SIP	Supplemental Instruction Programme
SIT	Social Independence Theory
SL	Socratic Learning
SMILE	Supplemental Mathematics Instruction Learning Enhancement
SU	State University
SWOT	Strengths, Weaknesses, Opportunities and Threats

TLC	Teaching and Learning Champion
UKZN	University of KwaZulu-Natal
UMKC	University of Missouri Kansas City
UN	University of Nigeria
UO	University of Oregon
UP	University of Pretoria
USA	United States of America
USU	Utah State University
UW	University of Washington

Abstract

The study sought to formulate a framework to enhance the functionality of Supplemental Instruction (SI) for first-year Mathematics students at an institution of higher education. Generally, many students find mathematics challenging, not only at high school level but also when they are enrolled for modules at higher education institutions. Most first-year Mathematics students usually withdraw from taking it and opt to pursue other fields of studies, whilst others drop out. It was on this basis and in trying to retain these students in Mathematics as one high-risk course that a programme such as SI was conceptualized then developed to enhance students' understanding of course content. Although SI proved to be a good intervention strategy which led to significant improvements in other high risk modules which were targeted it was not the case with Mathematics. The study therefore sought to establish the challenges pertaining to the implementation of SI for Mathematics students and to provide solutions to the identified challenges. The conditions conducive to the solutions to work, as well as the threats that could evade the successful implementation of the strategies, were reflected by the study. It further demonstrated the evidence of the successful SI framework's implementation. Critical Emancipatory Research (CER) was the paradigm underpinning the study, and Participatory Action Research (PAR) was adopted as the methodology for generating data. The generated data was analysed and interpreted through the use of Critical Discourse Analysis (CDA), which subsequently made it possible for data to be interpreted at textual, social and discursive levels. The study recommended the following in terms of enhancing the functionality of SI for first-year Mathematics students at an institution of higher education: formation of the SI team; the establishment of a common vision; performing a SWOT analysis; determining priorities; and strategic planning

Keywords: enhancing; functionality; supplemental instruction; mathematics.

Abstrak

Die studie het gepoog om 'n raamwerk te formuleer om die funksionaliteit van Supplemental Instruction (SI) vir eerste jaar wiskunde studente by 'n hoëronderwys instansie te verbeter. Oor die algemeen, vind baie studente wiskunde uitdagend- nie net op hoërskool nie, maar ook wanneer hulle vir wiskundige modules op universiteit geregistreer is. Meeste van die eerste jaar wiskunde studente onttrek gewoonlik uit wiskunde uit, en kies ander studievelde, terwyl ander studente uitsak. As gevolg van die bogenoemde, en in 'n poging om hierdie studente te behou om voort te gaan met wiskunde as 'n hoë risiko vak, dat die SI-program gekonsepsualiseer is. Die program is ook ontwikkel om studente se begrip van die kursus inhoud te verbeter. Hoewel die SI-program kon bewys dat 'n goeie intervensiestrategie in ander, geteikende hoë risiko modules was, was nie die geval met wiskunde nie. Die studie het dus probeer om die uitdagings met betrekking tot die implementering van SI te bepaal en ook oplossings vir die geïdentifiseerde uitdagings te voorsien. Die voorwaardes wat bevorderlik is vir die oplossings op te werk, asook die bedreigings wat die suksesvolle implementering van die strategieë kan ontduik, is weerspieël deur die studie. Die studie het verder die bewys van die suksesvolle SI-raamwerk se implementering gedemonstreer. Kritieke Emansiperende Navorsing is gebruik as 'n paradigma onderliggend aan die studie. Deelnemende Aksienavorsing is gebruik vir data insameling. Die gegenereerde data is ontleed en

geïnterpreteer met behulp van kritiese diskoersanalise wat op tekstuele, sosiale en diskursiewe vlakke geanaliseer is. Die studie beveel aan dat die volgende in terme van die verbetering van die funksie van SI vir eerstejaar wiskunde-studente by 'n hoëronderwys instansie: vorming van ’n SI-span, die vestiging van 'n gemeenskaplike visie, die uitvoering van 'n SWOT-analise, bepaling van prioriteite, en strategiese beplanning.

Sleutelwoorde: Verbetering, Funksionaliteit, Aanvullende Onderrig

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CHAPTER 1

OVERVIEW OF THE STUDY

ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

1.1. INTRODUCTION, BACKGROUND AND LITERATURE OVERVIEW

Supplemental Instruction (SI) is a cooperative learning model designed to improve student performance in high-risk courses with a history of high failure rates (Etter, Burmeister & Elder, 2000:355). It facilitates understanding of course content, simultaneously encouraging students to develop better learning skills (Bengesai, 2011:61). Sessions are led by senior students who have successfully completed a high-risk course (Lockie & Van Lanen, 2008:2) on a regular out-of-class basis. Literature shows the positive impacts made by SI in terms of improving students' performance, reducing attrition rates and increasing the retention rates (Arendale, 1994:1; Etter *et al.*, 2000:356; Zaritsky & Toce, 2006:23; Zeger, Clarke-Unite & Smith, 2006:66). However, other literature indicates instances in which SI for mathematics students was not effective (Wright, Wright & Lamb, 2002:30), as in the context of this study. The students' performance did not improve even though in other courses that were also targeted there was a significant improvement. This study therefore seeks to formulate a framework for enhancing the functionality of (SI) for first-year Mathematics students at an institution of higher education.

The higher education institution (HEI) under study, like other caring HEIs, has adopted SI as a response to high failure and attrition rates (Arendale, 2002:56). However, since its introduction, significant improvements have been recorded in other modules targeted, except for Mathematics. This is evidenced by the consecutive three years' academic results reflected within the university's Success Rates Document (SRD) (UFS, 2009-2011:23), in which the pass rates were: 25.2% in 2009, 19.1% in 2010 and 27.6% in 2011. The percentages clearly show

that there are serious challenges facing first-year Mathematics students and that an intervention is needed in order to address them.

The greatest challenge pertains to lack of coordinated plan, which results in SI leaders in most cases going to sessions with no idea of which content or concepts to focus on during the sessions. This then leads to SI not being effective for the students since their needs cannot be met. The SI vision also seems not to be clearly articulated or owned by all the stakeholders involved, which results in students perceiving it as a remedial programme meant to assist those who are not clever and so not attending sessions, as reported to be the case in the Republic of South Africa (RSA) and the United States of America (USA) (Arendale, 1994:3; Bengesai, 2011:66). Students are further amenable to believing all views, including negative ones, about the programme. In addition, some SI leaders are unable to model effective instructional strategies whereby, instead of applying the appropriate SI instructional strategies that promote student understanding of the course they act as lecturers and thus do much of the talking, more than the students themselves.

In certain instances leaders even repeat the lecture or introduce a new topic to the students which does not link with the one introduced by the lecturer, thus causing confusion to students. As a result, students do not develop meta-cognition. The study, which was conducted in RSA, revealed that the SI leaders who could not model effective learning strategies made it difficult for students to adopt learning strategies that could help them understand specific course content (Bengesai, 2011:61). In a study conducted in the USA, the SI leaders who re-lectured the students instead of acting as the facilitators in the collaboration of learning made it difficult for the students to understand the course content, and such an instructional strategy was discouraged (Hensen & Shelly, 2002:250).

Some leaders were unable to effectively engage students in their own learning, making it difficult for them to understand the content or become independent learners. A study conducted in the RSA revealed that SI leaders who could not act as facilitators in the collaboration of learning with the students made it difficult for SI to become a learning community made up of students, and it lacked the potential to increase student engagement (Bengesai, 2011:62). A lack of feedback

offered within the setup created knowledge gaps amongst the stakeholders and did not enhance critical reflection of the situation by all involved. It also failed to ensure maximum benefit from implementation of SI and its functioning. The evaluation took into account students' inputs, comments and marks in deciding whether the programme was effective. Other crucial issues, such as facilitation of large classes and timetable clashes that arose from the evaluation, required to be dealt with, even though little was done to address those issues (Fayowski & McMillan, 2008:848; Bentley & Hills, 2009:145; Bengesai, 2011:64). The feedback was not shared with all the stakeholders involved.

Based on the discussion above I propose to examine the different frameworks with a view to learn from them as I develop a new framework to enhance the functionality of SI for Mathematics students, starting with the components that constitute a functional SI. In an attempt to address the above challenges in some of the institutions with successful SI programmes, regularly coordinated meetings between the lecturers and the SI leaders prior to the SI sessions resulted in a coordinated plan being established. It enabled the SI leaders to attend sessions knowing which content and concepts to address (Zeger *et al.,* 2006:65; Wright *et al.,* 2002:32; Bentley *et al.,* 2009:144).

In terms of the programme's vision being clearly articulated and owned by the students, in the USA, frequent and vigorous promotion (communication) of the programme's vision to the students during the SI sessions was maintained, and resulted in the SI vision being understood and owned by the students. This consequently improved student attendance of the SI sessions, and the use of effective instructional strategies which were reinforced made student learning possible. Training of the SI leaders in the USA has enabled the SI leaders to apply effective instructional strategies which consequently helped students integrate mathematics course content and learning/study strategies (Bowles, Mcoy & Bates, 2008:5). Meanwhile, in Nigeria, coaching of peer teachers before the sessions on what they had to teach their peers, and how to teach them, helped students to comprehend the course content (Bentley *et al.*, 2009:144). Effective student engagement employed in the USA helped students understand the course content as they were allowed to sit in small groups and participative and proactive

activities were used (Fayowski *et al.*, 2008:845). A similar strategy in the RSA was used to fully engage students effectively in their own learning, although the challenge in most cases was that the sessions had many students, making engagement difficult as they formed larger groups which were not easily managed by the SI leaders (Harding, Engelbrecht & Verwey, 2011:851).

In terms of data provision, in the USA data was made available and shared with the faculties and the administrators of the programme (Zaritsky *et al.*, 2006:30). It covered performances of the students who attended the SI sessions as well as how the programme progressed. Meanwhile, in the RSA and Nigeria data was also made available and communicated to the stakeholders, though some of the issues which emanated from it and which required attention, such as teaching larger classes, were left unresolved and unattended (Harding *et al.,* 2011:851).

Cooperation in the RSA between SI leaders and faculty members (lecturers), wherein meetings were held weekly, provided a platform for reflection on difficult content and also for a coordinated plan to be established (Zeger *et al.,* 2006:65). In Nigeria, lessons which were offered to peer teachers by the course instructors and alternating their roles helped them to teach their peers more effectively (Bentley *et al.,* 2009:144). Because of this, peer teachers received empowerment as they learned from their instructors what to teach their peers and also how to go about imparting knowledge to the students. In the USA, in terms of making sure that the SI vision was communicated clearly to the students, and the involvement of the lecturers in the programme who frequently communicated it to students, made them realise the significance and need for them to attend sessions regularly (Wright *et al.*, 2002:32). In this institution, the SI leaders who listened to students' concerns and discussions in class while solving mathematical problems in groups were able to identify the gaps and misconceptions students had about the course content and thus modelled and applied appropriate instructional strategies that responded to students' challenges regarding certain mathematical concepts.

In the USA, the SI leaders merely coached the students in terms of how to attain solutions to mathematical problems and guided their discussions rather than acting as figures of authority, making it possible for student learning to take place (Gardner, Moll & Pyke, 2005:4,5; Spencer & Wallace, 1995:12). An atmosphere

which was not intimidating but relaxing for students to participate and learn was thus created. On the other hand, the use of the proactive and participative activities in the RSA and the USA made students more engaged in their learning and thus helped them better understand the course content, whilst increasing their meta-cognition (Bengesai, 2011:61; McGuire, 2006:9).

In terms of making feedback available, the evaluations were conducted in RSA and Nigeria in order to obtain data to report to the stakeholders about the programme and keep them updated on its progress. Although evaluations were conducted, certain crucial issues such as the teaching of larger classes and the peer teachers' inadequate teaching skills, which also stemmed from the evaluations and which required attention, were overlooked and not attended to (Harding *et al.,* 2011:851; Bentley *et al.*, 2009:147). Meanwhile, the SI leaders' writing of the reports regarding what transpired during the sessions and how they viewed the programme in USA helped in getting feedback which in turn helped the programme to advance, even though the data obtained seemed not to be shared with all the stakeholders involved (Wong, Waldrep & Smith, 2007:217).

Although the strategies applied seemed to have solved the problems experienced, some of the threats which could have hampered the implementation of SI were anticipated and solutions devised to address them. Students' lack of motivation to do a mathematics course was identified as one of the threats that could hinder the successful implementation of SI for mathematics students. According to Anthony (2000:8), lack of motivation is an influential factor which can potentially cause student failure if not addressed. However, in an attempt to address this challenge one of the strategies applied was to encourage mathematics SI leaders to alter students' negative attitudes by promoting better classroom practices and positive experiences in the course (Singh, Granville & Dika 2002:330-331).

Another threat that came to the fore as identified by the participants was students' insufficient prior knowledge. According to Nakhleh (1992:191), learners' preconceptions about the subject determine the information to which they pay attention. Their brain thus actively interprets this selected information and draws inferences based on it as stored information. This way, the newly generated meanings are then actively linked to the learner's prior knowledge base. This

therefore means that without prior knowledge it is difficult for learners to build new information or knowledge. Arendale (1994:2), in accordance with this notion, avows that SI is more challenging in subjects in which prerequisite skills are required, especially when the learners do not possess them. However, a strategy such as the establishment of learning communities, wherein all the courses that are typically associated by an organising theme which give meaning to their linkage, seems to address this challenge since the contents and activities of the linked courses are coordinated such that what is being learned in one course can be applied to what is being learned in the other courses (Tinto & Pusser, 2006:13).

The other threat identified was the limited pool of SI leaders who were majoring in Mathematics from which to select the potential ones. It proved to be difficult at times to appoint an adequate number of qualified and potential SI leaders to cater for such an extensive programme, since most of these students from which a selection could have been made switched to other majors (Ellington, 2006:4). In addressing this challenge, one of the strategies used was to consider the appointment of the other SI leaders who took the targeted course and passed it from the other cohorts rather than only from the Mathematics majors (Gardner *et al.*, 2005).

Literature indicates that a well-implemented SI, for which there is a coordinated plan, improves students' performance (Etter *et al.,* 2000:356; Fayowski *et al.*, 2008:852), increases retention rates (Zeger *et al.,* 2006:66) and reduces attrition and failure rates (Zaritsky *et al.*, 2006:23). There is also evidence suggesting that a well-implemented SI in terms of the appropriate application of instructional strategies increases student understanding of the course material (Gardner *et al.,* 2005). The supplemental instruction of which its vision is clearly articulated to all and has a well-executed plan can benefit all involved (Zeger *et al.,* 2006:63) and help students improve problem-solving skills, retain learned concepts and build frameworks for future learning (Ogden, Thompson, Russell & Simons, 2003:3). The evaluation shows that those who attend SI sessions have more persistence than those who do not (Hensen *et al.*, 2003:251), however, there are differences between the RSA, Nigeria and the USA in terms of how SI is being implemented, necessitating further research on how to improve the emerging framework.

1.2. RESEARCH PROBLEM AND QUESTION

A functional SI is characterised by cooperation between the lecturers and the SI leaders wherein this cooperation results in a coordinated plan being established. It also has clear articulation of the vision and its ownership and the employment of both effective instructional strategies and student engagement to promote student understanding of the course content. There is availability of feedback which keeps all the stakeholders updated. A Supplemental Instruction Programme (SIP) which lacks the above-mentioned aspects would not be functional.

Against the above background therefore, the study poses the following research question:

> *How can we (team) enhance the functionality of SI for first-year level Mathematics students at a higher education institution?*

The objectives derived from and directed towards attaining the aim of the study are:

i. To explore the need to formulate a framework to enhance the functionality of a Supplemental Instruction Programme at a higher education institution.

ii. To identify and analyse the components that constitute a functional supplemental instruction framework.

iii. To identify the conditions conducive to enhancing the functionality of such an SI framework

iv. To identify the threats that could impede the successful implementation of the SI functionality framework.

v. To recommend a framework that may enhance the functionality of SI for first-year mathematics students at a higher education institution

1.3. THEORETICAL FRAMEWORK

This study requires both the researcher and the participants (team) to propose a framework for enhancing the functionality of SI for Mathematics students at a higher education Institution. According to Tibane (2007:96), it is only through teamwork that great ideas that can contribute to enhancing the functionality of SI can be generated. Critical Emancipatory Research (CER) as a theoretical framework that promotes teamwork was therefore deemed fit for this study as it encourages teamwork that will make it possible for ideas on how to enhance the functionality of SI for mathematics students to be generated. CER also allows people's voices to be heard and respected (Dold & Chapman, 2011:512) within a context in which an agenda of peace, hope, freedom, social justice and equity in its all forms is advanced (McGregor, 2003:4). This therefore means that, through CER, the participants' voices in this study would be as highly valued as that of the researcher and would constitute this research project. It allows marginalised groups to have a voice in research concerning them (O'Cathain, Murphy & Nicholl, 2007b:148), which is what this study aims to do, that is, to empower the people who experience the problem so that they can understand their situation and transform it (Jordan, 2003:186).

CER's engaging nature, which allows people to talk freely, will then make it possible for ideas to be generated and consequently for a deeper meaning and multiple perspectives to be considered (Mahlomaholo, 2009:225-226). This will help the participants to better understand the challenges they face in improving their performance through SI, while its empowering and transforming agenda (Nkoane, 2012:99) will help the participants to provide solutions to the challenges and the conditions to make them work. Lastly, it will help the participants monitor the successes of the envisaged framework.

1.4. DEFINITION OF OPERATIONAL CONCEPTS

For this study, the following concepts are defined in terms of how they are understood and used for this study, to be explained in greater detail in the following chapter:

Enhancing in this study means improving the effectiveness of the Supplemental Instruction Programme (SIP) for mathematics students (*Merriam-Webster online Dictionary, 2011*).

Functionality means serving the purpose a thing is expected to fulfil, for example, improving students' academic performance. In this study, for SI to be functional the people involved need to work jointly by collaborating on ideas that will consequently enhance the SI's functionality (*Merriam-Webster Online Dictionary, 2011*).

The concept **enhancing the functionality of SI** in this study therefore means improving the implementation of SI in an attempt to improve first-year students' performance in Mathematics.

These concepts and how their definitions were constructed according to this study will be defined in more detail in chapter 2 as they are the main pillars in which this study is anchored.

1.5. RESEARCH DESIGN AND METHODOLOGY

Participatory Action Research (PAR) was used for this study as an approach informed by its objective to emancipate people from irrationality, injustice, alienation and the suffering found in social settings (Kemmis, 2006:463). Moreover, PAR has proven to be a powerful approach for working with oppressed groups in bettering their own circumstances within society (Jordan, 2003:186), which is what this study intends to achieve. It also operationalises CER, which is the theoretical framework couching this study, and both encourage teamwork and transformation of the lives of the people for the better (Jordan, 2003:186).

The team that conducted this research project were constituted as follows: the researcher (myself), two lecturers offering modules which were part of SI in which students had shown significant improvement in terms of academic performance; two Mathematics lecturers (5 – 10 years of experience); two SI leaders (two years' experience) who facilitated modules in which students had shown significant improvement in terms of academic performance; two SI leaders (two years' experience) who facilitated Mathematics courses; two students who had previously attended SI sessions (modules in which students performed well); two students who attended Mathematics SI sessions previously; two Mathematics subject advisors (eight and 10 years' experience); two high school Mathematics teachers (10 years of experience); the SI coordinator and the SI head.

The abovementioned participants were selected for the following reasons: the Mathematics lecturers, teachers and subject advisors were experts in the field. The lecturers who were offering other modules were able to share their successes in their modules. The students were the ones being taught and they could share their experiences. The supplemental instruction coordinator and the head could also share their experiences as they were involved in the day-to-day running of the programme.

The team met fortnightly in order to discuss ideas that would help in the process of enhancing the functionality of SI and to discuss progress made with regard to attainment of the objectives. Minutes were tape-recorded for transcription and analysis at a later stage. The Critical Discourse Analysis (CDA) technique was used to make sense of the generated data, to destabilise the authoritarian discourses (Liasidou, 2008:483) and to help identify power relations, dominance and inequalities which are enacted and reproduced by text and talk (Van Dijk 1995:20). Subsequently, findings were presented in line with the objectives of the study followed by the proposed framework for enhancing the functionality of SI for Mathematics students.

1.6. VALUE OF THE STUDY

It is hoped that this study will contribute significantly to enhancing the functionality of SI for Mathematics students in this Higher Education Institution, by proposing a framework that will enhance the functionality of SI for first-year Mathematics students. It should benefit the students by suggesting ways in which they could be effectively tutored. Lecturers will also benefit by understanding the role they have to play in making the programme beneficial so that student performance in Mathematics could be enhanced. The SI programme implementers will learn better ways to effectively implement the programme. The policymakers will also learn more about SI and hence find better ways in which to enhance the guidelines, especially to close any gaps identified.

1.7. ETHICAL CONSIDERATIONS

The participants were free to take part and their entry was negotiated. Permission was granted by the Higher Education Institution and consent forms given to them, all of which were signed. The participants were made aware that at any particular stage they wished to pull out they were free to do so. They were treated with respect at all times and their discussions remained confidential. Data was kept safe for a period of six months and a password used to gain access. This study was ethically cleared by the University of the Free State (UFS) and the Ethical Clearance number is UFS-EDU-2012-0026 (*see* Appendix B).

1.8. LIMITATIONS OF THE STUDY

A limitation of the study lies in the differences in higher education institutions that implement SI for mathematics students, as during its implementation they encountered different challenges which required to be addressed differently according to the context in which they operate. Based on this the findings of this study cannot be used in all the institutions that implement SI since the situations would not be the same. However, in a context in which similar challenges are

experienced under similar conditions as those of the institution under study, the findings of this study can be used.

1.9. CONCLUSION

In this chapter the introduction and background to the study have been provided highlighting, explaining SI, its focus, how it works and its positive impact. The challenges which the institutions of higher learning experience when implementing SI were also highlighted, with possible solutions briefly touched upon. The conditions that make the solutions work were also outlined, together with the threats that could impede the implementation of SI as well as the evidence that SI works. The chapter presented the research problem and posed the question for the study, together with objectives derived and directed towards the attainment of the aim of the study. The chapter also indicated the theoretical framework in which the issues in this study will be looked at and provided definitions of the operational concepts. The research design and methodology were described in brief. The value of the study was indicated together with the ethical considerations.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW ON THE IMPLEMENTATION OF SUPPLEMENTAL INSTRUCTION AT THE INSTITUTIONS OF HIGHER EDUCATION

2.1. INTRODUCTION

This study seeks to enhance the functionality of SI for Mathematics students at a higher education institution by bringing change to the way the programme is currently being implemented. The chapter will concisely and generally discuss the theoretical frameworks that couch this study, with the underlying purpose of justifying the choice of the most apposite one. This will be done by deliberating on their main ideas and by considering their impediments or limitations. The choice will further be justified in the sub-headings related to its historical background, objectives, nature of reality, the role of the researcher, and the relationship between researchers and researched.

The operational concepts will be explained and defined comprehensively so that they are understood as focal pillars on which this study is positioned. The related literature will be reviewed in order to use the best practices from the other countries' institutions for our own framework. The discussions will therefore highlight pertinent international, continental and local experiences on SI implementation.

2.2. THEORETICAL FRAMEWORK

A theoretical framework is a set of theories put together to provide a basis or support for explaining, viewing or contemplating phenomena (Lassa & Enoh, 2000:3). According to Labaree (2013:1), the role of the theoretical framework is to connect the researcher to existing knowledge. It permits one to move from simply describing a phenomenon observed to generalising about various aspects of that phenomenon and it is therefore significant for one to choose the theoretical

framework that will couch their study because it provides predominant viewpoints and direction to the research (Groenewald, 2004:2).

Three theoretical frameworks provided by the literature to couch this study were positivism, phenomenology and critical emancipatory research (CER). This study aims to bring about change in how things are done presently through a collaborative effort and, based on this, the most apposite theoretical framework was chosen. The choice was determined by an ability to help direct this study towards emancipatory, transformational and empowering praxis that helps address the research aim and objectives (Mahlomaholo & Netshandama, 2011:10-12; Merriam & Ntseane, 2008:184-187). It was made on the basis of embracing the engagement and participation of all people, including those usually excluded and marginalised from conversations and decision-making that involves them. It also sought to change the status of the marginalised by making them equal partners (Mahlomaholo, 2009:225-226) in the conversations and decision-making, wherein their voices would be heard and respected (Dold *et al.*, 2011:512). It afforded the marginalised an opportunity to engage in actions aimed at bettering their own circumstances (Jordan, 2003:186).

2.2.1 Positivism

Aristotle, known as the originator of positivism, averred that human knowledge begins with experience and that the first task of a philosopher should be to describe experiences and observations, then to classify them. As Higgs and Smith (2007:3) note, positivism was developed by two British philosophers, John Locke (1632-1704) and David Hume (1711-1776), followed by the Vienna Circle (1907-1938) led by Friedrich Albert Moritz Schlick (1882-1936). Their concern was to answer the question: “what makes an empirically verifiable statement true?” or what is the nature of scientific truth? Schlick noted that scientific truth was based on two factors, logic and experience.

Positivism in its comprehensive sense is about logic, experience and a rejection of metaphysics, a metaphysical statement being one that seeks to give information about non-physical worlds. For example, the claim “God is love” would, according

to Higgs and Smith (2007:7), not make sense to positivists as it can neither be confirmed nor refuted. Therefore, according to positivists, a factual statement is meaningful if it is possible to determine whether it is true or false. According to Krauss (2005:760), positivism holds that the goal of knowledge is to describe the phenomena that we experience. Its purpose as a science is to adhere to what we can observe and measure, beyond which any knowledge would be regarded by a positivist as impossible. Taking into account all these views, one could say that, operationally, positivism rejects reflection because the focus is on rules and procedures or processes in finding the truth, at the expense of human value systems and social issues that are not considered but are also significant (Nkoane, 2009:28).

Drawing from the above, multiple truths or realities cannot be accepted within this framework, nor people's experiences and insights unless they can be proven. Therefore, if this study were to be conducted using this framework only facts (meaningful statements that can be confirmed or refuted) would be considered, and any knowledge beyond that omitted. The question here would then be: "can there be an absolute truth?" It is held as true that knowledge is created by people and people are humans with feelings, insights and experiences which, therefore, in the process of knowledge creation, will form a part. We cannot rule out people's experiences and insights when creating such knowledge. Ben-Ari (1998:257) also rejected the claim that "there is an absolute truth", arguing that knowledge is created by individuals and that in such a process of knowledge creation there cannot be one truth but only multiple truths. It was in response to this position that phenomenology was brought into existence, for instead of denying the existence of the real world it sought instead to clarify the sense of this world which everyone accepts as actually existing (Moustakas, 1994:13).

2.2.2 Phenomenology

Groenewald (2004:5) explains the goal of the researcher within the phenomenological context as that of describing accurately the phenomenon, renouncing any pre-given framework, but "remaining true to the facts". Therefore,

the reality to a phenomenologist is determined by his or her experience. According to Moustakas (1994:13), Edmund Husserl, known as the father of phenomenology, claimed phenomenology did not deny the existence of the real world but rather sought to elucidate the sense of this world which people accept as actually existing. He further believed that phenomenology could provide a firm basis for all human knowledge, including scientific knowledge, and could establish philosophy as a rigorous science. My understanding of Husserl is that phenomenology does not appreciate information and insight as coming only from large amounts of data, but should arise from intense study of experiences performed through phenomenological methods. Although phenomenology takes into account experiences of the people the researcher is the one who explains and interprets these experiences, based on a reality that is confined to his or her immediate experiences. In this way, phenomenology allows for one person (the researcher) to "create knowledge", which in the case of positivism would be derived from numerical data and in the case of phenomenology from the textual data. Positivism and phenomenology cannot make it possible for critical reflection to be pursued or for a deeper meaning and multiple perspectives to be established (Mahlomaholo, 2009:225-226), and therefore cannot help this study achieve its objectives.

The following sections deliberate on CER as a theoretical framework and provide justifications for its selection for this study.

2.2.3 The origin of Critical Emancipatory Research

Critical Emancipatory Research (CER) advanced from Critical Theory (CT), first developed by the Frankfurt School (Higgs *et al.*, 2007:68). This group opposed the positivist idea behind science as being the only way of getting the truth. They argued that knowledge is created by human beings through their experiences, of which science does not take into account, insisting that the search for knowledge must be based on a desire to refine the quality of human life. They criticised and challenged the empiricist view of knowledge based on what could be experienced and measured. Like other earlier critical theorists, they claimed that this ignores

the notion that it is human beings who create knowledge, within the context of critical theory, and so serve to reduce human suffering in the world (Steinberg & Kincheloe, 2010:140). CER then emerged as a way of improving people's lives.

The most important action endorsed by CER is engagement of all people, including the oppressed, marginalised and those deprived of the freedom to participate in activities which involve them (Deeper, 2012:9). Within a CER framework all the people have to be treated with respect (Mahlomaholo, 2009:225-226) and their voices heard and respected (Dold *et al.,* 2011:512). The two issues here pertaining to CER are "respect for the marginalised" and "hearing of their voices". My understanding of the first is that people are human beings with feelings, opinions and experiences and, regardless of their status or stature, these should not be disregarded in conversation. My understanding of the second issue is that people have something to say, regardless of whether they are of higher or lower status, and so must be listened to. In this regard, CER helps in understanding humans as capable speaking beings (Campanella, 2009:2) and not as mere objects which can never think or do anything for themselves. The respect offered to people makes them feel free to talk and be carefully listened to, without being judged according to status. In this way one can discover the value in what they have to say and learn. Therefore, CER affords all the people an opportunity to be part of conversations that lead to transformation, the most important element in this case being that the people who experience the challenge may also find a solution to their own problems (Jordan, 2003:186).

I argue that people can only take charge of and improve their circumstances if they are provided with a platform that affords them empowerment which consequently leads to an understanding of their own struggles. In this context it plays a critical role because, even if people are engaged, if they do not understand their struggles and the role they need to play they will not be able to make a significant contribution to transforming their situation. However, since CER allows people to work together and talk freely it makes it possible for empowerment to take place. Shangase (2013:13-14), in affirming this, notes that within this context the participants have freedom to voice ideas and participate, and power sharing

amongst the participants prevails, making the whole process educative and empowering.

In my view, CER affords people an opportunity to learn about their struggles, understand their problems, reflect on what they can do about them, act in an attempt to solve them, realise a difference that they can make in terms of solving their own problems, and rejoice in the achievements of the outcomes of their own efforts. The research question for this study echoes the CER agenda of transformation, seeking clarity on transformation of the current state of the supplemental instruction's functionality into a better one. It is through the lens of CER, which places more emphasis on social and power structures, emancipating and empowering human subjects (Stahl, 2004:2), that transformation can be experienced.

2.2.4 Objectives of Critical Emancipatory Research

According to Ledwith (2007:599), Critical Emancipatory Research (EAR) is founded upon anti-oppressive philosophy and is a lens through which to identify and change the root sources of oppression. It focuses on the causes of oppression rather than its signs. Ledwith (2007:605) further notes that the practice of a more rigorous research that overtly intends to be liberating simply calls for a critical gaze that views current practice within a wider perspective, building theory in action and acting theory. Therefore, in line with this, one of the objectives of CER as part of critical pedagogy, as noted by Nkoane (2009:22), is to foster modes of enquiry that convert information into actions that address the problems. It is also to emancipate people by gaining understanding of the power relations that constitute their situation, which in turn requires demystification (Biesta, 2010:43) and to change the status quo, overcome injustice, alienation and promote participation of the people (Stahl, 2008:4). It emancipates the participants engaged in the strategic action from the dictates of compulsion, tradition, precedent, habit, coercion and deception (Kinsler, 2010:175). Lastly, it connects the personal, political and transformative situations so as to overcome perceived alienation, dissatisfaction, ideological distortion and the injustices of oppression

domination (Kemmis, 2001:92). In this way, practice moves beyond the ameliorative changes of local action towards the transformative potential of greater collective force for change (Ledwith, 2007:606).

The objectives of CER as explained above therefore helped the participants in this study to be empowered so that their knowledge could be converted into actions that address their problems (Nkoane, 2009:22). The emancipatory agenda that CER promotes (Kinsler, 2010:175) helped them take charge of their situation, especially because the context in which they were operating was one in which they were regarded as equal partners (Murugen, 2008:23), and they were afforded respect with their voices heard and respected (Dold *et al.,* 2011:512).

2.2.5 Nature of reality

CER's engaging nature promotes collaborative or team work amongst all the participants, with knowledge formed by the members of a team instead of an individual. These different people provide different meanings and solutions to a problem as CER encourages their voices to be heard (Dold *et al.*, 2011:512) and therefore it is possible to obtain as many solutions as possible. Since CER is founded upon multiple realities or truths, within its framework there cannot be one neutral or absolute truth. Knowledge construction depends on multiple perspectives from a mass rather an individual or proven statement, consequently within this framework people will be able to present different solutions to a problem, according to how they perceive it. Shared debate will ultimately make it possible for the researcher to be analytical, achieve deeper meaning and look into all sides of the story (Mahlomaholo, 2009:225).

The research question for this study begins with "how", which means that it seeks to find out in which way(s) SI for mathematics students can be enhanced. It thus requires those involved to look into all possible sides of the debates for amicable solutions. The expectation from this study is to come up with as many solutions as possible in an endeavour to make success of this SI, and as CER allows multiple realities and all perspectives to be looked into, different solutions can be obtained.

2.2.6 Role of the researcher

The role of the researcher within the CER context was that of engaging the participants in the research project with the aim of empowering, transforming and liberating them from not-so-useful practices and thoughts and consequently meeting the needs of a real-life situation (Mahlomaholo, 2009:226). It also helped them take control of their situation by bettering it (Jordan, 2003:186), hence owning the outcomes of the research project of their own efforts.

The CER theory is participative and collaborative in nature because it requires both the researcher and the participants to take part in the process of change (Ledwith, 2007:111). However, according to Campanella (2009:4), it is essential for the researcher to be genuine, thus adhering to ethical issues and ultimately establishing mutual trust among the participants. Researchers must be compassionate, patient, and mindful of the issues the communities face, and should allow the participants to voice these issues in a manner that is convenient to them. She also maintains that critical researchers must work *with* the people rather than *on* the people, thereby allowing them to be more human and developing the ability to listen and respect one another. This maintains reflexivity and humility among the participants.

On the other hand, Mahlomaholo and Nkoane (2002:2) regard the researcher's role as that of interpreting other people's interpretations and trying to make sense of them. This way, the framework informs analysis and guides investigation towards a deeper meaning from multiple perspectives of the research question. In order to alter the status quo of the supplemental instruction in institutions of higher learning, CER is deemed apt as it not only emancipates but also empowers, restores equity and endorses individual freedom within a democratic society. According to Shangase (2013:15,45), the role of the researcher is thus critical in this context because it gears the strategies to yielding the desirable results, particularly because all the stakeholders operate within a context of equal power relations and therefore own the programme that is put in place. The researcher

within this context is a facilitator and enabler who shares expertise rather than imposes it.

2.2.7 Relationship between the researcher and the participants

Within the context of CER the division of the powerful and the powerless dissolves into egalitarianism between the researcher and the participants, with both sharing a common interest in the site of community need (Rowan, 2001:126-127). In this way the researcher and participants work closely together without either party considered more powerful than the other. Lincoln (2001:127) captured this kind of relationship as a "lover model", existing in a state of mutual concern, caring and trust. Leave-taking occurs when it must, and is painful to both the researcher and the participants as both are missing each other's friendship and experiences. This means that through CER the participants and the researcher can bond and be closer to each other, tapping into each other's experiences and embracing them as they realise that they are valuable in making the research project successful.

Proponents of CER oppose the notion that there is absolute truth and hence allow for different ideas from different people within the context in which participants interact with the researcher as equals and are treated with respect (Mahlomaholo, 2009:13) equal to that of the researcher. This enables the participants to gain a status equal to that of the researcher and the relationship thus becomes a closer one, with open dialogue and what Kemmis (2006:472) refers to as "communicative spaces". This close kind of a relationship consequently emboldens transparency and openness, particularly because of the platform generated by CER, which at all times advances the agenda of peace, freedom, hope, social justice and equity in its all forms (McGregor, 2003:4). In this way, CER enables both the participants and the researcher to act in the interest of the whole and subsequently affords them all a mutual process of discovery wherein both contribute to the expansion of each other's knowledge (Ledwith, 2007:599).

It follows from this that one could regard CER's nature of awarding the researched or participants a status equal to that of the researcher and a respect for what they have to say (Murugen, 2008:23; Dold *et al.*, 2011:512) as a shrewd way of

transfiguring them into becoming researchers, and vice versa. This then means that the participants become empowered while the researcher is disempowered. The agenda of making the participants and the researcher interact as equals thus forecloses the perception of “the powerful and the powerless” and subsequently considers principles of social justice, democracy and liberation for all (Gustavsen, 2001:126). The participants together with the researcher then work collaboratively as equal partners across the entire research process in order to change their position through challenging their marginalisation (Campanella, 2009:5). In this way, CER promotes praxis and encourages the researcher and the participants to strive to find solutions rather than dwelling on the problems in a more participatory mode (Shangase, 2013:16).

The research question for this study was one that required people’s responses on ways in which the functionality of SI for Mathematics students could be enhanced. CER in this context hence created a more relaxed platform on which both the researcher and the researched interacted as equals, with a context of respect and humanity in which social justice and equity were advanced (McGregor, 2003:4).

2.2.8 Preferences of critical emancipatory research above positivism and phenomenology

Drawing from the discussions above it is evident that when people work together, as CER requires, the possibilities of achieving the goal are high and quick to attain. This is because in teamwork there is confluent thinking, referred to by Tibane (2007:158) as “shared thinking”, which breeds innovation and maximises productivity. Tibane avers that if one could trace the origins of a great idea one would probably discover that it came from three or four ideas and led to great returns. He further avows that when people share their thoughts they are bound to produce a greater energy that will help them share their efforts. His conclusion in this regard is that “if thinking is an ancestor of every action then shared thinking is definitely an ancestor of shared action”, it being the only form that can produce greater returns.

It follows that CER was chosen as the most apposite lens for this study as it encourages teamwork with which people are bound to share their thinking. Greater solutions to enhance the functionality of SI for Mathematics students will then emerge from the multiple ideas and perspectives that people will adopt. The goal can therefore mostly be achieved through CER that promotes shared thinking, regarded by Tibane (2007:96) as the only mechanism for breeding innovation and producing greater returns.

CER's engaging nature through shared debates therefore made it possible for the participants in this study to receive enlightenment that helped them understand the problem. Its empowering and transforming nature (Nkoane, 2012:99) made it possible for the participants to deliberate and formulate possible solutions to the problem and define the conditions that would make these solutions work. Its nature of allowing multiple realities and perspectives to be considered, and allowing one to go for a deeper meaning (Mahlomaholo, 2009:225-226), made it possible for the participants to recognise the possible and plausible threats that could impede the successful implementation of a functional SI and hence put measures in place that would help circumvent them. Lastly, CER made it possible for the participants to engage in the process of monitoring whether the strategies worked or not and to subsequently point out the indicators of success.

Finally, CER was chosen because it fosters mandates for action, presses for social justice, fosters a close relationship between the participants and the researcher, mandates for what constitutes ethical practices, and advances the agenda of expanded epistemologies for mutual learning (Gustavsen, 2001:126). It made it possible for multiple solutions to be obtained in attempting to enhance the functionality of SI, since it required people to work as a team. Through CER, the research question for this study could therefore be fully answered.

2.3 DEFINITION OF OPERATIONAL CONCEPTS

This section provides the definition of key operational concepts for this study by explaining or defining them comprehensively.

2.3.1 Enhancing

According to the *Oxford Advanced Learner's Dictionary* (2006), the word 'enhance' means to increase, or further improve the quality, value, or extent of something. In line with this, the *Merriam Webster Online Dictionary* (2012) defines 'enhance' as to increase or improve in value, quality, desirability, or attractiveness. From these definitions the commonality is that "enhancing" involves improving the value and quality of something, and in the context of this study improving the effectiveness of the SIP in helping students improve their academic performance in Mathematics (Arendale, 1994:1).

2.3.2 Functionality

According to the *Dictionary of Family Psychology and Family Therapy* (1993), 'functionality' means the suitability of behaviour for achieving common goals while minimising impasses. The *Oxford Advanced Learner's Dictionary* (2006) defines it as the quality of something being suitable for the purpose for which it was designed. The commonality here is that for something to be functional it needs to serve a useful purpose or the one it is expected to fulfil.

From a sociological perspective, Mooney, Knox and Schacht (2007:1) list one of the major theoretical perspectives as 'functionalism', with which every part of society is important in contributing to the stability of the whole. Different parts are primarily the institutions of society, each of which is organised to fill different needs and has particular consequences for its form and shape. All these parts are mutually dependent and contribute positively to society at large. Their absence can cause society to lack stability and become dysfunctional.

According to computer scientists' perspective of functionality, in terms of how the computer system operates, 'functionality' is the quality or state of being functional; especially the set of functions or capabilities associated with computer software or hardware (*Merriam-Webster's Collegiate Dictionary*, 2006). Referring to a

computer system, a computer has different components that make it function properly, and if any do not function then the whole system is affected. In this study, I hold a similar idea that for SI to be functional people who are involved need to work well together. I view SI as a system which comprises humans who contribute equally to its functioning, therefore if there is no teamwork or one party does not work as required then SI as a whole becomes affected and in such an instance there is a need for an intervention so that all the parties can be brought together in order to function well together. All these therefore mean that for SI to be functional the people need to discuss the problem about SI together, come up with strategies to solve it as a collective and reach a consensus as to which further steps they need to take. For this study, therefore, humans are considered the key players in making an SI's functionality possible. The definition of functionality in this study is further informed by the lens couching this study, CER, which confirms that people need to work together in order to enhance the functionality of SI for first-year Mathematics students. Based on the definitions and the discussion above, the definition considered best suited for this study in terms of functionality was serving the purpose it is expected to fulfil, in this context to improve Mathematics students' academic performance, curb attrition and withdrawal rates and increase retention rates thereof. This is a combined definition which is informed by the sources cited above. It should be noted that in this study that people are regarded as the central resources in making SI for Mathematics students functional. Justification behind the adoption of this definition is further informed by what the literature considers to be the purpose of SI in institutions of higher education, namely, to improve students' performance in high risk courses (Etter *et al.*, 2000:356), reduce attrition and withdrawal rates (Zaritsky *et al.*, 2006:23) and to increase the retention rates (Zeger *et al.*, 2006:63).

2.3.3 Supplemental

Before defining 'supplemental instruction' I examine the two components, namely, 'supplemental' and 'instruction". According to the online *Oxford Advanced Learner's Dictionary* (1993), the word 'supplemental' is a thing added to something else in order to complete or enhance it. The *Merriam-Webster Dictionary* (2012)

defines it as something that completes or makes an addition. The commonality is an addition to something, therefore the sessions provide additional assistance that enables students to improve their skills and increase their chances of success. The definition that best suited this study was an addition to improve learning.

2.3.4 Instruction

Heckman (1967:1) referred to 'mathematical instruction' as a series of physical objects with indicia thereon which may be easily utilised to instruct young people in arithmetic and mathematics. According to Weymeyer (1999:54), instruction is an effort to assist or to shape growth. The *Oxford Advanced Learner's Dictionary* defines it as the act of teaching (2006). The definition most suited to this study would be coaching, because during the SI sessions the students are not supposed to be re-lectured or introduced to a new topic. Rather, they are expected to indicate the areas wherein they find challenges, based on which they may be coached on how to solve a problem. This is usually done in order to improve student skills. In the context of SI, the role of the leader is not to act like a lecturer or professor (Marra & Litzinger, 1997:1), but as a mere coach. Nor is the SI leader expected to give students answers, but rather he or she should probe them in such a way that they themselves can discover the answers.

2.3.5 Supplemental Instruction

'Supplemental instruction' is not a lecture but a session which provides students with a platform on which they may be assisted with problems they encounter in high-risk courses (Gardner *et al.*, 2005). It is defined as an academic support programme designed to provide optional, informal, peer-mentored learning support to students in large, survey, or general education courses (Bowles, McCoy & Bate 2008:3), and a structured collaborative model designed to assist them in mastering course concepts while concurrently increasing their reading, reasoning, and study skills (Jones & Fields, 2001:532).

A cooperative learning model is designed to improve student performance and retention in the courses with a history of high failure rates (Etter *et al.*, 2000:355). It may also be a two-tiered programme that seeks to facilitate understanding of course content, while at the same time encouraging students to develop better learning skills and strategies and meta-cognitive skills (Bengesai, 2011:61). For the purpose of this study, SI is defined as an academic support learning intervention designed to improve performance and to increase retention in the courses which are perceived as difficult for the students. This intervention seeks to facilitate understanding of course content while simultaneously enabling students to develop better learning skills and strategies. The definition is informed by Bengesai (2011:61), Etter *et al.* (2000:355) and Bowles *et al.* (2008:3) above. The concept of enhancing the functionality of supplemental instruction means improving the effectiveness of the SI programme in pursuance of students' enhanced performance.

Based on the above, the subsequent sections review literature on the implementation of SI locally, continentally and internationally, discussing their experiences and attempts to improve the effectiveness of their SIPs.

2.4 RELATED LITERATURE

According to Tinto (2005:1), learning experiences and support services, both in and beyond the classroom, help students grow intellectually and develop personally. They acquire knowledge and skills to succeed academically, build confidence and resilience to accept and embrace challenges, and develop their personal and academic identity. He further avows that these learning experiences and support services make it possible for students to be challenged to become globally prepared, interdependent, critical thinkers, with an ever-increasing ability to locate, assess and apply knowledge resources that help them develop as whole, productive citizens and leaders on campus and beyond.

Drawing from the above, it is clear that a student academic support programme such as SI plays a critical role in helping students not only grow intellectually but also develop holistically. The SI goal of improving their performance in high-risk

courses is one special way of supporting success. According to Tinto (2005:2), most of the institutions of higher learning treat student success like many other issues, as one more item to add to the list of issues to be addressed by the institution. He adds that these institutions have done little to address the deeper roots of student attrition, especially in high-risk courses, that is those perceived to be difficult, for example, Mathematics. Regarding the need for supporting student success, for the institutions to be serious they need to recognise that the roots of attrition lie not only in their students and the situations they face but also in the very character of the educational settings.

The first-year Mathematics students in the institution under study were experiencing challenges with subject content, as indicated by the success rates. The attrition rates were also high and retention rates low, as reflected in the University's documentation. Extra scaffolding was therefore needed in order to enhance the performance of the students, as mathematics is important in daily life. If students continue to perform poorly and drop out in large numbers this impacts negatively not only on their academic lives but also on the institution itself.

From personal experience and observation, of the few number of students majoring in Mathematics in most institutions of higher learning, most do so because it is a prerequisite of their majors and not because they wish to. Harding *et al.* (2011:853) affirm this view in finding that the number of Mathematics majors is limited and that the demand outweighs the supply. It was against this background that the SI programme was introduced, so that it could help address the problems that first-year students encounter in Mathematics, stimulate interest in the course and so increase the retention rates (Jones & Fields, 2001:546). Although SI as a strategy or intervention proves to be helpful in supporting student success there are challenges that hinder its successful implementation, thereby depriving students of the benefits they should receive in terms of improved performance.

The next section examines implementation of SI in the RSA, Nigeria and the USA, beginning with the challenges experienced, followed by solutions, the conditions that made them work, the threats that impede successful implementation of the programme, as well as providing evidence of the successes.

2.5 CHALLENGES EXPERIENCED WITH THE IMPLEMENTATION OF SI IN THE INSTITUTIONS OF HIGHER EDUCATION

The following sections examine the challenges experienced during the implementation of SI for mathematics students. It should be noted, however, that in the context of the RSA and the USA, the students who assist other students with the learning of mathematics content are known as 'SI leaders', which is different from Nigeria, in which they are called 'peer teachers'. Therefore, in the subsequent paragraphs the two terms will be used in line with their respective contexts.

2.5.1 Lack of a coordinated plan

According to the *Business Online Dictionary* (2000), 'coordination' refers to the synchronisation and integration of activities, responsibilities, command and control structures to ensure that the resources of an organisation are used most efficiently in pursuit of the specified objectives. A plan explains in detail what needs to be done, when, how, and by whom. A coordinated plan is one which explicitly shows how the activities and responsibilities are being synchronised in pursuit of the specified organisation's objectives by elucidating what needs to be done, when, how and by whom.

According to the *Supplemental Instruction Leader Manual Guideline* (SILMG, 2008:10) one of the responsibilities of both the lecturer and the SI leader is to establish a coordinated plan in terms of the content to be presented to the students by meeting regularly prior to the SI session. In order for it to be effective the lecturer clarifies any uncertainties the SI leader may have regarding the material to be discussed during the session with the students. It is expected that the SI leader show the lecturer the hand-outs he/she plans to share with the students during the session and the lecturer is expected to help him/her by making them more appropriate to the course material. Thus, the lecturer's responsibility in

this case is to help the SI leader to create an effective and coordinated plan that will ensure his/her sessions are productive and beneficial to the students.

Although the guideline encourages the establishment of a coordinated plan, literature shows lack of one within the SI programme, which in turn leads to the SI not being functional. As a result, the students do not profit from the sessions and their performance does not improve. For instance, in RSA, as in the USA, SI leaders are expected to attend all classes, take notes, complete reading assignments and do all the homework, just as those enrolled in the class (Arendale, 1994:2; Congos & Schoeps, 1993:166; Obiunu, 2008:237). The schedules for the SI leaders, however, are not integrated into the institution timetable and in many occasions clash with their lecture schedules, that is, the classes they have to attend as students. This leads to them missing sessions in certain instances and thus not helping students with content they do not understand. The SI leaders could not meet regularly with the lecturers in order to establish the plan, and so found themselves presenting topics which were not similar to those presented by their lecturers. Examples of the resulting confusion arose when the SI leaders would present functions and logarithms while the lecturers would be presenting trigonometry. These concepts are different and not interrelated, therefore the students became exposed to two different contents simultaneously.

In the RSA, Nigeria and the USA, both the SI leaders and the lecturers are expected to meet regularly in order to discuss what should be dealt with during the sessions and other challenges experienced (SILMG, 2013:10, Zaritsky *et al.*, 2006:29). This is to ensure that the plan becomes effective, however, the students who are the ones taught and experiencing the challenges regarding the particular topics are usually not part of the meetings. In many instances, lessons which are prepared for them consist of topics with which they do not have problems and, because they are not given an opportunity to voice their challenges, they persist. The students are thus unable to contribute to the establishment of a coordinated plan. In these countries, lack of coordinated plan manifests in the simultaneous presentations of different topics by the SI leaders to the students, thus leading to

confusion. It also manifests in topics presented by the SI leaders being different from those presented by the lecturers.

This study therefore seeks to find out ways in which an effective coordinated plan could be established in order to help make the SI sessions for students effective and so improve their performance.

2.5.2 Lack of articulated vision and ownership

According to Halligan and Donaldson (2001: Online), a well-led organisation knows how the vision and values are being communicated effectively to all involved. Such communication will give staff a common and consistent purpose and clear expectations. It is therefore only when people understand the vision that they will focus their energy on ensuring that the goal is realised.

Clarkewood Consulting (2011:Online) notes that it is important that these statements are not just words put on posters without explanation. Every employee needs to be aware of the words but, more importantly, their meaning, energy and source so it is possible for all to work together in one direction for a common goal. An organisation that does not have a clearly communicated vision owned and clearly understood by all involved is unlikely to achieve its ultimate goal. Similarly, if the SI vision is not clearly articulated and owned by all involved it cannot increase the students' performance and retention, these being its primary goals.

According to the SILMG (2008:3), the vision which is clearly communicated and owned by all involved makes it possible for academic excellence to be achieved. Although the guideline points to that as an advantage, literature indicates that in the RSA, as in the USA, the vision was not clearly articulated or owned by all the stakeholders involved, resulting in SI not being functional. Students had negative perceptions about the programme, most feeling it was meant for students who were not clever and thus a remedial programme. When asked why they were not attending the sessions they made up excuses, in certain instances unable to provide substantial reasons (Bengesai, 2011:66; Bentley *et al*, 2009:144; Malm, Bryngfors & Morner, 2012:39).

Another challenge as highlighted in the USA related to the timetable clashes which were experienced by students and the SI leaders (also as students). Each leader was allocated two groups and it was preferable that one should be responsible for both groups for simplicity and consistency. The challenge however was that the SI leader was able to attend the lecture session with group A but not with group B, causing the students in group B to miss out on many benefits of SI. Nor did the students in group B perform as well as those in group A (Wright *et al.*, 2002:32). Drawing from this, apparently the university timetable did not include the SI session slots for SI leaders and they were not taken into account. The programme's vision was not fully recognised, embraced or owned by the institution, hence leading to clashes which could have been avoided.

Based on the above, it is therefore notable that in the RSA, Nigeria and the USA, lack of articulated vision and ownership was the cause of SI for first-year Mathematics students not being functional. Lack of articulated vision manifested in students not regularly attending the sessions as required, confusing the programme for a remedial programme and providing reasonable excuses as to why they were not attending. A framework therefore needs to be formulated to foster the articulation and ownership of the SI vision and explicitly outline ways in which it can be clearly articulated and owned by all involved, so as to make SI for first-year Mathematics students functional.

2.5.3 SI leaders' inability to model effective instructional strategies

According to the SISMG (2008:17), the SI leaders as key people in the programme are expected to present an appropriate model of thinking, organisation and mastery of the discipline. The training that they undergo thus enables them to know how students learn as well as use the appropriate instructional strategies aimed at strengthening student academic performance. The SISMG (2008:17) indicates that students who attend the SI sessions would be able to discover the appropriate application of the study strategies as they review the course material. Although it is an ideal situation for the SI leaders to facilitate the sessions, literature indicates their inability to help students integrate how-to-learn with what-

to-learn, thus making it difficult for first-year Mathematics students to understand course content and improve in their performance.

In the RSA, as in the USA, the SI leaders acted like the lecturers and re-lectured the students instead of facilitating the sessions by applying the principles of active collaborative learning when assisting with mathematical concepts they did not understand. They showed students how to solve the given mathematical problems on the board whilst students merely sat listening without being involved. The SI leaders applied such a teaching strategy, even though it was discouraged during their training. Re-lecturing thus deprived students of an opportunity to benefit from active collaborative strategies that could have assisted them in understanding first-year Mathematics content better (Congos *et al.,* 1993:166; Hensen *et al.*, 2002:250). However, in Nigeria, re-lecturing of the content was encouraged, with peer teachers taught prior to the sessions and expected to teach their peers what they had been taught the same way they were taught (Bentley *et al.*, 2009:144). In this kind of a setup the peer teachers are expected to *teach students* rather than to *facilitate the sessions*, which means that they were encouraged to dominate the sessions without allowing students' voices and interactive participation in class, thus making it impossible for student learning to take place.

On the basis of the above, it is clear that in the RSA and the USA the SI leaders were applying re-lecturing as a teaching method that only gave power and dominance to them without making it possible for effective student learning to take place. Such an oppressive teaching method created a tense environment for students as it suggested that only the SI leaders were the ones who had knowledge. What the students knew, their experiences and voices were overlooked in the process. This way they did not benefit as they were not viewed as equal partners who could also contribute to their own learning. Thus, the students could not discover the appropriate application of the study strategies.

The above sections indicate that the SI leaders' re-lecturing of the students prevented SI for mathematics students from being functional. In the RSA and the USA the SI leaders applied re-lecturing as a strategy, even though they were made aware of its disadvantages during the training. On the other hand, in Nigeria re-lecturing was encouraged for the peer teachers to apply. It was on the basis of

these findings that this study sought to establish ways in which the SI leaders could be empowered to effectively model instructional strategies that would assist students in learning and understanding first-year Mathematics content.

2.5.4 SI leaders' inability to effectively engage the students in their own learning

One of the guidelines in the SISMG (2010:10) is that students need to be engaged in activities and problem-solving during the sessions. The guideline emphasises that students who are engaged in the activities should also be the ones who do most of the talking, not the SI leaders. From the Social Independence Theory (SIT) as noted in the SISMG (2010:4), such engagement enables the students to actively construct knowledge as they work together cooperatively and interdependently. It further promotes dialogue and increases student knowledge and understanding of the course. While the guideline encourages student engagement, literature shows that when the first-year Mathematics students are not actively engaged in their own learning their understanding of course content does not increase.

The studies conducted in the RSA, Nigeria and the USA revealed that the SI leaders who did not act as facilitators in the collaboration of learning made it difficult for SI as a student learning community to increase engagement (Bengesai, 2011:62, McGuire, 2006:3), thus it became difficult for students to demonstrate understanding of the course content. They were not provided with the problems to solve as groups. Although the concept of student engagement was encouraged, research conducted in the RSA further revealed that on numerous occasions the number of first-year Mathematics students attending the SI sessions was large and made collaborative working of the groups difficult. The SI leaders found it difficult to apply the SI techniques of collaborative learning, problem-solving and student engagement since they were inexperienced in handling such large classes (Harding *et al.*, 2011:851). The students therefore could not exchange ideas amongst each other and their understanding of their first-year Mathematics content could not be enhanced.

From the above, it is evident that the SI leaders' inability to effectively engage students in learning left them unable to comprehend Mathematics content and made it difficult for them to demonstrate understanding of the course content. The study sought to establish ways in which the SI leaders could be empowered to effectively engage students in meaningful learning of first-year Mathematics content.

2.5.5 No feedback offered within the setup to keep stakeholders abreast and to promote individual growth

The SISMG (2007:7) notes the programme evaluation as one of the elements of the model which must be present in order to ensure the integrity of the programme. The programme is evaluated appropriately by assessing institutional outcome measures, for example, final course marks, course withdrawal rates, institutional dropout rates and institutional graduation rates. On the basis of this, the SISMG (2007:46-47) stipulates that the supervisor should give regular feedback to the departmental contact persons in quarterly meetings on attendance of SI versus student performance and other matter related to SI. Observations of the SI leaders should be performed regularly and immediate feedback provided to the individual SI leader so that all stakeholders will follow progress in the programme. The SI leaders will thus learn from the feedback and develop. However, literature shows that no feedback is offered within the setup to keep stakeholders abreast or promote SI leaders' growth (Harding *et al.*, 2011:851; McCarthy, Smuts & Cosser, 1997:222).

Most of the studies on SI indicate evaluation being performed by looking more into students' performance through the use of the statistical methods which often result in inherent self-selection bias (Bowles *et al.*, 2008:3) in order to determine whether the programme is effective or not. The studies however do not indicate how feedback was provided to the various stakeholders or SI leaders. When the programme could not serve best the needs of the students the people involved could therefore not make significant inputs which could have improved the programme and student performance. For instance, in the RSA, as in Nigeria and

the USA, the evaluation took into account the students' inputs, comments and marks in deciding whether the programme was effective or not (Fayowski *et al.*, 2008:848; Bentley *et al.*, 2009:145; Bengesai, 2011:64). Lack of feedback in the setup did not enhance critical reflection of the situation by all involved nor ensure maximum benefit in implementation of SI or well-rounded functioning of the programme.

Deducing from the above sections, it is clear that in the RSA, Nigeria and the USA, lack of feedback in the setup prevented the SI for Mathematics students from functioning. The stakeholders could not add their voices to improving the functionality of the programme with meaningful contributions that might have assisted it in improving student performance since they could not be heard. The study thus sought better ways to effectively provide feedback of use in improving first-year Mathematics student performance.

2.6. SOLUTIONS TO THE CHALLENGES EXPERIENCED

The following sections provide solutions to the challenges experienced in the mentioned countries.

2.6.1. The presence of a coordinated plan

According to the SILMG (2008:10), SI is offered only with the support of the lecturer and as such the SI leaders need to be supported by the lecturers, to help them plan and prepare for the SI session so that their lesson/preparation hand-outs to the students are more appropriate to the course material. This would also ensure that similar topics are addressed at the same time and that the same lesson outcomes are achieved. As indicated above, lack of coordinated plan caused the programme not to be functional so certain steps were taken in the RSA, Nigeria and the USA, with cooperative working established between the lecturers and the SI leaders that resulted in a coordinated plan being established. In the RSA, lecturers and the SI leaders met weekly in order to draw up a common

plan regarding concepts which required attention (Zeger *et al.*, 2006:65). For example, the lecturers would introduce the topic of quadratic equations to the students and explain all necessary information. The SI leaders would then be expected to engage students in practical activities of plotting the x and y values, the coordinates of the turning point and the symmetrical point on the graph. The plan thus enabled the SI leaders to know content they had to deal with in class.

Similarly, in the USA, lecturers and SI leaders held meetings in which they established a common plan (Zaritsky *et al.*, 2006:29). In Nigeria, however, meetings were not held but the course instructors responsible for Mathematics taught the peer teachers concepts that they needed to present in class as a way of preparing them for the role they needed to play (Bentley *et al.*, 2009:144). For instance, if the topic was quadratic equations and the students were expected to solve the equation $y = x^2 + 2x + 1$, the peer teachers would be shown different steps as to how the problem could be solved (determining the x and y values) and they would be expected in turn to show the students those different steps as indicated to them. It is apparent from this that the peer teachers did not have anything to contribute to the plan, taking what the lecturers taught and sharing it with the students.

From the above it is evident that the establishment of a coordinated plan was similar in the RSA and USA. The SI leaders knew which mathematical concepts they needed to deal with, and how and when, through the weekly meeting they held with their lecturers. However, in Nigeria peer teachers were taught what to do during the sessions rather than in meetings. Although these solutions somehow worked this study will look into other ways in which to make the coordinated plan effective.

2.6.2. Clearly articulated and owned vision

According to Halligan and Donaldson (2001:Online), a well-led organisation knows how the vision and values are being effectively communicated to all involved, therefore such communication gives staff a common and consistent purpose and

clear expectations, and it is only when people understand the vision that they will focus their energy on ensuring that the goal is realised. In line with this, the SILMG (2008:3) encourages the vision to be established and articulated to all involved so that they can share in its ownership.

In the RSA, communicating the vision, especially to the students, was deemed significant in ensuring that the SI for Mathematics students became a success. It was also pursued in order to ensure ownership by the first-year Mathematics students who did not know what the programme was about or intended for. During the orientation session, the students were informed about the programme and what it was intended for, and repeated emphasis was placed on diligence and hard work on their part, thus encouraging them to develop a sense of responsibility towards their studies (Harding *et al.*, 2011:851). They were therefore made to realise how their commitment towards the programme and embracing the SI vision could make it possible for the institutional goal to be realised. Their Supplemental Mathematics Instruction Learning Enhancement (SMILE) programme structure was made convenient for all of them to attend, whereby the first hour was used as an introduction to a subsequent tutorial session. The problem, however, with the first hour session was that students used the venue as a waiting room for the subsequent tutorial class and most did not contribute to the session.

In Nigeria, the vision was also communicated to the students, as they were also made aware of what was expected of them in order for the programme to achieve its goal. They were expected to attend sessions at all times and the whole institution knew about the programme (Boud, Cohen & Sampson, 1999:415). In the USA, the vision was also communicated to students and they were encouraged to attend the sessions. In trying to avoid the problem that could have been posed by timetable clashes, many sessions were provided for students and they were requested to attend those that fitted their schedules (Gardner *et al.*, 2005). The act of being careful about lectures that might have clashed with the SI sessions by providing the SI leaders and the students with as many sessions to attend is an indication of the institution that embraces the programme's vision and that has its ownership.

The discussions above indicate that in the abovementioned countries a similar strategy was applied whereby the programme vision was communicated to the first-year Mathematics students. The discussions also indicate that the vision was communicated and the students encouraged to attend the sessions. The time to attend was also made available for them to do so as well as the resources to use. Although this strategy worked to some extent, this study seeks to formulate other ways in which to effectively articulate the vision and endorse its ownership by all involved as part of enhancing the functionality of SI for Mathematics students.

2.6.3. The use of supplemental instruction strategies

According to the SISMG (2008:16), the SI leaders need to refrain from 'spoon-feeding' the students, re-lecturing, dominating the session and providing all the answers. They should not be the only ones taking the lead in discussions or problem-solving during the sessions, but the students must also be allowed to talk freely and engage in problem-solving activities. This way the students would not be viewed as 'clean slates' but as people who also have experiences to share and so increase their understanding of the course content as well as their performance. The use of effective SI instructional strategies for Mathematics was also used in the RSA, Nigeria and the USA.

In the RSA, the intensive training that the Mathematics SI leaders received enabled them to help students to integrate course content and learning/study strategies. The training also empowered the SI leaders to help students with other areas, such as reviewing of course material covered in lectures, hands-on exercises that were unlikely to be utilised in large lecture-classes, and discussion-based learning that is more difficult to accomplish in large lecture halls and study skills training, for example, note-taking, textbook use and exam-taking strategies, as well as problem-solving (Bowles *et al.*, 2008:5). In the USA, as in the RSA, during Mathematics SI sessions the leaders required the students to articulate their problem-solving approach to teach each other while they solved problems. At the same time, the SI leaders acted as mere coaches or facilitators rather than instructors, thus eliciting as much as possible the correct answers from the

students without explicitly leading them (Gardner *et al.*, 2005). In Nigeria, however, a different approach was used, with peer teachers employing the demonstration method of teaching whereby they demonstrated to their peers how they solved a mathematical problem (obtained the solutions) then asked their peers to repeat the routine by demonstrating to the class how the answers were obtained (Bentley *et al.*, 2009:144).

Drawing from this, it is evident that the strategies used in the three countries are not similar. Both in the RSA and the USA, the SI leaders allow students to engage in problem-solving while they facilitate the sessions, guiding the students. On the other hand, in Nigeria, the peer teachers demonstrate how the problem needs to be solved and thereafter expect the students to repeat it, demonstrating to the class how an answer was obtained. Based on these, the study will look into other ways in which the instructional strategies could be effectively applied in order to make SI for Mathematics students functional.

2.6.4. Effective student engagement

According to the SISMG (2009:10), in order for the students to understand the course content they need to be involved in more than listening. They also need to be involved in higher order thinking (analysis, synthesis and evaluation) and activities (reading, discussing and writing). Such student engagement will:

i. better the students' understanding of the course material;

ii. increase the students' cognitive processing of the material;

iii. expose the students to new ideas and more ways of thinking about solving the problem;

iv. enable the SI leader to identify the students' misconceptions and gaps in understanding of the material.

Literature also in line with these indicates instances when such student engagement was implemented, leading to improvement in their understanding of the Mathematics course and performance.

In the RSA, as in the USA, the strategy used was for the SI leaders to allow students to sit in small groups. They would then use the proactive and participative activities during the sessions such as “think, pair and share”, whereby students were encouraged to brainstorm ideas, pair up with another student and discuss their views or approaches to problem-solving. In the USA however, the SI leaders were also trained in questioning techniques based on Bloom’s taxonomy, which comprises six levels, namely, knowledge (recalling of formulae), comprehension (articulate and comprehend meaning), application (performing operations in mathematics), analysis (problem-solving), synthesis (combining concepts for a deeper meaning) and evaluation (making judgements on the basis of the given data). The SI leaders therefore prepared questions which varied according to these levels of difficulty and encouraged participation (Fayowski *et al.*, 2008:845).

Although student engagement proved effective in helping understand the Mathematics course, in the RSA one of the greatest challenges experienced was with regard to class capacity. In many instances the sessions were capacitated with many students, which prevented the SI leaders from letting them sit in small groups and utilise the SI techniques of collaborative learning (Harding *et al.*, 2011:849).

In Nigeria a different strategy was applied, as the course instructors guided the selected peer teachers through assignment, providing hints and helping them prepare to present to peer-learning groups. At the end of the session peer students received a quiz and each one in the group was assigned a task to perform (Bentley *et al.*, 2009:144). Ahead of the first session, the first subgroup would prepare a unit which they would then demonstrate to their peers as a way to solve a problem. The second subgroup would then prepare the second unit and thereafter demonstrate to the first subgroup how they obtained the answers. At that time, the peer teachers alternated in pointing out the features of interest and leading to the discussions amongst the students (Nnodim, 1997:113).

The discussion above clearly demonstrates that the manner in which students were engaged in learning was different in the three countries. In the RSA and the USA the proactive and participative activities were used during the sessions. Students were also paired and requested to brainstorm ideas as groups. In the

USA, however, the questioning techniques were also applied by the SI leaders, unlike in RSA, whilst in Nigeria students were given assignments, a quiz and tasks to perform as groups. On the basis of these, the study seeks to discover other effective ways in which to engage the students effectively in their own learning in order to promote understanding of their Mathematics course content.

2.6.5. Making feedback available to the stakeholders

The SISMG (2008:46-47) advises that the SI office give regular feedback to the departments or faculties and that immediate feedback be given to the individual SI leaders regarding observations. In this way, they would stay abreast while the feedback provided to the SI leaders would help them develop. Literature confirms that such feedback is necessary for SI to be functional (Stout & McDaniel, 2006:60). In the RSA, evaluations took into consideration the inputs from the SI leaders, however, some of the concerns were not attended to. For instance, one of the SI leader's concerns was with the larger classes they were facilitating, which made it difficult for them to adhere to SI techniques of collaborative learning. Although they pointed to these as a challenge on their part, making it difficult for them to effectively engage students in learning, nothing seemed to be done to address the problem. The SI leaders thus had to adjust and make sure that they coped under such circumstances (Harding *et al.*, 2011:851).

In the USA, the data available from the SI office was shared with both faculty and the administration as numerical evidence that the programme worked and was producing results. This included data that showed that SI need not be considered as an additional cost, but rather represented an economic savings since the cost of running the programme was modest (Zaritsky *et al.*, 2006:30). That was imperative because everybody involved got to know about the progress made in the programme. Data related to what worked and what did not work was also shared with both faculty and administration.

In Nigeria, the evaluation and observation processes were conducted and the students' opinions which also formed part of data were allowed. However, the peer teachers with whom the students were not satisfied regarding how they conducted

their sessions did not receive such information (Bentley *et al.*, 2009:144). This means that the peer teachers could not reflect on their teaching methods based on what their peer students said, nor develop in their teaching role.

The discussion above illustrates the significance of making feedback available to all the stakeholders involved in the RSA, Nigeria and the USA. Moreover, it shows how significant it is for all involved to reflect on this feedback and learn from it. This study therefore sought to find better ways in which feedback could be made available to all involved and also for all involved to be able to reflect on it.

2.7. CONDITIONS CONDUCIVE TO THE IMPLEMENTATION OF SI FOR FIRST-YEAR MATHEMATICS STUDENTS

The following sections will look into the conditions that made the solutions work.

2.7.1. Coordinated plan made possible by cooperation between the lecturers and the SI leaders

The SILMG (2013:10) requires the lecturers and SI leaders to have meetings prior to the SI sessions wherein they discuss the content to be covered. According to Smith (2009:15), this kind of discussion is important because it helps to maintain student core, facilitates balanced sessions, optimises content coverage and makes it possible to formulate questions that arise from several sections. This way, the students' comprehension of the course content increases, as what is prepared is what students indicated they do not understand.

In line with this, cooperation between the SI leaders and the lecturers in the RSA and the USA, wherein meetings were held weekly, enabled both the SI leaders and the lecturers to work as a team. Together, they were able to reflect on content which was difficult for the students and also provided the most apposite strategies that helped them to learn first-year Mathematics content (Wright *et al.*, 2002:32; Zeger *et al.*, 2006:65). These meetings helped in ensuring that similar concepts were dealt with by the SI leaders at the same time. Through these meetings the SI

leaders knew where the lecturers were with the students and that helped in linking their sessions to what the lecturers did with the students during a lecture. In Nigeria, lessons which were provided to the peer teachers by the course instructors before sessions and alternating the peer teachers' role helped peer teachers to teach their peers more effectively (Bentley *et al.*, 2009:144). The peer teachers knew what to teach their peers in class and also how to teach them. Furthermore, the teachers were able to teach common topics to the students. As a result, the students benefited from their sessions.

The above clearly shows that cooperation between the lecturers and the SI leaders/peer teachers in the three countries made it possible for a coordinated plan to be established. Its establishment consequently made it possible for the SI leaders to know what they had to do, when and how to do it. The students thus benefited from such an established coordinated plan as it enabled them to receive productive lessons from their SI leaders.

2.7.2. Articulated vision and taking ownership thereof

The SISMG (2013:3) emphasises the need for the SI vision to be embraced, which means that the people involved need to know about it, understand it and also have its ownership. According to the guideline, this is one condition that makes it possible for the programme to achieve its goal of improving student performance. Literature also indicates some of the conditions which led to the vision being clearly articulated and owned by all involved.

In RSA, as in Nigeria, the stakeholders involved in the programme together with the students for whom it was intended, were informed about it. It was during such a session that all got to know about the programme and what their part/role was within it. The students (beneficiaries) were encouraged to work diligently and were made aware of the importance of taking responsibility for their own learning (Harding *et al.*, 2011:851; Krych, March, Bryan, Peake, Pawlina & Carmichael, 2005:296).

In the USA, the involvement of the faculties that regarded themselves as 'gate-openers' rather than gatekeepers within the programme made it possible for the vision to be embraced (Zaritsky *et al.*, 2006:29). These faculties vigorously promoted the SI vision by articulating its goals and ensured that the students attended the sessions by continually encouraging them to do so (McGuire, 2006:9). This was done to ensure that the programme's goals were realised. Furthermore, the presence of the course instructor during the SI sessions, facilitating the session together with the SI leader, also promoted student attendance and a sense of honouring the programme's vision. The involvement of the campus principal ensured that the course instructors, SI leaders and coordinators worked together towards the realisation of a successful SI for Mathematics students (Wright *et al.*, 2002:32).

From the above, it is evident that in the three countries the communication and clarification of the programme's vision to the stakeholders helped in ensuring that the stakeholders had ownership. This manifested in students attending sessions regularly, lecturers being supportive towards the SI leaders and faculties encouraging student attendance.

2.7.3. Effective supplemental instruction strategies

According to the SISMG (2006:15), the students need to decide with what it is they are struggling, on the basis of which both the lecturer and the SI leader should decide what needs to be done in order to develop the skills necessary to overcome their hurdles. In line with the above notion, in the RSA, lecturers and the SI leaders held meetings prior to the SI sessions in which they reflected and discussed content that was difficult for the students, based on what they observed during the lectures and the SI sessions (Zeger *et al.*, 2006:65). They then devised strategies which they believed would respond to students' challenges in understanding the content. The formulation of strategies by the lecturers together with the SI leaders thus improved the quality of the SI sessions for Mathematics students and so helped them benefit.

In Nigeria, the course instructors guided the selected peer teachers through assignment, providing hints and helping them prepare to present to peer-learning groups. At the end of the session peer-students received a quiz and each one in the group was assigned a task to perform (Bentley *et al.*, 2009:144). The use of the quiz and assigned tasks increased the first-year student knowledge of the Mathematics course.

In the USA, the training offered enabled the SI leaders to act as mere coaches and not the instructors. The sessions which were made longer allowed the students to solve problems in groups. Students were able to articulate their problem-solving approach to each other as well as to the SI leader. At the same time, the SI leader, who merely acted as the coach rather than a lecturer, worked to elicit as far as possible the correct answers from the students without explicitly leading them to the answers. In that way, the students learned the content better and understood it (Gardner *et al.*, 2005). More emphasis was placed on the process of learning as a way of equipping students with the necessary skills for continued self-directed enquiry. Students were given an opportunity to discuss any difficulties they experienced in a pro-active manner. In order to master the content, students were given informal quizzes, as in Nigeria, to ensure that they were provided with opportunities to determine which areas in the content were potentially difficult. The most important thing here was that the agenda for the session was determined by the students whilst the SI leader planned the session in such a way that students could pinpoint areas that warranted attention (Spencer & Wallace, 1995:12).

From the above it is clear that in the RSA, the involvement of the lecturers in the programme made it possible for the SI leaders to incorporate effective instructional strategies into their session facilitation. Through the frequent meetings, the SI leaders learnt which effective instructional strategies to apply during the sessions which would respond to the students' misconceptions regarding certain first-year Mathematics topics. In Nigeria, as in SA, the course instructors provided guidance to the peer teachers in terms of how they should be facilitating the sessions and which strategies to apply improved the peer teachers' facilitation of the sessions. In the USA, sessions which were made longer made it possible for the SI

collaborative instructional strategies to be applied. For example, they used Paired Problem-solving (PPS), Group Problem-solving (GPS), and probing of questions. Although these conditions made it possible for students to benefit, the study seeks to establish other conditions that will make the instructional strategies more effective.

2.7.4. Effective student engagement

The SILMG (2013:4-6) requires students to be involved in more than listening, rather to be also actively engaged in activities during the sessions in order for them to have a better understanding of the course material and so make more cognitive processing of the material. Students who are actively engaged in their own learning acquire an increased retention of what they are learning and also get exposure to new ideas and more ways of thinking about things. In the RSA, the SI leaders who were encouraged to actively engage the students in their own learning helped increase the students' understanding of the Mathematics course. Whilst they were engaged in their own learning, they also developed better learning skills, strategies and meta-cognitive skills (Bengesai, 2011:61).

In Nigeria, the division of the students into groups, wherein group A would be requested to demonstrate to Group B and vice versa the way answers to the problems were obtained, enhanced students' mathematical knowledge. Student confidence also improved, motivating them to engage in various problem-solving exercises and so increase understanding of course content (Nnodim, 1997:112).

In the USA, sessions included time to review the course material covered in lectures, engage students in hands-on exercises and fully engage them in discussion-based learning that is more difficult to accomplish in large lecture and also in skills training, for example, note-taking, textbook use and exam-taking strategies. These helped students integrate content with study skills and consequently improved their knowledge of course content (Bowles *et al.*, 2005:5).

The extension of the SI sessions gave students ample time to actively engage in practical exercises and regularly practice Mathematics. While students were

engaged in problem-solving exercises, both the lecturer and the SI leader moved around and helped students with clarity-seeking questions. That not only gave the instructor help in an overcrowded classroom but also allowed the SI leader to build relationships with students and gain a better sense of where they struggled, so that he or she could inform the instructor about content that was difficult to the students (Wright *et al.*, 2002:2). This kind of student engagement helped students to comprehend the course content.

From the above it is clear that in the RSA, as in Nigeria and the USA, the encouragement of SI leaders and peer teachers to engage students in learning enabled students to better comprehend the course content. In the USA, however, the extension of the sessions provided the first-year students with ample time to practice Mathematics. In these countries, the presence of the SI leaders and the lecturers at the time the students were engaged in problem-solving exercises, helped students to receive clarity on concepts they found challenging.

2.7.5. Feedback availability

The SISMG (2008:46-47; 2013:46-47) recommend that feedback be made available to all the stakeholders involved. This way all get to know what is happening within the programme and they cannot experience a situation in which they are taken by surprise when they hear about other occurrences within the programme.

In the RSA, as in Nigeria, feedback from evaluation was obtained and comments read by the SI personnel, helping them understand challenges experienced, although such information was not shared with other people involved in the programme. In Nigeria, however, the course instructors together with the peer-teaching administrators were also part of the evaluation process and not only the SI personnel, as in the RSA. The students' comments were analysed by both the course instructors and the investigator (Harding *et al.*, 2011:851; Nnodim, 1997:115) with an intention of finding out from them whether they received maximum benefit from the programme. The other intention was to identify areas that required modification.

In the USA, writing of the weekly reports by the SI leaders to the SI administrators and the lecturers which also formed part of the evaluation made available more feedback. These reports covered various aspects, such as points of confusion for students, their experiences, methods of explanation and discussion that clarify the lecture, in particular problems and successes which also required serious attention. That information was communicated to the stakeholders involved, enabling the SI administrators to provide feedback to the SI leaders based on their session reports (Wong, Waldrep & Smith, 2007:217). The semester observations made by the Supplemental Instruction Coordinator (SIC) and the assistants made it possible for the SI leaders to receive constructive criticism during the meetings, and that consequently helped them improve their SI session facilitation.

The discussion above indicates that in the RSA, feedback was provided to the SI personnel, unlike in Nigeria and the USA in which feedback was also provided to other stakeholders. Feedback provided in these countries reflected not only on student performance of SI attendees versus non-attendees but also other relevant issues and student experiences of the course, student problems and points of confusion. In the USA, however, unlike in the RSA and Nigeria, based on the data obtained from the evaluations, the SI leaders received constructive criticism from the SI coordinator. This helped them improve their facilitation of the sessions.

2.8. THREATS TO THE SUCCESSFUL IMPLEMENTATION OF SI FOR FIRST-YEAR MATHEMATICS STUDENTS

This section details threats to the successful implementation of SI for first-year Mathematics students.

2.8.1 Student lack of motivation and commitment

In a study conducted in the USA, the following were found to be the most common factors in students' low motivation to study Mathematics: poor study techniques, insufficient work, inadequate Mathematics background knowledge, boring

presentations of lectures, and a perceived lack of relevance of course content (Anthony, 2000:7-8).

In an effort to address the aforementioned issues pertaining to student lack of motivation and commitment which resulted in students not doing well in Mathematics, several strategies were undertaken. These included increasing academic time, designing curricular strategies to enhance interest in Mathematics, and designing and developing specific strategies to involve students in Mathematics-related curricular and co-curricular activities.

The creation of a curriculum that focused on conceptualising and creating meaning and relevance was also encouraged. The information about Mathematics and its utility in future courses and career opportunities in Engineering, for instance, were made available. Because attitude and interest also affected achievement, policies and strategies to improve attendance and participation in classroom activities were considered. Giving students assignments of appropriate homework was found to stimulate independent engagement in learning tasks. Furthermore, students needed to be given information and counselling about Mathematics and its future use. The Mathematics lecturers and SI leaders were encouraged to alter negative attitudes by promoting better classroom practices and providing positive experiences in the course (Singh, Granville & Dika, 2002:330-331).

2.8.2. Limited pool of students from which to find potential SI leaders

In a study conducted in the RSA, it was found that the students who became Mathematics SI leaders were usually those who were majoring in Mathematics and the number was usually too small to cater for such an extensive programme (Harding *et al.,* 2011:853). On the other hand, the number of students who enrolled for first-year Mathematics used to be more than a thousand and finding the number of SI leaders to cater for such a large number was difficult, since the pool was limited from which to select qualified and potential SI leaders. As part of the solution to address such a challenge the students who were appointed to serve as SI leaders were selected not only from the Mathematics majors but also

from cohorts such as Engineering, provided they had taken the course before and passed it well, so that they met the requirements of the programme (Gardner *et al.*, 2005).

2.8.3. Insufficient prior knowledge

According to Arendale (1994:2), SI is more challenging in content areas in which prerequisite skills are a key variable. For example, in the USA it was found that if students did not remember any algebra they would have learning challenges not only in Mathematics but also in other courses which require Mathematics as a prerequisite, such as Chemistry and Physics. Based on this, one could therefore say that prior knowledge is important because it makes it possible for students to learn effectively and promptly. According to Ambrosse, Bridges, DiPietro, Lovett and Norman (2010:12-13), the challenges have been that sometimes the instructors overestimate the students' prior knowledge and thus build new knowledge on a shaky foundation. Sometimes the students bring prior knowledge to bear that is not appropriate to the context and which is distorting their comprehension. Moreover, the instructors happen to uncover misconceptions and inaccuracies in students' prior knowledge that are actively interfering with their ability to learn new material.

As part of addressing insufficient prior knowledge, in Nigeria students were made to register for courses that were typically connected by an organising theme which gave meaning to their linkage. The reason for doing so was to engender coherent interdisciplinary or cross-subject learning that was not easily attainable through enrolment in unrelated, stand-alone courses (Tinto, 2005:2). For example, Mathematics and Chemistry are linked and students are able to apply the knowledge that they have acquired (from Mathematics) to balancing of the equation in Chemistry, where they also have to balance the chemical reaction equations.

A strategy that was also used to address the challenge in the USA was to engage students in Socratic Learning (SL). In this regard, redirecting of students' questions (RSQ) was used whereby the instructor, instead of stepping in to

answer them would ask if anyone else knew the answer. Other SL strategies were reciprocal questioning (RQ), an alternating question and answer process that helped students achieve deeper understanding of the course content, and concept mapping (CM), whereby students were exposed to a web diagram in order to explore knowledge, brainstorm ideas and organise large amounts of material (Painter, Bailey & Gilbert, 2006:74).

2.9. INDICATORS OF THE PROGRAMME'S SUCCESS

From the discussions above and also from the literature it is evident that SI has a positive impact on student learning and performance. There is substantial evidence that in a well implemented Mathematics SI, performance and the course grades of the students significantly improved (Etter *et al.*, 2000:356; Fayowski *et al.*, 2008:852), retention rates increased (Zeger *et al.*, 2006:66), and the attrition and failure rates reduced (Zaritsky *et al.,* 2006:23). There is also evidence that such an SI implementation increases student understanding of the course material (Gardner *et al.*, 2005), and that a well-executed SI plan can benefit all involved (Zeger *et al.*, 2006:63), helping students improve problem-solving skills, retain learned concepts and build frameworks for future learning (Ogden, Thompson, Russell & Simons, 2003:3). The SI evaluation shows that those who attend SI sessions show persistence more than those who do not (Hensen *et al.*, 2003:2).

2.10. CONCLUSION

This chapter has revealed the different approaches for the effective implementation of SI for first-year Mathematics students. It reviewed literature in terms of how SI is implemented in institutions of higher education in the RSA, Nigeria and the USA. The theoretical framework couching this study was explained and the justification for its suitability indicated. I defined and discussed the important operational concepts in the context of the study, namely, enhancing the functionality of SI for first-year Mathematics students at a higher education institution.

The next chapter presents the research methodology, design and data generation.

CHAPTER 3

DATA GENERATION ON ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

3.1. INTRODUCTION

In formulating a framework to enhance the functionality of Supplemental Instruction (SI) for first-year Mathematics students at an institution of higher education, the research design and methodology included Participatory Action Research (PAR) and its pertinence to Critical Emancipatory Research (CER) as a paradigm to supports the arguments of this study. This chapter outlines reasons behind the selection of PAR as a methodology for generating data and the conditions prior to the commencement of the intervention, including responses of the team during the brainstorming sessions on the refinement of the current situation. Discourses around the Strengths Weaknesses Opportunities and Threats (SWOT) analysis, identification of priorities, drawing up of an action plan and profiling of the participants are also outlined. Methods of data analysis will be briefly outlined as used in the next chapter.

3.2 METHODOLOGY

The following sections will provide a description of the methodology used to generate data in this study.

3.2.1 Defining Participatory Action Research (PAR)

Participatory action research (PAR) is not a new methodology for generating data but had been used for some time by theorists, such as Scherer nearly two decades ago. According to Scherer and Mckee (1993:3), PAR as a methodology is a deliberated, goal-driven, structured and applied means of obtaining

information, one that looks at informants not as passive providers of information but as active participants in the research process. For these theorists, PAR de-generalises the “generalisability of findings” in favour of localised individually meaningful action outcomes. According to Dold and Chapman (2011:512), it combines systematic research with the development of a practical intervention.

Jordan (2003:186) later noted that PAR has been traditionally a methodology of margins in at least two senses, firstly, as a research methodology that has rejected the ‘lore of objectivity’ which has characterised mainstream social science research, secondly, as a powerful approach for working with oppressed groups to better their circumstances within society. In this respect, PAR has promoted the interests of the poor and disenfranchised. Within a PAR mode the people who are usually excluded from the conversations and whose voices are not recognised in decision-making are also included, with the rationale that by voicing their perspectives they are going to better their own situation. Although not of high status, their inclusion was significant since they reported experiences that they could share and which were considered potentially useful for this study.

PAR is a methodology that humbles people, especially the powerful, as it disengages them from their ranks and prominence, thus making them equal with other groups otherwise perceived as less erudite. It has the power to make people feel welcomed, worthy and gratified and able to discover themselves in terms of the contributions they can make as well as the changes that they can effect towards the attainment of desired change. In this study, PAR helped me as a researcher to be less of an imposer (Heron & Reason, 1996:47) and more an enabler and an equal partner in attempting to bring about the desired change.

3.2.2 The relevance of PAR to this study

This study acknowledges that PAR is not the only methodology that can be used to collect data as there are others, such as quantitative and qualitative that could be used. However, since this study seeks not only to produce knowledge but also to change the status quo of the oppressed and to instil a sense of ownership to all involved, PAR was deemed pertinent. Unlike other research methodologies, it was

specifically chosen because it recognises that “no individuation is possible without socialisation and that no socialisation is possible without individuation” (Habermas, 1992b:26). This is a crucial point which this study values and upholds since no individual can make SI functional, rather it is a collective effort. The belief therefore is that through social interactions and deliberations we can devise effective strategies that will enhance the functionality of SI for Mathematics students. It is a process in which all individuals in a group try to grasp ways in which their knowledge shapes their sense of identity and agency and reflect critically on how their current knowledge frames and constrains their action (Kemmis & McTaggart, 2002:567).

People engaged in this study through conversations and thinking that their knowledge would be shaped as they learn and critically reflect upon what they will be doing. Dold *et al.* (2011:512) note that this type of collaboration is a powerful tool in effecting treatment outcomes for marginalised populations. Because of the inclusion of all the people and the value placed on the marginalised, one could say that, in PAR, participants are elevated and thus become co-researchers, not the researched. The researchers are lowered in their status and become the participants, hence all those engaged operate from the same power level, wherein nobody is superior in knowledge.

Unlike positivistic inquiry, which sees no scope for human value (Waghid, 2003:46), PAR acknowledges the experiences and views of the people and endorses their active participation within the research project. In opposition to conduct a positivistic enquiry, as an interpretive inquiry it views human beings as subjects of knowledge principally capable of reflection, rationality, discursive communication and social interaction (Kelchtermans & Schratz, 1994:244). According to Mbhele (2008:29), PAR as an approach is ‘warm’, since it concerns itself with human beings, interpersonal relations, personal values, meanings, beliefs, thoughts and feelings. It thus allows participants to interact and together observe events as they ensue. On the basis of these, PAR is an appropriate methodology for this study since it encourages active participation and involvement of all stakeholders who are affected by the issue being studied

(Azaiza, Hertz-Lazarowitz & Zelniker, 2010:271), with the aim of creating a space for power-sharing amongst participants.

Following the above, PAR as a methodology embraces and instils basic values that contribute towards the building of more cohesive humanities. It teaches the practitioners not to take glory to themselves but to acknowledge that other people are also capable of doing things and that their efforts can contribute significantly to bringing about the desired change. Nelson Mandela was known to value joint effort in the process of making change, and believed that *"together people can do more"*, which is in essence what PAR advocates. PAR thus cultivates the culture of working together, understanding others and respecting their views, thereby eliminating perpetual behaviours that lead to belittling knowledge of others, by promoting the affirmation of the significant contribution they can make towards making change.

Also couched by the CER framework, the study aimed at emancipating and providing a platform on which to transform one's situation, by overcoming perceived dissatisfaction, alienation, ideological distortion and injustices of oppression and domination (Kemmis, 2001:97). PAR, in line with CER, also seeks to emancipate people by promoting engagement within the research project and allowing voices to be heard and respected (Dold *et al.*, 2011:512). People can only be emancipated if they are engaged in the discussions that allow their views to be freely expressed on a platform that does not limit their social development or determination. One may conclude that CER is theory and PAR is CER in action, meaning that PAR operationalises CER. They both seek to liberate, emancipate and empower the people, provided they happen within a context of peace, hope, freedom, social justice and equity in its all forms (McGreggor, 2003:4).

3.2.3 The use of PAR in this study

According to Denzin and Lincoln (2000:573), PAR emerges in situations in which people want to make changes thoughtfully, usually after critical reflection. It transpires in situations in which people want to think realistically about where they are, how things came to be that way, and how in practice things could be altered.

PAR therefore initiates the need for change. Eruera (2010:2) writes that the beginning of a PAR project often occurs with a reflection when a group of people identify a thematic concern or issue and that is turned into a common goal. Participation therefore is obtained through this shared goal and desire to do something to resolve it. The PAR group will then construct the project with the researcher as they are experts of their own community. This commences with reflection and planning, including identification and clarification of the issue, who should be involved, how the research process should happen (including research activities), where it could take place, and similar issues. The next stages are action and observation, whereby the research process is trialled and reviewed with a pilot group from the community and feedback gathered as to its effectiveness, impact and outcomes.

In this study, after analysing the results of the students in all the courses which were part of the SI programme, I realised that first-year students who were taking Mathematics did not perform well. I then compared the Mathematics 1 success rates for the previous three consecutive years, observing that they were a cause for concern (*see* annexure A). I approached the Mathematics lecturers and students who also regarded such performance as distressing, and that they wished it could be altered. I proposed to them the idea of formulating together a framework that would help increase the students' chances of success. We then decided to involve other people who we thought would contribute significantly to the attainment of the purpose of the research project. Invitations to take part in the research process were extended to other lecturers who were part of the SI programme, students who were taking Mathematics 1, SI leaders (those who were facilitating Mathematics SI sessions and other courses which were also part of SI programme), programme heads and the support staff of the campus community.

Because PAR allows for the disenfranchised to be included and heard (Eruera, 2010:2), the invitation was also extended to the parents' representatives of the students who were taking Mathematics 1, Mathematics teachers from high schools, Mathematics subject advisors, members of association such as the Association of Mathematics Educators in South Africa (AMESA) and the Mathematics non-governmental organisation members (NGOs), so that they could

also take part in the research project of enhancing the SI programme's functionality aimed at improving the academic performance of Mathematics students.

3.3 THE UNFOLDING OF THE INTERVENTION

The following sections examine how the intervention unfolded starting with the conditions prior to the beginning of the intervention.

3.3.1 Conditions before the commencement of the intervention

Many structures, such as the offices of the social worker, the psychologist and student affairs were put in place in order to help students who were struggling. In 2007, the psychometrist was appointed to help students by providing the basic study skills that would enable them cope with their studies. Those included note-taking, listening, writing and presentation skills. In 2008, a career officer was appointed to provide career counselling for such students. Some lecturers provided extra lessons and opportunities for one-on-one sessions for students to improve academic performance. Despite those efforts, there was little or no significant improvement (UFS 2012 success rate document 2009-2011). Later in 2008 the SI programme was introduced as a response to students' failure and attrition rates in the modules generally perceived as difficult (for example, Sociology, Chemistry, Physics, English and Mathematics). All the modules introduced in the SI programme showed significant improvements, except for Mathematics. For example, the success rates for Sociology were 37.1% in 2009, 38.6% in 2010 and 73.8% in 2011. The success rates for English were 53.9% in 2009, 91.4% in 2010 and 81.7% in 2011.The success rates for Mathematics were 25.9% in 2009, 30.6% in 2010 and 19% in 2011. These Mathematics success rates made me realise the need to conduct this research.

3.3.2 Discussions with the coordinating team

The first forum for this research project was held on 28 June 2012, the agenda for which is shown in Annexure B. All participants were present but some appeared a little bit perplexed. One of the students asked if they would be able to communicate their views, since they were not used to having meetings with such "qualified and educated people". He indicated that he was intimidated by their presence. On the same note, one Accounting lecturer asked what contribution the Accounting lecturers were going to make since they were not offering Mathematics. He ended by saying that such an intervention was supposed to focus only on Mathematics lecturers and students and not them. The Teaching and Learning Manager (TLM) was present in that forum also as a participant, and because she was conversant with the principles of PAR she started to give a brief lesson on PAR. She highlighted the principles of PAR by making reference to what the whole team would be expected to do. She further emphasised the value of PAR that lies with the inclusion of all the people in making a change, and what Kemmis and McTaggart (2000:563) believe to be vital for participants engaging in PAR, that is, to affirm the participants' worth and valued contributions to the research project by allowing them to join as the co-participants in the struggle to remake the practices in which they interact in order to bring about the desired change. She further pointed out that answers would not always come from "the lecturers who are normally perceived as custodians of knowledge", but the students could also contribute significantly to the success of such a research project since they were the ones being taught and the ones for whom the intervention was being designed. She pointed out that the main reason behind the arrangement of seats round the table was to promote equality, because nobody would stand in front of others lest they showed a sign of knowing more than them. The presence of such a person in the team made things easier.

One of the teachers was happy about the brief lesson she gave, consequently commenting: "*One of the reasons Outcomes Based Education did not succeed in schools, was the fact that it was designed by the practitioners alone, up there without involving other relevant stakeholders down there. Such stakeholders were only involved during its implementation. They never owned it but only implemented*

it just to secure their jobs even though they did not understand it". He realised that in this project, unlike in OBE, they were involved from the commencement, the planning stage, of the project, not only when they were expected to implement it. He ended by commending the thought behind the use of PAR for this research project and acknowledged that its success would also be theirs. All the participants then seemed to be at ease and indicated that they understood their roles in the whole process and that they were more than willing to help make the research project a success. The Accounting lecturer who initially wondered as to what their role and contributions were, indicated that although he was not offering Mathematics he was also affected because there were some sections in Accounting that require students to apply Mathematical knowledge. He then realised that by being part of the project he was going to contribute to the success of the Mathematics students and help students do well also in Accounting.

As all the participants understood the principles of PAR I took the opportunity to acknowledge their presence and affirm their highly valued contribution to altering the current situation. I explained the purpose and objectives of the study to the whole team, to ensure that in all the discourses in which we were going to engage we would not lose focus. I then highlighted what I perceived to be the problem by showing them the institution's previous consecutive three years' success rates. We all agreed that Mathematics 1 students' poor academic performance was a serious problem that needed to be addressed. One of the participants indicated that Mathematics was one of the subjects that were challenging for most students, not only at the institution under study but also globally, and that students must be supported in order for their chances of success to increase. The participants indicated that if that could not be addressed it would be difficult to find potential Mathematics teachers in future, or Engineers. It was also highlighted that the consequences of lack of Mathematical skills affected other courses in which Mathematical knowledge is a prerequisite, such as Accounting, Economics, Chemistry, Physics, Geography and Statistics. The language lecturers also pointed out that if students cannot master Mathematics as a subject then it becomes difficult for them to reason and to make logical arguments in their presentations.

These were some of the points which led to a proposal that we meet as a team on 9 July 2012 to discuss challenges in the implementation of SI and brainstorm possible solutions (*see* Annexure C for agenda) to the following question:

> ***How can the functionality of SI for first-year Mathematics students be enhanced?***

Before we began with the discourses, one of the subject advisors recommended that the performance of the students in the Natural and Agricultural Sciences (NAS) be compared with that of the ones in the Economic and Management Sciences (EMS). This would show how widespread the problem was, whilst indicating which students were struggling in more than one area and what could be done to support them. The head of the academic division, who was also the participant, then promised to provide statistics in the next meeting.

The participants proceeded to share their views on how the functionality of SI for Mathematics students could be enhanced. Teachers from the performing schools shared their successes with the rest of the team and those from the poor performing schools shared their experiences. The learning facilitators compared the performances of the different schools and shared their experiences as well as the strategies they use in schools which were not performing, in order to improve the performance of the students thereof. They outlined what they believed to be possible winning strategies that could increase Mathematics students' chances of success. The team members specified contributions that they could make towards the enhancement of the programme's functionality. The first-year Mathematics students and the SI leaders presented some scenarios to the brainstorming session. They portrayed the winning strategies for improving the students' academic performance through dramatisation. For example, one of the scenarios read as follows: "*You are the SI leader and the students attending your SI session are passive. How would you engage them in solving problems*?"

Description of dramatisation (how the dramatisation was carried out)

Introduction

i. The students were seated in small groups (set-up of the class).
ii. The SI leader recapped on what happened in the previous SI session.
iii. The SI leader introduced the topic that needed to be discussed on that day.

Discussions

iv. The SI leader asked questions in order to initiate discussions
v. Students did not respond to any of the questions.

Solving a problem

vi. The SI leader applied a strategy to solve the problem (here the SI leader showed how he deals with such a problem).

After the dramatisation

The SI leader explained to the team:

i. What the problem was
ii. Why it was a problem
iii. Why it was supposed to be solved
iv. How it was solved
v. Why it was solved that way

All these were explained with reference to the specific actions during the dramatisation. For example, the distribution of worksheets and assigning of tasks to every student in the session was done as a strategy to engage the students in problem-solving and to encourage participation in class. The winning strategy in this scenario was to make students participate and through participation enable them to learn and better understand the course content, affirming the views of Fritschner (2000:351). At the end of that brainstorming session, which lasted for almost four hours, the team agreed to meet on 18 July 2012 in order to engage in

the SWOT analysis, for identification of priorities and the drawing up of an action plan.

3.3.3 Proceeding with the SWOT analysis

The agenda for the meeting that was held on 18 July 2012 is shown in Annexure D. The minutes of the previous meeting were read by one of the students who were part of the coordinating team in order to reflect on the discourses. The minutes were adopted as a true reflection of what transpired in the brainstorming session. Before the team could engage in the SWOT analysis, one of the learning facilitators indicated that his involvement in the research project had made him realise the importance of engaging different people in the process of changing the situation. He indicated with much enthusiasm that he liked PAR and proceeded to say that he intended to adopt it, in order to try to address poor academic performance of learners in one of the schools that fell under his supervision. On that same note, one of the honours students who were also part of the team added that he was going to choose PAR for his master's degree in the coming year. One of the educators asked to be provided with more notes on PAR and the Teaching and Learning Manager promised to give them to all, with a promise to invite them to workshops that she normally organised on PAR. The smiles on all faces after this assurance showed that the team members acknowledged the value of PAR. This was evidence that PAR empowers, liberates, educates, and transforms the lives of people for the better (Jordan, 2003:186).

The team then engaged in a SWOT analysis of the SI programme and of the team itself. It was used as one of the reflective steps which, according to Kemmis and McTaggart (2005:563), involve spiral self-reflective cycles, namely, planning change, acting and observing the process and consequences of change, reflecting on the processes and consequences, then re-planning, acting and observing, reflecting on these processes, and so on. The points derived from the SWOT analysis are discussed in Annexure E. It was after long deliberations on the SWOT analysis that people became more aware of the vital role they were playing in the research project. Participants were more ardent about participating in a mutual

effort to enhance the functionality of SI for Mathematics students. There was a suggestion made by one of the participants, that we adjourn the meeting and set up another on the identification of priorities and drawing up of the action plan. The rationale was for the people to reflect on the SWOT analysis and be able to identify priorities in order of significance. All agreed with the suggestion and the team agreed to meet on Friday 20 July 2012, the same week. It was just after that agreement that I realised how committed the team members were in making the project a success.

3.3.4 Identification of priorities and drawing up the action plan

The team duly met on 20 July 2012 as agreed (*see* Annexure F for agenda). The participants identified five matters to be addressed (identified as possible weaknesses) in order of priority:

i. Coordinated plan
ii. Articulating the vision clearly and ensuring its ownership
iii. SI leaders' capacity development on content
iv. Lecturers' capacity development on SI techniques
v. Effective use of instructional strategies and student engagement

Following the identification of the priorities, the action plan, that included the identified priorities, to help achieve the objectives of the study was also drawn up (Annexure G). It indicated the activities to be carried out, persons responsible for carrying them out, the resources to be used in order to perform the activities, the stipulated timeframes and the evaluation.

3.4 DATA GENERATION

This section describes the various methods by which data was generated.

3.4.1 Participant profiling

Ross (2010:Online) notes that profiling the right participants is the foundation of effective user research, because the results are only as good as the participants involved. He considers representative, well-spoken, and thoughtful research participants as important since they provide invaluable feedback, however, even though such participants can be helpful for a research project, finding and recruiting them and getting them to show up for their sessions is sometimes difficult. This therefore means that profiling is significant in making a research project a success and it has to be done for the research to produce the desirable results.

In line with this notion, Eruera (2010:1) notes that PAR, as an approach, requires active research participation and ownership by people who are motivated to identify and address issues that concern them. Therefore, research tasks and issues are co-constructed and informed at all stages by the identified participants from that community. This is significant because the experts can then extract information from a community and use it for purposes which will directly benefit that community. Dold *et al.* (2011:512) argue that PAR as a methodology should draw on the knowledge of the user population to identify problems, tailor treatments and disseminate the results. Bearing this in mind, the Mathematics lecturers and I identified the people who we thought would significantly contribute towards the attainment of the purpose of the study. These were the ones who had expertise in their own fields and were affected by the current situation. The participants who were selected to take part and their contributions to the research project are shown in the table below.

Table 3.1: Profile of research participants

Participants	**Contribution**	**Experience**
Mathematics lecturers	They know the challenges that students encounter in class. They are to carry out the action plan by making it a reality.	They have extensive teaching experience (10 – 15 years in the field)

Motivational speaker	He is able to motivate students – make them perceive Mathematics not as a difficult subject but as a subject that one can pass through hard work. He is able to instil a self-fulfilling prophecy that will make students see themselves beyond their current level.	He has graduated in the field of Psychology. He also holds honours' and master's degrees in Psychology. He is a motivational speaker at national level. He is usually called to present motivational speeches over the radio. He is also the author of two best-selling motivational books.
Psychometrist	She provides study skills (e.g., note taking) and developmental skills (e.g., self-confidence) using psychometric measures. She has been doing this for more than five years.	She once worked as a facilitator for a Skills and Competency for lifelong learning module. She is working in a private organisation as a psychometrist where she assesses school readiness and provides subject and career choices. She is also employed at the University as a psychometrist. She provides students with both academic and developmental skills.
Social worker	She provides social support by identifying social factors that affect academic performance. e.g., family problems, domestic violence, drug abuse, financial matters.	She has 11 years of experience in the field of social work. Two years non-governmental organisation (NGO), five years at a social development department and four years at the student counselling of the university. She is registered with the South African Council for Social Services (SACSS), and the South African Association of Social Workers in Private Practice (SASWPP).
Mathematics subject advisors	They know what is happening inside Mathematics classrooms. They were once teachers and now supervisors. They work with different schools and are able to share and compare their achievements as well as the winning strategies used by the performing school management teams. They taught mathematics for a period of more than 12 years.	They were previously employed as mathematics educators. They were later appointed as the heads of the Mathematics department. One of them was also appointed as the deputy principal at one of the most reputable and performing schools in Science and Mathematics in the Thabo-Mofutsanyane district. He is now working as the subject advisor for Mathematics in the

	They were once heads of departments.	Department of Education.
Mathematics educators	They meet with learners daily. They know the challenges that mathematics learners have. They also know how learners think within Mathematics classrooms and they can help such learners to overcome their challenges.	They have long teaching experience (10 – 20 years in the field) They also have lengthy experience of marking centre.
NGO Mathematics facilitators	They were once educators at school settings but now in different set-ups. They are able to address the problems that Mathematics students face in class. They can also motivate Mathematics students. They also train mathematics teachers on content development.	They have extensive teaching experience (10 – 20 years in the field). They also have a long experience of marking centre. They have been working at the non-school setting for a period over five years.
Career officer	He provides career development, guides students towards making transition through personal branding. He can provide job hunting and interviews skills and also be able to frequently engage these students through the workshop seminars on career guidance. He will keep students abreast of the most exhilarating mathematics careers they can pursue.	He has 12 years teaching experience and he is now working as a career officer.
Ex-subject advisors	They will be able to work with Mathematics lecturers and to constantly provide them with advises that will significantly contribute towards the refinement of the students' academic performance. They will also advise them on strategies they can employ in class in order to make students find mathematics interesting. They once worked as educators for mathematics. They were once appointed as the heads of the department (Mathematics). They were further appointed as the	10 – 20 years of experience

	deputy principals. They are no longer working but contribute when necessary towards the sustainability teaching and learning of Mathematics.	
Mathematics and Science extended programme coordinator	She is able to bridge the gap between the students' mathematical knowledge of high school and tertiary. She once worked as the educator for Mathematics for 15 years. She was appointed later as the head of the department (Mathematics). She worked at the most reputable schools in terms of	Students' academic performance.
Accounting lecturers	They teach accounting which requires Mathematics as a prerequisite. Some of them once taught Mathematics and they will be able to provide basics skills required in order to help these students cope within the commercial classes.	They have 10 – 20 years of experience in the field of teaching.
Economics lecturers	They teach Economics which requires Mathematics as a prerequisite. Some of them once taught Mathematics and they will be able to provide basic skills required in order to help these students.	They also have 10 – 20 years of teaching experience.
Chemistry lecturers	They teach Chemistry which requires Mathematics as a prerequisite. Some of them once taught Mathematics and they will also be able to provide basic skills required.	They also have 10 - 12 years of teaching experience.
Mathematics SI leaders	They lead Mathematics SI sessions. They will among other things, report on the progress that students will be making so to help the team see if the intervention is really working or not.	Some have three years' experience of facilitating Mathematics SI sessions and some have two years. They have had good marks in the module they are facilitating.
Mathematics1 students	These are the people whom the intervention is designed for. They have to be part of this team as they can be able to share the problems they	90% of these students are doing this course for the first time. 10% of these students are repeating the course.

	encounter in some of the Mathematical concepts. They can also be able to suggest what could be done in order for their problems to be addressed.	
Centre for Teaching and Learning (Manager)	This is the person who heads the SI programme. She is conversant with the principles of PAR and can contribute significantly to this study. All the SI matters are reported to her.	She holds a doctoral degree. She worked as the head for Centre for Higher Education Studies and Development (CHESD) and now for the Centre for Teaching and Learning.
Parents' representatives	These are the people who have close relations with the parents of these first-year Mathematics students. They therefore have to take part in this project as they can be able to instil motivation in students and also be able to report to the parents on the progress of their children after the implementation of this intervention strategy.	The other one is a reverend. He is known for the things he does for the community. The other one is a representative from the municipality. He is in close proximity with the parents and is also looking out for the parents' interests.

3.4.2 Data generation procedures

Angrosino, Barbour, Flick and Kvale (2007:8) aver that if a researcher wishes to know and understand how people understand their world then the researcher needs to talk to them in person. According to these authors, the researcher will be able to understand how these people understand their world through intense discussion processes and by listening to what they are saying about their world using their own words and interpretations. For this reason, data needed to be generated through discussions that involved these people and which required their participation. According to Eruera (2010:3), in PAR there are many methods and activities that can be used to maximise active participation and achievement of a depth of data generation. He further notes that there are wide variations in PAR and that some do not look like research at all. However, these PAR projects most often use PAR groups and include a range of information gathering methods, such

as community theatre, focus groups, brainstorming, group activities and individual exercises.

Since this study sought understanding of what people say about their own world and how they make sense of it, a platform was created that allowed the participants to tell about their experiences, fears and hopes. This platform helped us move away from discovering knowledge through primarily external observation and experimental manipulation of human subjects, to conversations in which human beings could be understood (Thusi, 2004:39). I believed that, although conversations are regarded as vital means for understanding how human beings make sense of their own world, it is equally vital to note that such understanding can be reached provided that the level of participation is encouraged. Taking this into consideration, in this study we used brainstorming as an activity for maximising participation and for generating data. The question, "*How can we enhance the functionality of SI for first-year mathematics students?*" was asked in order to initiate conversations during the brainstorming sessions. Through the exchange of ideas and intense deliberations captured through the electronic devices, data was generated, as well as through dramatisation.

All our meetings and brainstorming sessions took place in our usual venue since it provided us with comfortable seating. Since there were different languages being spoken the agreement was for us all to speak in one language with which we were all comfortable, English. All involved were told in advance about the nature of the research meetings and the appropriate ethical research principles were observed. All the participants gave their informed consent and the forms were signed. I made them aware that they were not forced to participate in the study or to respond to any question. At the same time I had to also explain the rationale behind the use of a tape recorder, which was for the purpose of accurately recording the conversations for later transcription. Since the participants engaged in verbal deliberations that came with different meanings, Critical Discourse Analysis (CDA) as a tool was used in order to make sense of the generated data (Fairclough, 1992:95; Van Dijk, 2009:62-85). The tape-recorded discussions were transcribed word-for-word, in order to make sure that people were not misquoted. At a later stage, when the data was interpreted, the participants were consulted in order to

allow them to check if the interpretation provided was indeed what they were saying. The participants were further promised that their conversations would be kept safe and the transcripts destroyed after six months.

3.4.3 Instrumentation

According to Krishnaswamy (2004:1-8), for a PAR project to be successful, the research partners need to have an understanding of its extensive goals. He advises that the researcher's goals be elucidated so that they can be related to those of the other members of the team. This means that without a clear sense of what the research project is trying to realise it will be difficult to formulate a practical and effective participatory research project. The participants and I therefore developed a common vision which would guide us towards the accomplishment of our research objectives. We then agreed upon meeting in our convenient venue for discussions, forums and brainstorming sessions on how to enhance the functionality of SI for Mathematics students.

Through discussions we were able to generate data, however, when people engage in the discourses it is important to note what they are saying in order to report on it. Assigning one to minute the conversations does not guarantee that everything will be noted. Interruptions occur during discussions and the pace at which people are talking can hinder the process of taking notes. Niemann and Brynard (2008:16) maintain that while a participant is talking the conversations must be recorded. However, they advise that in order to use the devices that will capture the data, permission first be sought from the participants in order to do so and that they should state that they do not have any objections. They state that recording of such conversations will enable people to be heard, especially because their words will be transcribed verbatim. In this study, I therefore used devices tape recorders, voice recorders and video recorders, with the participants' knowledge. However, I first explained why such devices needed to be used and sought their permission to use them.

A question was asked during the brainstorming session in order for the participants to engage in the discussions, namely: *How can we enhance the*

functionality of SI for first-year Mathematics students? Participants then freely deliberated on this question. We used the data collection instrumentation in line with the objectives of the study presented in chapter 1.

3.4.3.1 To explore the need to formulate a framework to enhance the functionality of SI programme (First objective)

To address this objective, we carried out the following:

i. Brainstorming sessions:

- Brainstormed ideas on how to formulate such a framework as we realised that there was a need for such a framework to be formulated.

ii. Forums:

- Discussed the need to formulate such SI framework.

3.4.3.2 To identify and analyse the components that constitute a functional SI framework (Second objective)

i. Observations:

- Observed the proceedings within the SI thereby identifying what could constitute a functional SI.

ii. Document analysis:

- Looked at the previous intervention documents to find out what happened in terms of making SI functional. Found out who the key players were, what did they do, how did they do it, and how long did they do it.

iii. Discussions with the previous implementers:

- Discussed with those who knew about the programme in order to find out more about what could constitute a functional SI.

3.4.3.3 To understand the conditions conducive for enhancing the functionality of such an SI framework (Third objective)

i. Observations:

- Observed carefully the operation of the programme, identifying what did not work and finding solutions thereof. Through observations we were able to realise and identifying conditions under which the programme could operate and produce the desired results.

ii. Discussions

- Discussed with the different people who were involved in the programme in order to establish what could be done to refine the situation.

3.4.3.4 To recognise and anticipate the possible and plausible threats so as to put in place the risk management plan for the successful implementation of the SI framework (Fourth objective)

i. Discussions

- We had discussions with various stakeholders within the programme in order to discuss the plan to enhance SI for mathematics students. Through intense discussions we were able to identify factors that could impede our plan of enhancing the functionality of SI.

ii. Brainstorming

- Brainstormed on what could possibly go wrong during the implementation of such SI framework.

3.4.3.5 To provide evidence of the successful implementation of SI (Fifth objective)

i. Observation and feedback form

- Observed what SI leaders did in class and recorded what happened on the form so to provide feedback to the SI leader.

iv. Class visits

- Visited classes unannounced just to check whether SI sessions were taking place and also to check whether the sessions were carried out in adherence with the SI principles (i.e. active collaborative principles).

v. Evaluation form

- Evaluated SI leaders on a quarterly basis.
- Evaluated the functionality of the programme on half-yearly basis.

3.4.4 Ethical considerations

Cohen, Marion and Morrison (2007:133) and Henning, Van Rensburg and Smit (2004:96) note that for one to gain access to research sites and the participants it is important to ask for permission to do so. Therefore, the directives laid out by the University in terms of respectful research were observed and operationalised. Permission to conduct research was sought from the office of the campus principal and was granted. All the participants were requested to act of their free will and were treated with respect and dignity throughout. The participants were anonymised, the right being respected both where it had been promised explicitly and where no clear understanding to the contrary had been reached. The conditions of anonymity applied to the collection of data by means of cameras, tape recorders and other data gathering devices such as voice-recorders, as well as to data collected face-to-face or through participant observation (Opdenakker, 2006:3).

During the first forum, the participants were given consent forms to read, understand and sign. They were promised that the data would be anonymised and kept safely for a period not exceeding six months and thereafter be destroyed as is normal practice in research (Mkhwanazi, 2007:30; Smith, 2003:56). The study was ethically cleared by the University Ethics Board (*see* paragraph 1.7).

3.5 DATA ANALYSIS

In this section I provide a brief outline of the technique I used to analyse the generated data namely, CDA and its linkage to CER as the theoretical framework couching this study. Bloor and Bloor (2007:2) define CDA as a cross-discipline that encompasses the analysis of text and talk in all disciplines of humanities and social sciences. The use of CDA was deemed appropriate since the aim was to understand meaning and also make meaning (Fairclough, 2013:3). We transcribed data which were recorded for coding word for word, as Monyatsi, Steyn and Kamper (2006:219) recommend. The use of CDA was also to help in analysing verbal exchanges (and cues) captured on video cameras during the process of generating data. It was deemed critical because when people engage in a discourse they use different texts that could be interpreted differently in different contexts. For example, in Sesotho if someone says: "*ke lapile*" (I am hungry), it could mean 'I'm hungry', or 'I'm broke', or 'I'm lonely', depending on the context in which the words are used. The use of CDA would therefore help us understand meaning in different contexts, for example at textual, social and discursive levels. Mahlomaholo and Nkoane (2002:5) also encourage the use of CDA since it helps us understand how society influences what we say and do.

The use of CDA in this study was also motivated because together with CER they seek to expose the power relations, dominance and inequalities which are enacted and reproduced by text and talk in social and political contexts (van Dijk, 2009:352). In this respect, one could say that CDA complements CER since they both advocate similar values, such as peace, hope, freedom, social justice and equity in all their forms (McGreggor, 2003:4).

3.6 CONCLUSION

This chapter has discussed PAR as the methodology used to generate data. It further outlined the relevance of PAR for this study as well as its relevance to CER as the theoretical framework that supports the arguments. The conditions prior to the commencement of the intervention, how the discourses with the team unfolded as well as the profiling of the participants also received attention. The data

collection procedures and instrumentation were described as well as their applicability to CER as the theoretical framework. Lastly, the chapter provided a brief highlight of data analysis.

The next chapter will give detailed presentation, analysis and interpretation of data generated in this chapter. The level of data interpretation will be extensive and consequently reveal what is new about the study and the difference this study will make in the lives of the people.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND INTERPRETATION ON ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

4.1. INTRODUCTION

This study sought to formulate the framework for enhancing the functionality of SI for first-year Mathematics students at an institution of higher education. This chapter focuses on how the data was analysed, interpreted, presented and discussed, in line with the objectives of the study. The data generated during the forums indicated the need for the formulation of the envisaged framework. The challenges regarding the implementation of SI included lack of coordinated plan; an SI vision which is not clearly articulated and owned by students; and SI leaders' inability to apply effective teaching strategies and student engagement to promote learning and student understanding of the course. The solutions to the challenges are also addressed in line with the objectives of the study and include the establishment of a coordinated plan, clear articulation of the programme's vision, the use of effective teaching strategies and student engagement.

The conditions conducive to enhancing the SI's functionality for Mathematics students were also identified, amongst which were cooperation between the SI leaders and the lecturers that made it possible for the coordinated plan to be established; the establishment of a common vision to guide all the team members; more awareness of SI vision which led to it being owned by the students; the expertise of the people who provided content capacity development to the SI leaders; as well as the expertise of the person who provided the SI leaders with capacity development on effective instructional strategies and student engagement.

The chapter also explores the possible and plausible threats, such as student lack of motivation to learn Mathematics; insufficient student prior knowledge and the shortage of potential and qualified Mathematics SI leaders which could hamper

the programme's functionality; and measures which were put in place in order to evade those threats. The chapter also presents actions and strategies that were then developed and prioritised for implementation of SI and subsequently operationalised as part of enhancing the functionality of SI for Mathematics students.

4.2. CHALLENGES TO THE IMPLEMENTATION OF SI

In this section, challenges to the implementation of SI are discussed in detail. These are the challenges pointed out by the participants during the forums, brainstorming sessions and meetings which were organised. According to the participants, these were the challenges which hampered the SI's functionality and resulted in the first-year Mathematics students not benefiting from the programme. The participants' desire for a framework to be formulated was therefore informed by these challenges. The section deliberates on the main five challenges as indicated by the participants.

4.2.1 The absence of a coordinated plan

According to SILMG (2013:10), SI is only offered with the support of the lecturer, who is expected to meet with the SI leader in order to plan together the session and for the uncertainties he/she may have regarding the material to be discussed and clarified by the lecturer. It is in such a meeting that the SI leader would show the lecturer the hand-outs he/she plans to share with the students during the SI session and the lecturer would then help the SI leader by making them more appropriate to the course material. This kind of plan thus enables the SI leaders to know what to do during the sessions in terms of how to help students effectively with certain concepts and when to apply certain strategies that would help students understand the concepts. Although the guideline encourages this kind of a plan, the participants' utterances during the forum wherein the challenges were identified indicate that there was lack of coordinated plan which caused the programme not to be functional. The participants commented as follows:

Pule: The most frustrating thing is that we do not get to meet with the lecturers to discuss what needs to be done during the sessions. Our lecturers do not make time for us to meet with them in order to prepare for the sessions. When we personally go to ask them about what needs to be done, they tell us that they do not have time as they are busy with other stuff.

Dineo (interrupting): *That's true. I also encountered the same problem. I always find myself having to go to class not knowing what to do. Mhhhhm! But then what can we do? We have to attend sessions anyway!*

Lerato (also interrupting): *This is problematic because sometimes students ask questions which I am not prepared to answer at that time. I feel embarrassed and useless because it then looks like I do not have what it takes to be an SI leader. Students also doubt my ability and do not respect me as their SI leader.*

The above extracts show that there was an absence of coordinated plan within the programme. Judging from the words of SI leader (Pule), "*even when they personally go to ask their lecturers about what needs to be done during the session and they respond by saying that they are busy with other stuff and that they do not have time*" it was clear that the lecturers were aware that they had to help the SI leaders with the planning of their sessions. Evident from Pule was that lecturers did not take SI seriously and that it was not a priority in the list of the things that they needed to do, hence they hesitated to help them with the planning of the sessions.

In agreement with Pule, both the second and the third SI leaders (Dineo and Lerato) confirmed that there was no coordinated plan. Dineo said that as a result of not being provided with the plan to carry out during the session with the students by the lecturer, she found herself having to go to class not knowing what to do. On the other hand, Lerato found herself in a position in which she could not answer the questions that students asked her as she came to class without a plan. She added that as a result it looked as though she did not have the capability to facilitate the session. The SI leaders' viewpoints indicate that there was no plan

that served as a guide for what they needed to do during the sessions. Since they were expected to facilitate the sessions they did what they thought they could do at the time they were with the students, as a result finding themselves dealing with different topics that did not link to what the lecturers were doing, and that led to students' confusion.

The feelings portrayed by the three SI leaders (Pule, Dineo and Lerato respectively), namely, " the ***most frustrating***…"; "I always find myself having to go to class ***not knowing*** what to do"; and "***I feel embarrassed and useless***" (my emphasis) clearly show that there was no fairness prevailing. The SI leaders' feelings were as a result of receiving no support from the lecturers. They regarded their value in presenting SI in a meaningful manner as dependent to the support of the lecturers who in turn could not provide it. The SI leaders therefore disliked the act of not being supported by the lecturers and regarded it as unfair as it deprived them of an opportunity to lead effective SI sessions that benefited the students. What I also realised was an element of unequal power relation which caused one of the SI leaders to feel as though she was "*useless and not worthy*". For instance, the SI leaders in that case expected to have a plan to follow in conducting their sessions and that was supposed to be made possible by the lecturers who served as their mentors in helping them facilitate effective sessions. However, lecturers seemed not to be helping the SI leaders by providing them with the plan as expected and as a result, that made it difficult for the SI leaders to carry out their tasks as expected. The SI leaders in that case thus felt "*marginalised by the lecturers and also helpless*" as they did not have any power to stand against or challenge what they were doing to them hence the second SI leader's comment "*there is nothing that we can do*".

As the participants were busy deliberating on this challenge, two crucial issues were raised by the Mathematics SI leader and lecturer respectively:

> *Pule: For as long as we do not plan together, I don't see bad Mathematics results changing anytime soon.*
>
> *Ms Nala* (interrupting): *I agree with you although my case is different. I provide specific topics to my SI leaders in order to help students with on a*

weekly basis and ask them to provide me with feedback. They have never done that until today! I have been preaching this for a long time and I do not know what to do anymore.

Pule's words *"For as long as we do not plan together, then I do not see bad mathematics results changing anytime soon"* were an indication that his hope that the results would be better relied heavily on the establishment of a coordinated plan which seemed to be absent since the lecturers and the SI leaders did not meet in order to draw it up. The point he made was that, without their mutual working in the establishment of a coordinated plan there was no hope that poor results would be altered and that SI would not be presented in a meaningful manner to the students as a result of its absence.

In the same breath, the SI leader's referral to "*we*" in his statement made me realise that the SI leader as a participant was aware that altering the students' poor performance in Mathematics required a collective rather than an individual effort, which is a point advocated by this study. Ms Nala (the Mathematics lecturer) on the other hand brought in another picture that made all the participants realise that it was not only the lecturers who were supposed to make it possible for the coordinated plan to be established, but also the SI leaders as the key role players in the programme, thus agreeing with the SI leader's notion: *"For as long as we do not plan together, then I do not see bad mathematics results changing anytime soon"*. The lecturer further explained that as a result of not receiving any feedback from the SI leaders as she requested, she did not know what to do in order to fully support them.

Ms Nala reported that she requested her SI leaders to provide her with feedback regarding students' progress but that the SI leaders had not done so. Ms Nala thus felt upset by what her SI leaders were doing, hence she raised that point in the meeting. From her words: *"I have been preaching this for a long time and I do not know what to do anymore"*, it was clear that she had been asking for a feedback for a long time and felt this was unfair. It deprived her of a chance to see where students needed her assistance. Although she very much wanted to help not only the students but also the SI leaders, she could not do so as she was not provided with feedback by the SI leaders whom she regarded as the mediators

between her and the students. One could then say that Ms Nala was not at peace as she waited for long without the feedback she required and came to look like one of the lecturers who did not provide support to the SI leaders. While she was trying so much to assist she was only disappointed by her SI leaders.

From the above discussion it is evident that the absence of a coordinated plan makes it difficult for SI leaders to know what to do during the sessions. This thus makes them unhappy as they do not have an idea of what to do. Although this is the case, the absence of a coordinated plan cannot only be blamed on the lecturers. SI leaders can also make it difficult for the lecturers not to receive meaningful feedback that could make it possible for the coordinated plan to be established.

Drawing from the discussion above, it is also evident that when the SI leaders and the lecturers do not work together it is difficult for a coordinated plan to be established. As a result, harmony would not prevail as others (lecturers) would feel that they are deprived feedback whilst others (SI leaders) would feel that they are not receiving sufficient support. On the basis of all these factors, the participants were in agreement that lack of coordinated plan prevented SI from being functional and as such needed to be addressed.

4.2.2 Lack of an articulated SI vision and ownership

According to Halligan and Donaldson (2001:Online), a well-led organisation knows how the vision and values are being communicated effectively to all involved. Therefore, such communication will give those involved a common and consistent purpose and clear expectations. Clarkewood Consulting (2011:Online), in line with this, adds that it is important that these statements are not just words stuck up on posters without explanation. Every employee needs to be aware of the words but more importantly the meaning, the energy and the source from which these statements came. Only then is it possible for all to work together in one direction for a common goal. Deducing from this it is evident that the vision needs to be clearly communicated to all involved so that all the people can understand what it

means. The people's understanding in this case would therefore make it possible for all to own up to the vision and make the programme a success.

Although literature shows the significance of clearly articulating the vision and owning it, the participants during the forum in which the challenges were discussed pointed to lack of articulated vision and ownership as another cause of SI not being functional:

> *Dika: We were told about the SI programme at the beginning of the year and later on we were told that we can attend sessions when we encounter the challenges. Hmmm! To be honest, I still do not understand who should attend and who shouldn't.*
>
> *Jabu: I also do not fully understand what the programme is all about and I think this is the reason why other students do not attend even though some provide other reasons for not attending. They are probably confused as I am.*

Drawing from what Dika (Mathematics student) was saying, it looked as though students were only informed about the existence of the programme and little was said to them, which is probably why "*she still does not know who should attend or not*". On the other hand, it sounded as if students were provided with information but later given contradictory messages: "*We were told about the SI programme at the beginning of the year and later on we were told that we can attend sessions when we encounter the challenges"*. In this case, if there was an explicit communication of what the programme was about and stood for then the students would not be confused and not know who should attend.

Jabu (SI leader) agreed with Dika, that he also did not have full knowledge of what SI was intended for. He pointed out that most students did not attend the sessions and that he thought it was because they also did not understand what the programme was intended to achieve. Listening carefully to what Jabu was saying, it sounded as if students' lack of understanding the vision was the main reason they did not attend the sessions, although there were other reasons they pointed to. The point highlighted by Jabu in this case is similar to the findings highlighted in chapter 2, that as a result of students being unclear about the programme's

vision they provided various excuses as to why they were not attending the sessions.

What was different here from what was highlighted in chapter 2 (2.5.2) was that not only the students seemed unclear about the vision which was not clearly articulated, but also some of the lecturers. This emerged clearly from what the Mathematics lecturer said:

> *Ms Nala: …I had to take over his responsibilities. I was told that he was also involved in the programme and that I also have to be involved. I must just be honest with you guys, I do not know much about the programme. My SI leaders do come to my office and we do preparation together. I don't even know if we prepare correctly or not.*

It was clear from this response that her involvement in the programme was just an imposition, since the person from whom she took over the responsibilities was part of the programme. She was informed neither about the programme's operation nor about its vision. However, just because she was appointed to the position of someone who was part of the programme she found herself having to comply with what was required of her. Her state of not knowing anything about the programme's vision to some extent would mean that she did not own it. She did what was expected of her without putting in much effort hence her utterance "*My SI leaders do come to my office and we do preparation together. I don't even know if we prepare correctly or no*t". This means that she helped her SI leaders only because it was expected of her to do so and not necessarily because she understood the programme's vision or owned it.

It is common in society that when one is entrusted to do something one would just do what he/she is expected to do, not because the person understands or owns the vision but because he/she is expected to do so, and because he/she does not have a choice. In such a situation, therefore, the person cannot show commitment and ownership or ensure high quality standards. A similar trend in this case is shown by the lecturer who also finds herself in a position in which she has to work with the SI leaders, even though she does not fully understand what the programme's vision is and does not own it.

From what the participants were saying, it was evident that the vision which was not clearly articulated or owned caused SI to be ineffective. Other students did not attend later sessions as expected, preventing their performance from improving. The vision, which was not clearly articulated, caused confusion, especially to the students as they did not understand what was expected of them in upholding it and making it a reality. Moreover, lack of articulated vision led to lecturers not owning up to the programme's vision and thus not showing full commitment towards the programme's success. Based on this, the participants were unanimous that the vision needed to be clearly articulated so that it could be owned by all.

4.2.3 The SI leaders' inability to apply effective teaching strategies

The SILMG (2013:11) emphasises that SI should remain student-centred and that the primary focus should be on the needs of the students. The SI leader as the key role-player is thus expected to apply effective SI instructional strategies that will promote student involvement with the course content. The SI leader is expected to:

- encourage students to sit in groups that allow them to interact
- let students do most of the talking and problem-solving
- encourage students to search their own notes for information
- remember that he/she is a facilitator for students' learning and not their instructor
- redirect questions to the groups rather than attempt to answer on their behalf.

Although the guideline is clear on how the SI leaders should go about facilitating the sessions, the participants claimed that the SI leaders did not do as required:

Phenyo: I visited some classes just to check how the sessions were conducted and in most cases I found the SI leaders providing students with the solutions and not giving them direction or guidance.

Lesedi (interrupting): *I agree with you on that one! Our SI leader comes to class with the problems that have already been solved and then write them on the board. Although he explains how he arrived at a solution, I find it difficult to understand.*

The point made by Phenyo (an assistant in the programme also as a participant) was that during his class visits in most instances he found SI leaders teaching the students instead of allowing them to engage in problem-solving by interacting with one another. The assistant's expectation was to see a situation wherein the students interacted by exchanging ideas on Mathematical content with the SI leader simply guiding the discussions but not giving answers to the students. Lesedi agreed with the assistant that indeed the SI leaders gave them a lecture instead of allowing them as students to actively participate and thus discover solutions on their own. According to Lesedi, such a teaching strategy used by the SI leaders did not make it possible for them to understand Mathematics course content or for their knowledge of the course content to be enhanced.

What the participants were saying is in agreement with the literature in chapter 2, that the SI leaders who did not allow students to actively participate in their own learning made it difficult for students to learn or for their knowledge of the course content to improve. One can therefore say that the SI leaders in that case resorted to the traditional way of teaching wherein "***focus was on the quality of teaching and not quality of learning***". According to McGuire (2006:4), this type of teaching strategy which places focus on teaching and not on learning does not promote student learning and comprehension of the course content, which is what SI is intended for and therefore needs to be discouraged.

As explained by the students, their appointment as SI leaders meant that they knew more than the students they were assisting and that elevated their esteem/status. They believed that solutions and guidance could only come from them, therefore they talked more in class than the students for whom the

programme was specifically intended. To some extent the SI leaders saw themselves as more knowledgeable than the students and did not think that they could share ideas amongst each other. They regarded themselves as powerful human beings who could provide knowledge. Simultaneously, the students who were not given an opportunity to exchange ideas failed to be exposed to different ideas and thus did not develop mastery of content. As a result, effective learning could not take place and thus students' knowledge of the course content could not advance.

The discussion above indicates that lecturing during the SI session as a teaching strategy does not promote student understanding of the course content nor promote mastery of the course content. Furthermore, it creates an atmosphere wherein students' misconceptions and gaps about the content cannot be addressed, since they are not allowed to freely exchange ideas or learn from each other. According to Bengesai (2011:62), one of the goals of SI is to develop students' metacognition, thus making them independent learners. That can only happen if students are allowed to exchange ideas and thus become exposed to multiple ideas that enhance their knowledge of the course.

The participants were in agreement that the SI leaders' inability to apply effective instructional strategies was a challenge which needed to be addressed, since it did not increase student understanding of the course.

4.2.4 The SI leaders' inability to effectively engage students in their own learning

The SISMG (2010:10) encourages student engagement and thus stipulates that the students need to be involved in more than listening, with less emphasis placed on transmission of information and more on developing student skills. The guideline further stipulates that students need to be engaged in high order thinking, for example, analysis, synthesis and evaluation, and that they be engaged in activities such as problem-solving. According to the SISMG (2008:11), engaging students in their own learning enables them to have a better understanding of the course material, develop more cognitive processing of the

material and gain exposure to new ideas and more ways of thinking about things. Most importantly, it helps the SI leaders to have a better identification of students' misconceptions and gaps in understanding of the course content.

Although engaging students in their own learning greatly benefits them, as the guidelines point out, one of the Mathematics students, Lebo, indicated during the forum that the students were not actively engaged in their own learning. He commented as follows:

> *Every time we attend the sessions we do what we were doing with the lecturer and this does not benefit us, and I think that is why other students end up not attending…*

The point made by Lebo was that the SI sessions were conducted as lectures and did not provide a platform wherein students engaged meaningfully in their own learning. His words "*Every time*…" indicated that for the most part of the sessions students did not actively take part in learning on their own. The other issue that Lebo raised was that the SI leaders repeated what the lecturers did, hence his claim, *"…we do what we were doing with the lecturer…".* According to Hensen *et al.* (2002:250), SI leaders are not supposed to re-lecture as this does not promote understanding of course content. It therefore means that re-lecturing deprives students of an opportunity to reflect on content that challenges them and also robs them of a chance to receive clarification of content they find challenging as they are learning. Re-lecturing in this case was a sign of injustice in the sense that the SI leaders who did not give students a platform to freely participate and exchange ideas with their peers deprived students of an opportunity to develop metacognition and content mastery. They instead created a tense atmosphere which could not liberate students to share their knowledge with others or to be exposed to other new ideas that could have emanated from their interaction.

Lebo's words "*Every time* …." also indicate that the challenges they had with content did not receive much attention as more focus was on lecture repetition. This did not benefit Lebo or the other students. As a result they became discouraged and did not attend later SI sessions. In this case one could say that they did not benefit while SI leaders benefited, as they received their payment for

attending the sessions which students did not find beneficial. This was an indication that students were not allowed to voice their concerns, therefore regarding SI leaders as their superiors and thus unable to oppose what they were doing. On the other hand, the SI leaders, by not fully engaging the students "*Every time they attended the sessions*" in learning clearly shows that they believed they knew more than the students and that they did not reflect on their facilitation practices in class. Nor did they hold their students' opinions in high regard as one way in which they could have assessed themselves and realised whether or not they were fully engaging their students in learning. The unequal power relation is also notable in this case in that students could not challenge the SI leaders' classroom facilitation practices, which deprived them of opportunities to learn effectively, whilst the SI leaders carried on as if all was well and they were remunerated for what they were doing.

As the deliberations proceeded, another issue emerged regarding student numbers which did not make student engagement possible, as stated by the Mathematics lecturer:

> *Mr Ndimande: We have a large number of students who attend our lectures and these students also attend SI sessions. We divide them according to the number of the SI leaders we have but others later on decide not to attend sessions offered by their SI leaders and attend other SI leaders' sessions. When there are many students in the class it is not easy for the SI leaders to allow the students to discuss and solve problems in groups.*

Mr Ndimande highlighted a point acknowledged by most SI leaders, that the sessions were capacitated with large numbers of the students and thus student engagement could not be possible. The point here was that the SI leaders who found themselves having large numbers of students could not adhere to the SI techniques of collaborative learning as they were not trained in the facilitation of larger group sessions. The point was in accord with the literature in chapter 2, that the SI leaders who facilitated larger sessions could not adhere to the SI techniques of collaborative learning.

Another point he raised was that students who did not adhere to their allocated groups contributed to making it difficult for the other SI leaders to effectively engage students in learning. As a result, students did not learn effectively and could not grasp the content. Although the guideline is clear that students must be seated in small groups, it does not provide rules on what should happen once the groups have been allocated to respective SI leaders and students who do not stick to their groups in order to avoid overcrowded sessions. This emerged as a challenge which also requires attention.

The above discussion indicates the challenges posed by not effectively engaging students in their own learning as claimed by the participants. The discussion also reveals that students who are not actively engaged in learning will experience serious challenges, including lack of understanding of the course content. It was on the basis of this that the participants felt strongly that a framework needed to be formulated.

4.2.5 Lack of feedback offered to keep stakeholders informed and to promote individual development

The SILMG (2008:7) points out the programme evaluation as one of the elements of the model which must be present in order to ensure the integrity of the programme. According to the Guideline, the programme is evaluated appropriately by assessing institutional outcome measure, for example, final course marks, course withdrawal rates, institutional dropout rates and institutional graduation rates. The guideline further stipulates that the supervisor should provide regular feedback to the departmental contact persons by having quarterly meetings with the departments. The feedback must be on attendance of SI against student performance. Although the guideline encourages feedback provision to the stakeholders involved, participants indicated lack of feedback as one of the challenges within the programme implementation:

> *Mr Dlomo: …we expect to be briefed on the progress that students are making. However, we have not received anything thus far from the SI office…*

Mr Chikuka (butting in): We once received a progress report a while back although it was never discussed in a formal meeting. We were sent an email with all the details. A promise was also made that after every semester we will receive feedback. However, that hasn't been happening.

From what the participants were saying it looked as if Mr Dlomo (the Mathematics lecturer) had not received any feedback on student progress in Mathematics. However, the second participant (Economics lecturer) had once received the report through email. Mr Dlomo's words "*we expect to be briefed*…" indicate that feedback was important to the SI participants. His words "*however, we have not received anything thus far from the SI office*…" are an indication that although they value feedback it had not been brought to their attention. This means that the SI personnel did not fulfil what they were expected to fulfil.

The Economics lecturer (Mr Chikuka) also expressed agreement that indeed they did not receive feedback on student progress as expected, although he indicated that he received it once through an email. He pointed out that even after receiving that report it was not discussed in a formal meeting. Although the lecturer could not express his feelings regarding the report which was not discussed in a formal meeting, he regarded it as a clear indication that he was expecting it to be discussed formally in a meeting. The point made here by the lecturers regarding feedback which was not provided was in agreement with the point made in chapter 2, that this omission created knowledge gaps. Thus, no meaningful contribution was obtained from the other participants that could have had a significant impact on the advancement of the programme and student performance.

A further concern was raised by the Mathematics SI leader regarding the feedback not provided.

Dodo: … someone would just come in during the sessions and distribute the forms to the students. The students will then complete those forms. Eeerr!! The problem is that we do not know what the students were saying about us. We do not even know what we need to do in order to help these students based on that…

The Mathematics SI leader also confirmed that feedback was not offered in the set-up. Apparently he was evaluated by his students during sessions and thus expected to be informed about his students' comments so he could see if he was helpful to students. According to the SI leader, the feedback could have assisted them in knowing how the students perceived them and made it possible for them to know the areas in which they needed to improve on so that they can effectively help students.

Immediately after she had raised that point, the Mathematics teacher pointed out the disadvantage of not receiving feedback by making reference to where she was working:

> *Mrs Motsoeneng: It is really not nice to work without receiving feedback especially when you have been evaluated or monitored. Just to make an example, as teachers we are expected to undergo IQMS process whereby an HOD together with a peer would go to class to see what the other teacher is doing with the aim to help the teacher to improve in certain areas. The challenge that we have is that we also do not get feedback which is why we are not improving.*
>
> *Bonolo* (interrupting): *…we complete the evaluation forms every semester but our SI leaders still do the things we indicated that we don't like. Sometimes we get the new SI leaders who also repeat the same mistakes…*

The Mathematics teacher's example which she provided regarding what was happening at her work place was a clear indication that lack of feedback provision was not only a problem in our context but also in schools. Her utterance that "*the challenge that we have is that we do not get feedback which is why we are not improving*" indicates that as a result of receiving no feedback she and the other teachers could not reflect or improve on their teaching practices. This also meant that the goal of the Integrated Quality Management System (IQMS) could not be realised as intended. The Mathematics teacher in this case, by making an example about the school in which she was working, was merely emphasising the point that lack of feedback was a serious challenge that needed to be addressed.

She wanted to show how disadvantageous it was not to have feedback within the set-up.

On the other hand, Bonolo (the Mathematics student) also agreed that there was a challenge regarding feedback provision, and highlighted very important and interesting issues. The first issue was that the SI leaders whom they evaluated did not show any sign of improving in terms of facilitating sessions. Her words "*We complete the evaluation forms every semester but our SI leaders still do the things we indicated that we don't like*" provide evidence that the SI leaders did not do anything about their facilitation practices, as students commented. On the other hand it could also mean that the SI leaders did not receive feedback regarding students' feedback on how they facilitated their sessions and were not provided with the capacity to work on the challenges pointed out by the students thereof. The second issue which the student highlighted was that sometimes the newly appointed SI leaders also "*repeat the same mistakes*" as those who were appointed before. This means that feedback was not shared with the newly appointed SI leaders.

As the participants were citing this as a challenge and indicating the need for it to be addressed, I realised how significant it was to engage with the people in discussing issues that affect them. As a result the participants were able to voice their experiences and feelings which, if they were not given this platform, would not have been possible. Even though the student could not say that "*I hated the repetition of mistakes committed by SI leaders"*, her facial expression denoted it. Repetition of mistakes is a habit which societies do not like. For example, if learners have a problem with a teacher, claiming that they do not understand him/her, they do not wish his or her replacement to make the same mistakes. The student in this context shares the sentiments of "*not liking the mistakes which were repeated by the newly appointed SI leaders*".

The participants were thus unanimous that feedback was not offered in the set-up and as a result stakeholders could not stay abreast of the developments. The conclusion therefore was that the challenges to proper implementation of SI were a result of lack of feedback, which made it impossible for the stakeholders to

critically reflect on the situation. Based on this the participants felt that such a challenge needed to be addressed.

4.2.6 Summary

The above sections discussed the challenges with the implementation of SI as identified by the participants. Based on these identified challenges the participants felt strongly that a framework needed to be formulated so as to respond to these challenges. Such a framework would also help students improve in their academic performance in Mathematics. The subsequent section will deliberate on the components of the solution, and show how the solutions were provided and systems put in place.

4.3 COMPONENTS OF THE SOLUTIONS

In formulating a framework that will enhance the functionality of SI for first-year Mathematics students at a higher education institution, requires the ideas to be shared. A platform was therefore provided, founded upon the principles of emancipation and social justice, seeking to empower members of a community or group who are less powerful and/or oppressed by dominating groups (Azaiza *et al.*, 2010:271). When the participants and I were communicating ideas on what could be done to address the challenges we made sure that we kept in mind transformative approach principles, with the participants' ideas being acknowledged, respected and highly valued. They were treated as equals with the hope that they would contribute as much as the researcher to this project. The platform on which the ideas were deliberated upon allowed everybody to speak.

4.3.1 Formation of the team as part of the solution

The process began in 2011, after performing an analysis of the results for the modules which were part of the SI programme. I realised that the performance of

the students who were taking Mathematics was poor as compared to the performance of those in the other modules. I realised that in 2009 and 2010 the results had also been alarming and felt measures had to be taken to rectify the problems. I then set up a meeting with the Mathematics lecturers, in which the need to alter student poor performance was emphasised:

> *Ms Dikobe: We are aware that students' performance is poor and it is our wish to see it altered.*
>
> *Other Mathematics lecturers agreeing: mmhh…mhhh*
>
> *Mr Ndimande* (interrupting): *we really need to work hard on this because the academic head is also not pleased by this poor performance.*

Ms Dikobe noted that their department was aware that students' performance was poor. She further indicated that they were not happy about that and that their wish was to see that poor performance being altered. Mr Ndimande also added that such a poor performance was of concern not only to them but also to the academic head. From the lecturers' faces it was evident that students' poor performance worried them all, and it had also portrayed a bad image of their department. I then proposed that we engage in the formulation of a framework that would respond to those challenges and the idea was welcomed. I requested the lecturers to identify other people who we thought would contribute significantly in that project (identified in chapter 3.4.1).

Our belief was that if we worked as a team we would able to devise solutions that will enhance the functionality of SI for Mathematics students. We were influenced by what we saw in society, wherein joint effort is encouraged. The use of the pronoun "*we*" on several occasions was an indication that, as the participants, we felt strongly that by working together we could help make SI for Mathematics students functional. One common example which shows the significance of working as a team is that of the police working together with members of the communities in combating crime, since the criminals live within the communities and the members know who they are.

A suggestion was made by Ms Nala, one of the lecturers:

I would suggest that we invite these people to a meeting so that we can share the ideas we have with them.

Ms Nala's suggestion was that all the people they had identified as part of the team be invited to a meeting in which they could also be briefed about the ideas they had regarding the enhancement of the SI's functionality for Mathematics students. The intention in this case was to sell the idea to those identified people so that they could support it. Ms Vrede, one of the lecturers present in a meeting, volunteered to write an email to invite them. The meeting was scheduled for 28 June 2012.

At the meeting Ms Dikobe presented the poor performances of the Mathematics students for the previous three consecutive years, followed immediately by explanations of why it was supposed to be addressed as a challenge. Mr Mazibuko (one of the Mathematics lecturers) remarked:

The students are not doing well and we are deeply concerned about that. We called you to this meeting in order to ask you to help us in the project that we will be engaging on in attempting to curb this poor performance.

Mr Mazibuko emphasised that students were not performing well in Mathematics and that as a department they were profoundly concerned about the matter. He further explained to all in the meeting why they had been invited, namely to hear about the current situation and accept a formal request for their participation in the project. They were deemed appropriate for this project because of the contributions we thought they were going to make as indicated in chapter 3.4.1.

After the explanations had been provided people showed keenness to be part of the team. Mr Tau, one of the high school Mathematics subject advisors, commented:

I agree to be part of this beautiful project that's aimed at improving the performance of the students.

(All other members nodded their heads showing that they also agreed to be part of the team)

Thandaza (interrupting): *We can alter this situation by working together, striving towards a common goal. An individual can never alter this situation.*

Mr Tau agreed to be part of the project he perceived to be "*beautiful*" as it aimed to enhance Mathematics students' performance. The motive behind the establishment of this project fascinated him and he felt that he needed to be part of it. Nodding of heads by others was an indication that they also wanted to be part of the team. Thandaza, one of the Mathematics students, noted powerful points that such a situation could only be altered by working jointly towards a common goal. She further noted that an individual could never alter such a situation.

Another suggestion was made by one of the economics lecturers who was also part of the team as follows:

Mr Chikuka: Perhaps we should also discuss the roles and responsibilities of the team members so that at least everybody knows what is expected of them

Mr Chikuka's suggestion was that the roles and the responsibilities of all the people involved be discussed thoroughly so that everybody could understand what was expected of them. He deemed that significant as it was going to make it possible for people to know what to do and also make sure that whatever action they were going to take would be in line with the programme's goals and objectives.

After lengthy discussions on the roles and responsibilities then the agreement was reached and Ms Vrede as the secretary was requested to document those roles and responsibilities so that everybody could have a copy (*see* Annexure H). All the participants agreed wholeheartedly.

Having different representatives in our team brought many benefits, including manifold angles and, most importantly, a democratised team (Jessop, 2012:2), which is also what the lens couching this study (CER) promotes. The main function of this team was to carefully look into the identified challenges and to

devise solutions to them. Amongst other functions, the team had to prioritise items based on the challenges identified, and the drawing up of an action plan.

4.3.2 Establishment of a team common vision

Towards the end of the second meeting, held on 5 July 2012, a suggestion was made to establish a common vision. Mr Mokoele, the Mathematics subject advisor suggested:

> *I think we need to have a common vision since we are a team. It will help guide us towards our goal of enhancing the functionality of SI for Mathematics students.*

His suggestion was welcomed by all who attended the meeting. Mrs Motsoeneng (the high school Mathematics teacher), after realising that all were of the opinion that the common vision be established, requested all members to form five groups. The groups were then requested to think about the vision for our team and charts were distributed so that they could be written down. One group would then share with the other groups what they thought the vision should be and all the visions would be consolidated into a single one to be shared and owned by all the team members.

The vision that the participants were requested to create was the one that was going to guide the team and remind them of what they wanted to achieve with SI. It was also to make sure that all the team members had ownership of the project in which they were engaging (i.e., a project aimed at enhancing the functionality of SI for Mathematics students). The five groups, as shown in Figure4.1 (below) discussed the vision that they thought would be appropriate for the team. In doing so, the teams were given time to brainstorm on it and to provide feedback.

The following five visions were written down on the different charts and presented by groups 1 to 5 respectively during the brainstorming session:

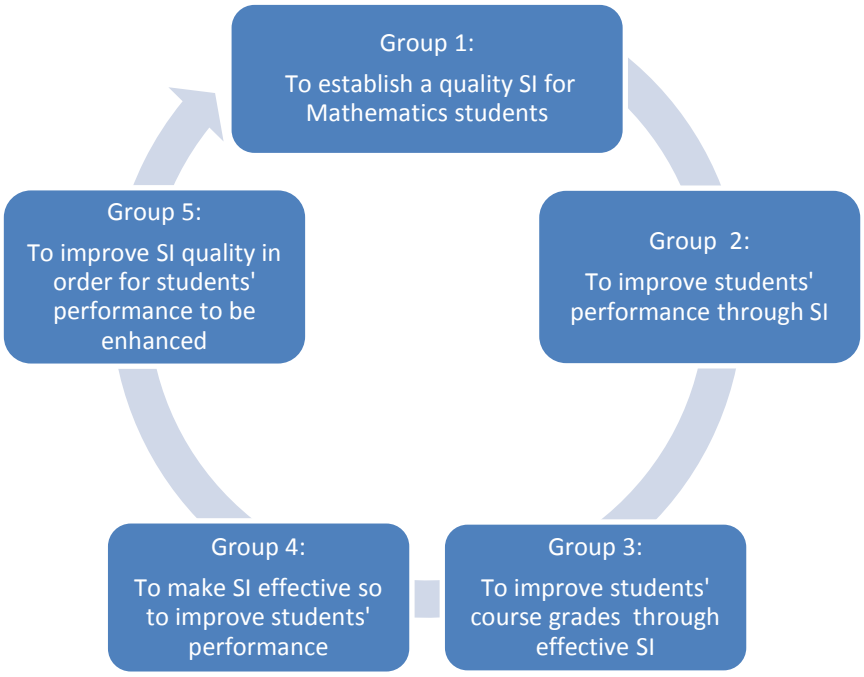

Figure 4.1: ***Visions presented by groups 1 to 5***

After the presentations of the different visions as brainstormed by the different groups and more deliberations on them, agreement was finally reached that the vision to guide the team would be: "***To pursue the enhancement of SI in order to improve Mathematics students' course grades and performance."***

The established vision was therefore a combined effort of all the stakeholders in ensuring that the supplemental instruction for Mathematics students was enhanced so that they could benefit and thus improve in their academic performance and course grades. A significant aspect of this exercise, though it took long, was that, the participants understood where that vision came from and the energy it was derived from, which was something to count on as a driving force to challenge them to make this project a success. This established vision was deemed vital because it was going to bind the efforts of the people in order to achieve the goal (Steyn, 2011:222).

4.3.3 SWOT Analysis

In order to effectively implement the activities, the team conducted an assessment to assist in identifying the most valuable resources needed and the ones that we have which can help us achieve our goal. The team found that we had some dedicated lecturers, SI leaders and students who were keen to make this project a success. The SI head and the SI personnel were also committed to the initiative and the team realised that the educators from the schools as well as the subject advisors were more than willing to partake in this research project in order to share their expertise, which might in turn directly benefit the institution's SI programme. We had resources such as computers and Internet access and therefore were able to call meetings and communicate. We took advantage of these as our *strengths* and used them to our own advantage.

Although the strengths promised success in what we anticipated to do, it was equally important to look into our *weaknesses*. The ones which were notable were the time schedule which did not make it possible for all the participants to meet regularly as expected, and lack of suitable space for our meetings in adherence with the principles of CER, notably rooms which allowed members to sit around a table and share ideas. The *opportunities* were receiving support from the educators and the subject advisors from the schools and the DoE respectively, as well as from the NGOs. Our *threats* were students' lack of motivation to study or to take part in the SI, poor pass rates of first-year Mathematics students, and lecturers' lack of interest in the programme. The team had to carry out the SWOT assessment because it provided a basis for better serving the needs of SI.

4.3.4 Determination of priorities

During the deliberations with the participants, many challenges were identified but because of the tight schedule for all involved, even though they were dedicated to making this project a success, not all were going to be addressed in just one year. The agreement therefore was to prioritise the needs, as Monyatsi (2006:152) espouses. In our case five needs were prioritised:

i. Coordinated plan

ii. Articulating the vision clearly and ensuring its ownership

iii. Training of the SI leaders on content

iv. Training of lecturers on SI techniques

v. Effective use of instructional strategies and student engagement.

These were the needs that we agreed were crucial to start with in terms of enhancing the functionality of SI for Mathematics students. The priorities were then included into the strategic planning. According to Hayward, Johnson and Ncayiyana (2003:21), the strategic plan envisions how a team can leverage the strengths of the institution to increase its future performance. Based on this, the team then agreed that the point of departure to enhance the functionality of SI for Mathematics students was to incorporate the identified priorities into the strategic plan, which will indicate how those priorities were going to be addressed (*see* Annexure G).

4.3.5 Strategic planning

Having drawn up the strategic plan to detail how the priorities were addressed, the next sections will explain how each priority was addressed.

4.3.5.1 Coordinated plan

The following activities were proposed in terms of establishing a coordinated plan: creating strong collaboration between the lecturers and the SI leaders; clarifying the roles and responsibilities of the parties; and designing the pacesetter. The team utilised the expertise of the members involved in the project. The academic head was responsible for creating strong collaboration between the lecturers and the SI leaders; the SI head was responsible for outlining and clarifying roles and responsibilities of both the lecturers and the SI leaders; while the head of the Mathematics department together with the Mathematics lecturers and SI leaders

were responsible for drawing the pacesetter. The meeting on creation of strong collaboration was held in November 2011, when the academic head (Mr Scheepers) emphasised the need for the lecturers and the SI leaders to work together:

> *For SI to flourish, you need to work together. Working together will ensure that the coordinated plan becomes established and this should be the starting point in making the SI sessions effective*.

The point that was stressed by the academic head was that for SI to achieve its goal, both the SI leaders and the lecturers needed to work collaboratively (*see* 2.6.1). He emphasised collaboration between lecturers and SI leaders because he knew and understood that they were the main pillars to drive the SI and that the success of the programme relied heavily on them. He further pointed out that such a mutual working would assist in the establishment of a coordinated plan. According to the academic head a coordinated plan is important because, through it, effective SI sessions can be realised. His remark: "...*and this should be the starting point in making the tutorials effective*" was an indication that without a coordinated plan SI sessions would not be effective and thus the students would not benefit by improving their performance.

In addition to what the academic head proposed, that a coordinated plan be established, the Mathematics departmental head (Mr Lehasa) made a suggestion:

> *I think we will need to design a pacesetter which will ensure that we do the same activities simultaneously. This will help us manage our time as we need to deal with all the concepts in the module for the whole year.*

The Mathematics departmental head felt it was significant for all the lecturers who were offering Mathematics 1 as part of SI programme to engage in similar activities. He further indicated that the time to engage in these activities also needed to be managed and therefore thought that the pacesetter would be an asset. His suggestion that the pacesetter be designed emanated from the challenges which he realised pertained to lecturers and SI leaders not performing similar activities, and in some instances other concepts were given much attention while others were not given sufficient time, hence disadvantaging the students. His

idea of introducing the pacesetter was a way of bringing about coherence to maintain student understanding of the course content throughout, and also to ensure that there was enough coverage for each concept in pursuance of content knowledge enhancement.

In a meeting in November 2012, wherein the roles and the responsibilities were outlined, the SI head (Mrs Van Tonder) commented after distributing the documents she had compiled:

> *This is just a step further to a meeting we had previously with the academic head to ensure that you as the main drivers understand exactly what you are expected to do.*

The SI head's words *"This is just a step further to a meeting we had..."* meant that in ensuring the establishment of a coordinated plan as espoused by the academic head, collaboration between the lecturers and the SI leaders as indicated in the previous meeting by the academic head was not the only aspect that needed to be pursued. Her opinion was that collaboration could be there, however, if the lecturers and the SI leaders did not have a clear picture of what their roles and responsibilities were it was not going to be possible for the goal to be accomplished. The SI head's words: *"...to ensure that both lecturers and the SI leaders as the main drivers understand exactly what they have to do"* indicated that the lecturers and the SI leaders as the other main pillars of the programme also needed to have an understanding of what their roles and responsibilities were in improving student performance and making the programme a success.

4.3.5.2 Clear articulation of the vision and ensuring its ownership

The second priority was pursued in order to ensure that the programme vision was clearly articulated and owned by all the people involved. This was to ensure that the people were steered in the direction of the vision in attempting to realise the programme's goals. This priority was identified as a result of realising that some of the students and the lecturers still did not fully understand what the programme was about and what it was intended for. Based on this, during the awareness

session which was also held in November 2012 with the students who enrolled for the Mathematics 1 course, the Economics lecturer (Mr Chikuka), after explaining and communicating the programme's vision, concluded:

> *I am glad that as a team we were able to explain what the programme is all about. I am also glad that we were able to respond to your questions and I am sure that now we are on the same page. However, this is not the last time we are talking to you as we plan to keep you posted with the developments around the programme as we go along. We also plan to communicate this to the entire institution so that everyone knows about the programme*.

Here, having been nominated by the team members to talk to students on behalf of the team, he explained to the first-year Mathematics students what the programme was about and also communicated its vision. He valued the act of communicating clearly the vision to students, hence the comment, *"I am glad that as a team we were able to explain what the programme is all about"*. He strongly believed that was a positive move by the team in ensuring the programme's success, and was happy to see the team engaging with the students in discussion and responding to their questions. He knew by so doing that the misconceptions about the programme would be clarified and that all would understand this vision and consequently have its ownership: *"...and I am sure that now we are on the same page"*.

However, the lecturer made it clear that more awareness would be needed regarding the programme: "*This is not the last time we are talking to you as we plan to keep you posted with the developments concerning the programme".* He realised that frequently talking about the programme would establish more understanding which would make people realise that their involvement within the programme was significant. As a result, they would then develop a sense of ownership towards the programme. He explained that he and the rest of the team members were planning to extend communication to the entire institution as a move to make them develop a sense of ownership. The team's pursuance of developing a sense of ownership by clearly articulating the vision was to make it

possible to realise the SI goal of improving the Mathematics students' performance.

The participants employed the strategy used in the RSA and USA by communicating the vision to the students (*see* paragraph 2.6.2), although in our case we extended the communication even further to the entire campus community at large. That helped the programme to be recognised and supported not only by the students but also by the institution's management and other structures within the institution.

4.3.5.3 Training the SI leaders on subject content

The third prioritised item was to support the SI leaders on content, since their training focused mainly on the techniques to be applied in class as a way of enabling them to facilitate the sessions but not on content. The workshops on content development were then established as a way of enhancing the SI leaders' knowledge of the course content. The Mathematics lecturers as experts in the field then took different turns in facilitating these workshops. During one of the SI leaders' content developmental workshops in March 2012, Mr Mazibuko (Mathematics lecturer) noted:

> *...yes you can have content knowledge, but you must make sure that students also receive that knowledge. This therefore means that you need to make sure that the students understand if they have to pass the course.*

The point that was emphasised by Mr Mazibuko in that workshop was that the SI leaders should not be the only ones to have content knowledge, but rather it was their responsibility to ensure that the students also received that knowledge. According to Mr Mazibuko, when the students could understand the course content it would then become possible for them to pass:

> *In promoting student understanding of the course, you need to relate the content to real life situation. This way the students will see relevance and that will interest them...*

Mr Mazibuko told the SI leaders that they needed to relate content to real life situations in making students understand the content. His stance was that students already know and understand the world they are living in and therefore when content is related to what they already know it will be much easier for them to understand. Students will understand and realise the relevance of what they are learning and consequently develop a love for the course: "*This way the students will see relevance and that will interest them."*

Towards the end of the workshop, whilst engaging with the SI leaders, Mr Mazibuko remarked and provided an example:

> *It also helps when you understand the content to be creative so that you can establish ways in which you could help students understand it.*

Through his remark he challenged the SI leaders to be creative and thus produce ideas on ways in which they could help students understand. What I noted from Mr Mazibuko's words quite often was that in as much as he needed the SI leaders to be knowledgeable about the content, he also felt strongly that the students also needed to receive knowledge, so as to *"… establish ways in which you could help students understand content"*. What stood out in the session that day was the manner in which Mr Mazibuko "practiced what he had been preaching", taking SI leaders through practical examples in problem-solving.

The following, are some of the examples from the session where Mr Mazibuko showed the SI leaders how they could help students understand the concepts, namely "mapping of the x and y values" (Domain and range) and "determining the pie value". The main idea behind the first activity was to show how mapping happens between the x and y values as indicated in Diagrams A – C (below). The lecturer was therefore expected to show the SI leaders how to introduce that concept to the students and also how to make students understand it.

RULE:

According to the rule when mapping the values: a "y-value" can be mapped to either a single "x-value" or "multiple x-values" and that an "x-value" can only be mapped to one "y-value" and not to multiple "y-values".

Diagrammatically these can be illustrated as follows:

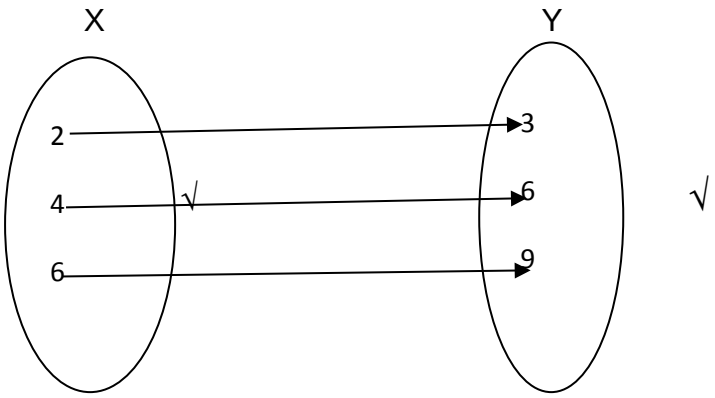

Diagram A: One to One mapping

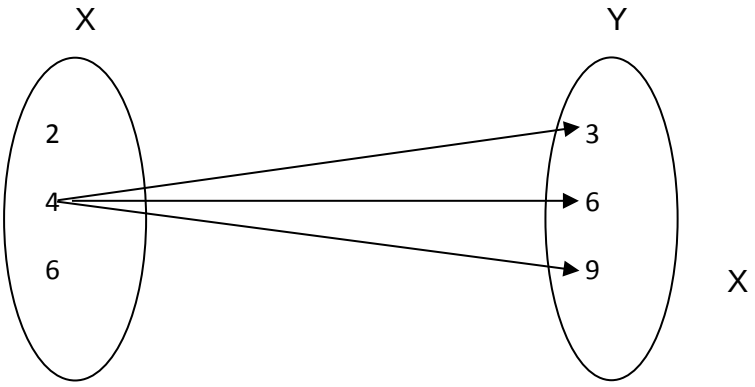

Diagram B: One to many mapping

Diagrams A & B represent the correct and incorrect mappings of “x and y” values respectively

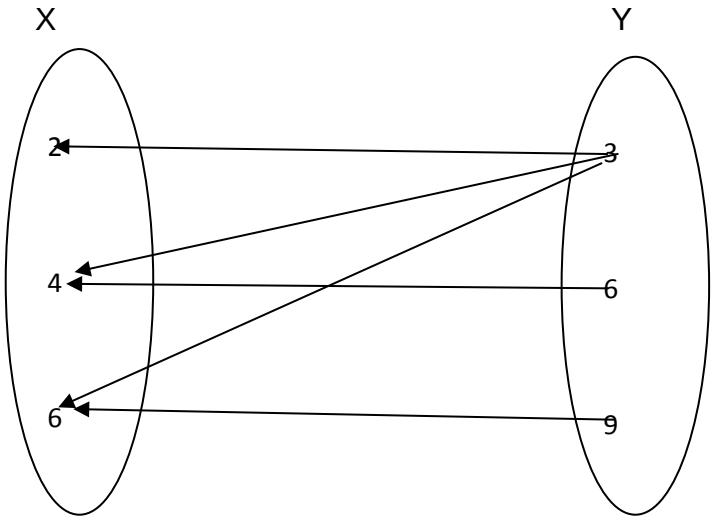

Diagram C: The mapping of the y-values

Mr Mazibuko’s creativity became apparent when he explained concepts relating it to a real-life situation. He named the x-values “women” and y-values “men”, saying that in African culture a woman is not allowed to marry more than one man (as in diagram B), but only one man (as in diagram A); however, a man can marry one or more than one woman (as in diagram C).

The manner in which he explained it made it easy for students to understand the concept. Such an example also helped students retain an understanding of the concept for examination purposes. It was interesting to discover that one could incorporate real-life situations into a Mathematical context and make the lesson interesting, memorable and easy to comprehend. Literature on SI emphasises the need for developmental trainings on SI techniques (Stout & McDaniel, 2006:56) and does not focus much on content, however, it emerged clearly that more developmental workshops on content were required.

Another example from Mr Mazibuko working together with the SI leaders was to determine the value of pie (π), as indicated in *Figure 4.2* (below). In order to do

that, Mr Mazibuko realised that the SI leaders needed to be engage so that they can know and understand how they arrived at the value of pie without being told but by discovering the value for themselves. He then suggested:

> *Ask students to come with different round figures or objects, strings and rulers. Then request them to measure the circumference of each round figure and then write the measurements down. You can then request them to do the same with the diameter of each round figure. Eeeh! At the end you will have something like this:* (drawing on the chalkboard)

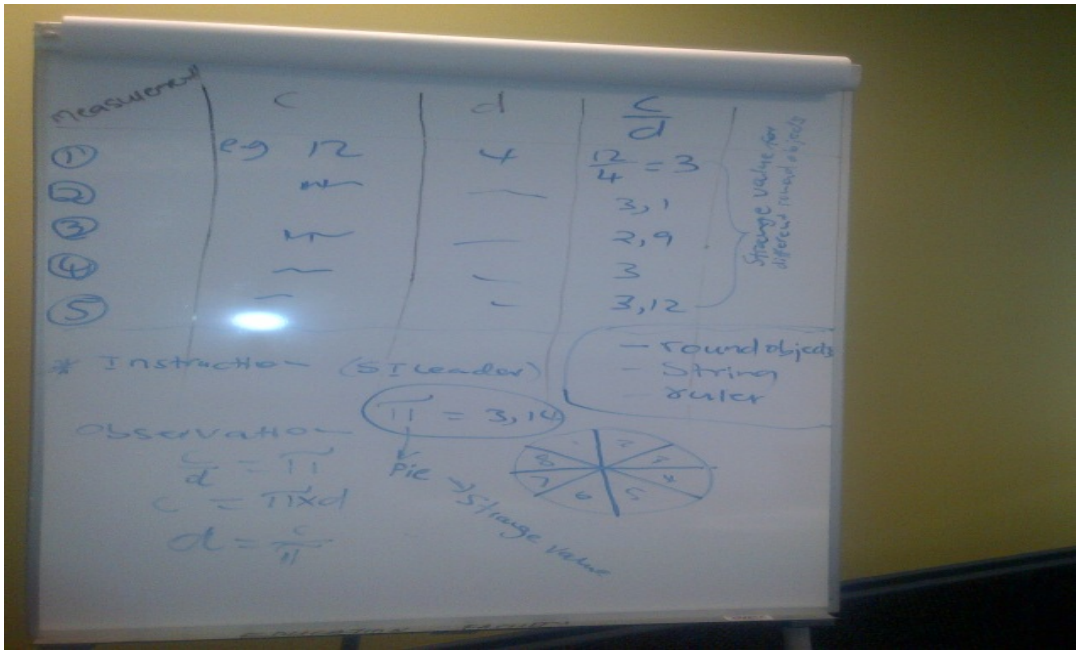

Figure 4.2*: *An illustration of how the value of pie can be determined

> *After they have completed the table, then you can ask them to explain their observations regarding the ratios they got* $(\frac{C}{d})$ *(see column 4). They will then discover for themselves that all the ratios they got were close to each other (as in the fourth column). You can then explain to them that the (ratios) they got are close to 3.14 which is the number that was obtained when measurements were done accurately and that is a "strange number" because it is obtained when all the round objects with the different sizes were measured and that mathematically we call that number pie*

(symbolised: π). That will help students to understand how the ratio ($\frac{c}{d}$) is determined. Even when students are provided with the formula $\pi = \frac{c}{d}$: they would then be able to determine for themselves the value of the diameter (d) if the value of the circumference (c) is provided. They will also know how the formula would then have to be written ($d = \frac{c}{\pi}$)

They can also follow the same procedure in determining the value of the circumference when the diameter is provided.

Mr Mazibuko's explanation above was to illustrate to the SI leaders how they could engage students in learning and also assist them to understand how an answer was obtained. If students could establish how the equation $\pi = \frac{c}{d}$ came about, then they could play around in determining the value of ***d*** if ***c*** is provided and also determine the value of ***c*** if ***d*** is provided. As in the illustration on the whiteboard, I could see how cheerful the SI leaders were, which was an indication that they liked how the students needed to be engaged in their own learning, as demonstrated by Mr. Mazibuko. Also interesting was to see the SI leaders discovering ways in which they could not only engage students in learning but also help them to apply the knowledge that they had previously acquired in order to obtain the solution to the given problem.

4.3.5.4 Training the lecturers on SI techniques

The fourth prioritised item was to train lecturers on SI techniques so that they could fully support the SI leaders, not only on content but also on the effective application of SI techniques. The team made use of the SI head as an expert to train the lecturers on SI techniques. The training was held in May 2012. At the end of the training session one of the Mathematics lecturers (Mr Taku) commented as follows:

I feel honoured to have attended this kind of training. I think the knowledge I have acquired on SI techniques specifically for Mathematics will assist me in fully supporting my SI leaders. What makes me happy is that I can still utilise certain techniques in my own lectures so to encourage active collaborative learning.

The Mathematics lecturer was delighted to have attended training on SI techniques. He felt that was going to assist him in fully assisting his SI leaders. As he would be preparing for SI sessions with his SI leaders he would assist them not only with content development but also with appropriate SI techniques that would consequently promote active collaborative learning. The lecturer thus felt that such training would make the SI sessions effective and that the students who were the main beneficiaries would gain from such sessions. The lecturer further acknowledged that the training was not only going to enable them to assist the SI leaders but also directly benefit them as lecturers, as they could also apply such techniques in their own classes.

The training of lecturers on SI techniques has also been deemed significant in the USA, as it provided lecturers with the knowledge of SI techniques of collaborative learning and enabled them to fully support the SI leaders (*see* paragraph 2.2.2). However, the difference in the strategies applied is that in our case the lecturers were engaged in practical training on SI techniques of collaborative learning while in the USA they were merely provided with the material for them to read and familiarise themselves with the techniques.

4.3.5.5 Effective use of instructional strategies and student engagement

The fifth priority was identified in order to empower the SI leaders on the effective application of instructional strategies and student engagement. It was also to help make their sessions more effective so that the students could learn and stand a good chance of improving their performance. The training on instructional strategies and student engagement was also held in May 2012 for the Mathematics SI leaders. The Supplemental Instruction Coordinator's expertise was utilised for this training. During the training, the coordinator (Ms. Mokoena)

stressed the significance of effective application of instructional strategies and student engagement:

> *It is important that you apply effective instructional strategies and also engage students in their own learning so that their understanding of the course content can be enhanced.*

The supplemental instruction coordinator emphasised the use of effective application of instructional strategies and student engagement. According to her, the application of these strategies enhances student understanding of Mathematics course. The effective application of these strategies would therefore contribute significantly in improving students' performance, as in the RSA and USA (*see* paragraph 2.6.3).

The coordinator noted some of the things that needed to be considered as part of effectively engaging students meaningfully in their own learning:

When you try to engage students in their own learning:

- *Make sure that students sit in small intimate groups.*
- *Be careful when you form groups that you do not group capable students together and those that are less capable together as that can discourage those who are less capable*
- *Allow them some time to engage in problem-solving. Also make sure that the activities that you prepare make it possible for them to participate or engage in problem-solving.*

The SI coordinator encouraged the formation of groups as a starting point towards engaging students effectively in their own learning. The rationale behind that was to enable students to exchange ideas amongst each other. She however cautioned the SI leaders not to group capable students together with those who are less capable together as that can develop a sense of discouragement, particularly to the latter. Her experience taught her that students in low ability classes are usually ignored and made to feel inferior. A study conducted in Nigeria confirmed that students in low ability groups are usually ignored, are provided with

fewer learning opportunities, have less variety in instructors' schedules, and fewer interesting and challenging activities, thus developing lower self-esteem (Chisaka, 2002:20). Although literature and the Guidelines on SI also emphasise the formation of groups, little is said about the composition of groups, which seemed to be a crucial point the SI coordinator made in this case.

The coordinator further emphasised the engagement of students in problem-solving as one way of enhancing student learning and increasing their understanding of the course content. Emphasis was placed on the designing of participative activities which would encourage student participation in class and also meaningfully engage students in problem-solving as another way of encouraging understanding of the course content and content mastery. The points noted by the coordinator were similar to those in the RSA, Nigeria and USA (see paragraph 2.6.4), that when students are engaged in their own learning they tend to have an increased understanding of the course content.

The above sections outlined solutions which were provided for the identified challenges. Identification of priorities and the plan that indicates how the priorities were addressed were also discussed. The subsequent sections will deliberate on the conditions that made the solutions work.

4.4 CONDITIONS CONDUCIVE TO THE SUCCESS OF THE IMPLEMENTED STRATEGY

The success of the implementation of the strategy as detailed in the foregoing sections depended on several factors. The next sections therefore discuss these factors that made the strategies work.

4.4.1 Factors that supported the establishment of a coordinated plan

The formulation of a team made it possible for members to come together and discuss what they all believed to be a problem. Debating the lack of coordinated plan as a problem and the extent to which it impacted negatively on the students

and the institution itself made everybody realise how serious student poor performance in Mathematics was. The lecturers and the SI leaders who were regarded by the team as the “main pillars” of the programme also shared the same sentiments as the rest of the team. Their realisation of the benefits of the coordinated plan and their devotion contributed significantly to the establishment of a coordinated plan. They regarded this as the starting point towards the smooth running of the programme and making it possible for students to improve in their performance. Hence, the pacesetter was designed to provide a guide as to which topics needed to be dealt with, for how long and how assessment would work (see Annexure I).

The plan also included workshops, training and meetings. That way, both the lecturers and the SI leaders knew exactly what needed to be done, and how and when. Furthermore, the involvement of the academic head who showed keenness in assisting the department of Mathematics in altering the situation by creating a strong collaboration between the SI leaders and the lecturers also contributed significantly to the establishment of a coordinated plan. The Mathematics departmental head made sure that all the Mathematics lecturers and SI leaders came together and drew the pacesetter, which detailed all the activities that needed to be performed, making it possible for the coordinated plan to be established. The collaboration between the SI leaders and the lecturers made it possible for the coordinated plan to be established, as it did in both the rest of RSA and Nigeria (*see* paragraph 2.7.1). The difference, however, is that in our context the pacesetter which detailed how the activities were going to be carried out was drawn and that the strong collaboration was also created amongst the stakeholders who sternly followed the pacesetter, unlike in the rest of the RSA and Nigeria, wherein it was not drawn.

4.4.2 Factors that contributed towards a clearly articulated vision and taking ownership thereof

The team members met with the first-year Mathematics students who were the main beneficiaries of the programme. The team explained in detail to the students

what the programme was about, what was expected to be achieved by it, and its vision. The students were also given an opportunity to ask questions and such a detailed open communication platform about the programme made it possible for them to understand the vision and take ownership of it. What also contributed to making the vision owned was its frequent articulation to the first-year Mathematics students and institution at large. These conditions were similar to those noted in chapter 2.7.2, in the USA, although the difference in our case was the frequent communication about the vision encouraged, and that the vision was not only communicated to certain selected faculties but to all the stakeholders within the institution. That way the programme became recognised and supported by all the people.

4.4.3 Conditions that contributed to the enhancement of SI leaders' content knowledge

Additional first-year Mathematics developmental workshops which were provided enabled the SI leaders to understand the content. The use of the lecturers as experts in this case significantly contributed to the enhancement of content knowledge. During the workshops, the SI leaders were intensively engaged in problem-solving and were allowed to exchange ideas and asked questions. This means that the practical engagement of the SI leaders in problem-solving refined their content knowledge. Moreover, the examples which were provided to the SI leaders enabled them not only to understand the content but also to relate the content to real-life situations. As a result of these workshops, which enriched their knowledge and understanding of the course content, the SI leaders were able to effectively impart knowledge to the students. The additional content developmental workshops further provided the SI leaders with the advantage of continuously receiving content development, which allowed them to deliver content and lessons with self-confidence (Tsotetsi, 2013:174).

4.4.4 Factors that contributed towards successful training of lecturers on SI techniques

The SI head who trained lecturers on SI techniques of collaborative learning had extensive knowledge of how the programme worked, and how the Mathematics SI sessions were facilitated. She then introduced the lecturers on the principles of SI, focusing on active collaborative learning principles before demonstrating to the lecturers how the principles were applied in class with the aid of first-year Mathematics examples. Furthermore, she demonstrated the significance of applying the appropriate SI techniques of collaborative learning when dealing with content so as to enhance student understanding of the course. The clarity which the lecturers received and their participation during the training also contributed to the success of the lecturers' training on SI techniques. Such participation also enhanced the lecturers' knowledge on SI techniques of collaborative learning and thus they were able to fully support the SI leaders in terms of making their preparation for the sessions effective. Some of the SI techniques of collaborative learning in which they were trained included the use of paired problem-solving (PPS), group problem-solving (GPS), models of organisation and informal quizzes (SILMG, 2008:21).

4.4.5 Conditions which made the use of instructional strategies and student engagement effective

The training workshops on effective instructional strategies and student engagement empowered the SI leaders, providing an opportunity for the latter to acquire knowledge on how to effectively engage students meaningfully in their learning and apply effective instructional strategies that would respond to students' challenges. The knowledge they acquired included how to group students and encourage discussions amongst them, a strategy also used in Nigeria (*see* paragraph 2.7.4). Furthermore, the scenarios provided during the training on student engagement and application of SI session strategies, such as the use of informal quiz procedures, models of organisation, and group problem-solving, promoted the level of participation and debates amongst the SI leaders and

consequently increased their understanding of the effective use of these SI session strategies. The SI coordinator's expertise also helped SI leaders make use of effective instructional strategies and student engagement. The demonstration of such participative activities needed to be prepared and how students should be engaged in such activities also gave the SI leaders a clear idea of how to effectively prepare productive sessions, that is, ones that allowed students to effectively engage in meaningful learning that enhanced their comprehension of the course content.

Having outlined the conditions that made the strategies to work, the following sections deliberate on the threats which were anticipated and the steps taken to counter them.

4.5 THREATS TO THE SUCCESSFUL IMPLEMENTATION OF SI

The following sections discuss threats and the measures put in place to circumvent them.

4.5.1 Students' lack of motivation to study Mathematics

The participants realised that in as much as they wanted the framework to work, student lack of motivation was going to have a negative impact on the implementation and that as a result student performance was not going to improve. During the meeting wherein the threats were identified Mrs Dlala (high school Mathematics teacher) commented:

> *...these students do not like Mathematics and for as long as they remain like that, there won't be any improvement in terms of performance. Emm! The question I keep asking myself is; how are we going to motivate them?... How are we going to make them love Mathematics...?*

Mrs Dlala indicated that students' dislike of Mathematics would make it difficult for the results to improve. Her words "*for as long as they remain like that*..", imply that

even if the students could attend both the lectures and the SI sessions, if they were not motivated and did not like the course it would be difficult for their performance to improve. I noted from what the teacher was saying that motivation and performance were "complementary", meaning that if students were not motivated to learn Mathematics they would not perform well. The questions that she continually asked herself: *"How are we going to motivate them?"* and *"How are we going to make them love mathematics?",* as well as her facial expression at the time she was speaking, indicated that she felt strongly that something needed to be done in order to motivate students to love Mathematics and so enhance their performance.

Mr Dinala (the subject advisor) shared the sentiment of Mrs Dlala, though felt that something could be done:

> *It is true, most of the students do not like Mathematics, but I think a lot could be done in order to make students like the subject. For instance, we have programmes such as "**Hey Math**" which could be loaded on the computers. I like these programmes because students get to learn and understand Mathematical concepts while playing and having fun!*
>
> *Mr Chikuka* (Adding to what was said)*: ... We could also invite the career counsellor in some of our meetings so that he could inform our students about the exhilarating career prospects in Mathematics...*
>
> *Ms Lerole* (Also adding to what was said)*: ...I think we could also invite the specialist who could show students how what they are doing is related to what is happening in real world...*

The subject advisor (Mr Dinaala) also agreed that most students did not like Mathematics, however, he thought that much could be done in order to reverse this. He pointed out the use of "*Hey Math programme*" as one way of engaging students in learning and ensuring that they understood the Mathematics course. The tactic which he liked about the use of the programme was that students were going to play while simultaneously learning and understanding the content. The subject advisor believed it was necessary to capitalise on what we knew students

liked (which in that case was the use of computers) and use it to their own advantage.

Mr Chikuka (the Economics lecturer) on the other hand, was still trying to provide a solution to the challenge of students who dislike Mathematics. He recommended that we invite the career counsellor to our meetings with the students so that he could inform students about the interesting Mathematics career prospects. The lecturer believed that somehow that would stimulate the first-year students' interest in the course and make them aware of the careers they would be missing out if they did not take the subject. According to the lecturer, students sometimes end up disliking it because they do not know what they could become or accomplish with it, therefore to him it was necessary that they be better informed.

Ms Lerole (the Chemistry lecturer) recommended that a subject specialist be invited in order to show students how the concepts they were learning were related to real life. Her belief was that the students did not like Mathematics because they did not see how what they were learning was having any relevance to real life and so were not stimulated.

The participants appeared unanimous that lack of motivation was one of the factors which could impede the functionality of SI for first-year Mathematics students. Therefore, the conclusion was that a career counsellor be invited to some meetings with the students in order to share with them career prospects in Mathematics, a strategy used in the USA (*see* paragraph 2.8.1). Although the strategies were similar, the difference in our context was that we did not only consider student counselling, but also agreed that the subject specialist be invited to chat with the students and, where possible, have a session in which he/she could teach students in a manner that would show the relevance of what they were learning to real-life situations. The SI leaders and the lecturers were thus encouraged to be part of those sessions and so gain some experience. Since lack of motivation created a negative attitude to the course and affected attendance and participation, policies and strategies to improve attendance in our context were also recommended.

4.5.2 Students attending sessions unprepared

As indicated above, students' lack of motivation was one of the risk factors that could impede the functionality of SI for Mathematics students. It was noted that this could also cause students to come to class unprepared and SI leaders to be demotivated. This was declared by the Statistics lecturer (Ms Dikobe):

> *If students are not motivated, surely they won't come to sessions prepared. I could just imagine how the poor SI leaders cope when students come to sessions unprepared and yet they are expected to engage them in collaborative learning. Even if the SI leader could come to class prepared, for as long as students are not prepared, there won't be an improvement.*

Ms Dikobe, taking into consideration what was said regarding students' lack of motivation to take the course, also noted the issue of students coming to the sessions unprepared. She emphasised that students who were not motivated would not come to sessions prepared: *"I could just imagine how the poor SI leaders cope when students come to class unprepared and yet they are expected to engage them in collaborative learning".* This showed her apprehension for the SI leaders since they were expected to engage those students in collaborative learning. Here she meant that student engagement was going to be possible if students came to class prepared and had something to share, discuss or ask. However, in the case in which students come to the sessions unprepared, effective collaborative learning would not take place and consequently the students' understanding of the course would not be enhanced: *"even if the SI leader could come to class prepared, for as long as the students who are supposed to be engaged in collaborative learning are not prepared, there won't be an improvement"*. The conclusion I drew from what Ms Dikobe was saying was that, for SI sessions to be effective, it is both the responsibility of the students and the SI leaders to come to the sessions prepared. Meaningful discussions and exchange of ideas could thus take place.

Mr Mnguni (the other Economics lecturer) noted that the SI leaders themselves could become demotivated:

...If they get to class and find that the students are not prepared, they might also be demotivated and next time come to sessions also not prepared. They would see no point in coming to the sessions prepared when students don't...

This comment showed how bad the situation could become when students lack motivation to learn Mathematics. He indicated that the students' habit of coming to class unprepared could ultimately be demotivating to the SI leaders. According to the lecturer, that would be bad in the sense that the SI leaders could stop preparing for the sessions since they would not see any point in preparing to help students who do not prepare for the sessions either. According to SISMG (2010:17), the act of SI leaders who come to sessions unprepared is discouraged as it makes it difficult for the students who attend the SI sessions to discover appropriate application of study strategies as they review content material. On the basis of that, student content knowledge could not be enriched. As the participants were deliberating on this issue I realised how shared debates made it possible for the participants to receive empowerment and enlightenment, which also makes it possible for them to foresee what could impede the SI's functionality framework.

The conclusion in that regard was that the students be given work to do and the work be monitored regularly when they attend the sessions. The other suggestion made was that the SI leaders should make their sessions interesting by designing the participative and interesting activities, as encouraged in the USA (*see* paragraph 2.6.4), since they promoted understanding of the course content.

4.5.3 Shortage of potential Mathematics SI leaders

Since the concern was with students' poor performance in Mathematics, it was also of the essence that the SI leaders, who according to Arendale (1994:3) are also the other important key personnel, are able to effectively assist students. Their capability would help students comprehend the content, however, during the forum in which the threats were identified, one of the geography SI leaders, who was also part of the team, pointed to shortage of potential Mathematics SI leaders as a potential threat to the envisaged framework:

Poloko: ...the number of students who are majoring with mathematics is so small and this makes it hard for the lecturers to appoint capable SI leaders who can effectively help students master the course.

Poloko's concern was on the limited number of the students who were majoring in Mathematics, arguing that the number was too small and made it difficult for the lecturers to select the potential and qualified SI leaders. The idea I received from what Poloko opined was that the limited pool of students who were majoring in Mathematics sometimes left the lecturers with no choice but to appoint everybody available, despite the capability and performance. Poloko thus saw that as posing a great challenge to ensuring that the suitable SI leaders were appointed.

On a differing note, Sibahle (one of the Chemistry SI leaders who was also part of the team) revealed another matter which seemed to be disturbing regarding the appointment of the SI leaders:

...I think the other challenge pertains to the kind of SI leaders we have. Some were just appointed on the basis that the lecturers know them and not necessarily because they are capable and I think that must be corrected...

Sibahle's concern was with regard to the SI leaders who were appointed without meeting the qualifications and having no potential to do the job. She indicated that at times the SI leaders became appointed on the basis of acquaintance and not necessarily because they were capable or deserving. The point made by Sibahle was that the correct procedures must be pursued and that the SI leaders be appointed in an appropriate manner, hence her remark *"I think that must be corrected"*. Sibahle's opinion on the matter was that the students would not benefit and that their performance would not be enhanced if the SI leaders did not have the potential to facilitate Mathematics' SI sessions.

Mr Chikuka (the Economics lecturer) interrupted by making a suggestion which seemed to have been the solution to the threat as identified and was acknowledged by all involved:

I would suggest that we do not only focus on third year students when we appoint the SI leaders, but that we also consider the second year students and also those who are not majoring in Mathematics, but who have also completed the modules to be tutored from other cohorts.

According to Mr Chikuka, the problem of shortage of SI leaders was caused by more focus being placed on the Mathematics majors, particularly those at third-year level, when appointing the SI leaders. He felt that those were not the only students on whom focus should have been placed as there were others, although not on third-year level, in other cohorts. His suggestion was that instead of focusing on the third-year Mathematics majors when appointing the SI leaders we should also focus on the second-year students who were also majoring in Mathematics and who had performed well. He added that other students in other cohorts who had also completed the course (Mathematics 1) and had performed well should also be considered for the position. This was also the strategy used in the USA (as indicated in chapter 2.8.2).

4.5.4 Student insufficient prior knowledge

Insufficient prior knowledge was also one of the challenges pointed during the deliberations as posing a threat towards the successful implementation of SI for Mathematics students. The participants pointed to it as follows:

Ms Vrede: We can come up with this beautiful initiative in assisting first-year students to pass mathematics. However, if students come to class having no clue about certain concepts, the sessions would not be productive.

Boipelo (the Mathematics SI leader interrupting)*: I agree with you on that. Sometimes I go to sessions fully prepared and when I get there, I would find students in a state in which they do not understanding anything! I would sometimes even refer to a grade twelve textbook just to help them understand and that wastes a lot of time...*

Ms Vrede (the Statistics lecturer), being aware of the plan that had been put in place and seeing it as a good one, however felt that students' insufficient prior knowledge was going to obstruct it and that as a result we were not going to achieve our goal: *"however if the students come to class having no clue about certain concepts then the sessions would not be productive"*. According to Ms Vrede, prior knowledge plays a large role in assisting students' comprehension of course content. She strongly felt that students' insufficient prior knowledge would make SI leaders' preparation for the sessions less prolific.

Boipelo, in agreement with what Ms Vrede was saying, showed how disadvantageous it was working with students who had insufficient prior knowledge during the sessions. Boipelo claimed that more often she would go to class fully prepared only to realise that the students would not understand what she had prepared due to insufficient prior knowledge. That made her sessions with the students less beneficial as they could not demonstrate understanding of the content. She further avowed that in trying to help them comprehend the content she would resort to using a grade 12 textbook. What I realised from what Boipelo was saying was that most of the first-year Mathematics students did not have good foundation of grade 12 Mathematics content and as such it was difficult for them to cope during the lectures or during the SI sessions. Her words *"I would sometimes even refer to a grade twelve textbook just to help them understand..."* indicated that the concepts that they were doing required grade 12 knowledge, which in that case students seemed not to have. Boipelo's concern was that it wasted time. I also noted that although she did not say it in so many words it also obstructed her plan for the session and prevented her from achieving the goals that she had set for herself during her session with the students. Boipelo's concern here indicated how serious the challenge of insufficient prior knowledge was, especially when students did not have those prerequisite skills to help them to understand the course (*see* paragraph 2.8.3).

Mr Chikuka could not waste time sharing his experiences with the rest of the team:

> *...Aha! I always complain about this. You see! These students also give us a hard time even in economics. You ask them a simple question sixteen divided by three, and they will not give you an answer! They stand up in a*

class and look for a calculator. I think it is high time that we make the department of education aware of the challenges that we come across. We cannot let the high school polish and pass things onto us just like that. Otherwise we are going to shoot ourselves in the feet. You see! When we also get tired of them, then we will also give them their fifty and let them go. Then they become the employers' headache and then they get fired and come back home and become the parents' headache and then this becomes a vicious circle...

Mr Chikuka also confirmed Boipelo's view that insufficient prior knowledge was a result of students not being taught well in high school. I took note here that insufficient prior knowledge not only obstructed the Mathematics SI sessions in that the students could not demonstrate an understanding of the course content, but it also affected other courses which required Mathematics as a prerequisite, hence the Economics lecturer's refrain: *"I always complain about this..."* The lecturer provided an example which indicated that insufficient prior knowledge made it difficult for students to master even simple basics in first-year Mathematics.

The lecturer expected the students at that level to have been in the position to answer basic questions without wasting time: *"These students also give us a hard time even in economics. You ask them a simple question sixteen divided by three, and they will not give you an answer! They stand up in class and look for a calculator..."* The lecturer's facial expression at the time he said that was filled with disappointment. He felt that the high schools were somehow failing them by not making it easy for them to do their work, hence his suggestion that the DoE needed to be confronted and informed about the challenge posed by the students who came to higher education institutions without sufficient grounding. The lecturer thus perceived insufficient prior knowledge to be one of the factors which hindered students from understanding Mathematics and made it difficult for them to build on the knowledge that they had already acquired.

The lecturer further demonstrated how severe insufficient prior knowledge is, as it could affect students not only in class but also beyond. According to him, students do not get to be taught well at high school level, nonetheless they obtained a pass

at the end of the year and proceeded to higher education institutions wherein the challenge becomes palpable. However, because these students are also expected to pass (in higher education institutions), the lecturers also act as do the high school teachers in letting them proceed to the next level without proper grounding, until they complete and find employment. The lecturer said that when the employer is dissatisfied with these students (as employees) he or she would dismiss them and they would be left with no choice but to return home and trouble their parents. The point the lecturer was trying to make here was that if insufficient prior knowledge is not addressed students would not understand the content and consequently, they would not improve in their academic performance or become productive citizens.

After lengthy deliberations on this issue, Mr Mokone (Mathematics lecturer) suggested the use of problem based learning (PBL), which most participants, especially the SI leaders and the students, seemed not to be familiar with, as one way of assisting the students in understanding the course content and bridging their knowledge gap:

> *I would suggest that we use problem based learning. I'm not sure how many of you know about it. It is just another way of teaching students by first presenting them with a problem and then the students can then use whatever they know to try to solve the problem. What is interesting about it is that the students who think that they do not know would then realise that they could still solve the problem anyway.*
>
> *Ms Vrede* (interrupting the subject advisor): *It sounds interesting I know, but then I wonder if the SI leaders are familiar with it.*
>
> *Pule:* (also interrupting): *It is for the first time I hear about this, but I must indicate that it sounds interesting and I believe that it could assist.*

Mr Mokone's suggestion in trying to address the issue of insufficient prior knowledge was that the PBL be used. According to him, this would allow students to be engaged in their own learning in that they would be presented with a problem and expected to solve it using whatever knowledge they had. From what he was saying, it seemed as if PBL would make it possible for students to be

actively engaged in their own learning, since they were going to apply whatever knowledge they would have acquired to solve the problem given to them.

Ms Vrede found the strategy to be appealing, although she wondered if the SI leaders knew how to apply it as one way of teaching the students. She wondered because she was used to visiting her SI leaders during their sessions with the students and she had not once seen them applying that strategy. Pule, on the other hand, confirmed that indeed they did not know about the strategy. However, he indicated that it sounded interesting and he believed that it could work. His words: *"but I must indicate that it sounds interesting and I believe that it could assist a lot"* indicated that he liked the strategy as briefly explained by Mr Mokone and he believed that it could somewhat help solve the problem of student insufficient prior knowledge.

The conclusion therefore was that both the SI leaders and the lecturers should undergo training on PBL. Since the high school teachers and the subject advisors were also part of the team it was suggested that they inform the superior stakeholders within the DoE about the findings of this study, particularly on the issue of student insufficient prior knowledge, since it also emerged that students performed poorly because they had no good background of the subject from high school. The expectation was to see the DoE making sure that the teachers provide students at a high school level with education that would make it possible for them to cope with the curriculum at the higher education institution.

The participants were unanimous that insufficient prior knowledge posed a threat to the envisaged framework. On the basis of that, the idea of establishing learning communities as in chapter 2.8.3 was also suggested as a way in which the courses which were typically connected by a theme that gave meaning to their linkage could be dealt with simultaneously. That way, the students could apply the knowledge which they would have acquired from the other course to the other one.

4.6 EVIDENCE OF A SUCCESSFUL FRAMEWORK

This section provides indicators of success for the envisaged SI framework.

4.6.1 A coordinated plan

The creation of strong collaboration between the lecturers and the SI leaders made it possible for the coordinated plan to be established. Through this collaboration, lecturers and SI leaders developed strong working relations which resulted in lecturers fully supporting the SI leaders, with *inter alia* the plan for the SI sessions. The Mathematics departmental head made clear the plan by ensuring that the pacesetter was drawn, reflecting all the activities that needed to be done and also detailed other aspects such as responsible people, timeframes, and resources required to perform activities. This made it possible for all the people to know what should happen, when and how. The formation of a team which debated the problem and the extent to which it impacted on the programme made everybody understand the situation. The lecturers and the SI leaders then realised how important they were regarded in altering the situation. They became dedicated to making a success of the programme and making the team that backed them proud.

The success of the establishment of a coordinated plan was acknowledged by the two Mathematics SI leaders during the reflection meeting as follows:

> *Theko: We knew all what we were supposed to do with the students during our sessions. We planned in advance and our plan made it possible for us to be on top of our game. No wonder why students performed well.*
>
> *Boipelo: Our plan worked perfect for us. Had it not been because of it I think we would have still be talking about student poor performance.*

Theko acknowledged that a coordinated plan worked for them as the SI leaders, that through it they were able to plan in advance and this helped them to facilitate effective sessions which profited the students: "…*We planned in advance and our plan made it possible for us to be on top of our game*". The plan also enabled

them to know which areas they were supposed to help students with during the sessions, which is why they were always on point. Theko thus attributed the performance of the students to a coordinated plan which had been established. Boipelo agreed fully, and acknowledged that the plan enabled them to hold prolific SI sessions with the students: "*Our plan worked perfect for us*". She added that if the coordinated plan was not established the students would still not be doing well: *"I think we would still be talking about student poor performance".* This was an indication that the situation had been altered, meaning that the performance of the students in Mathematics had improved as a result of establishing a coordinated plan.

4.6.2 Articulated vision and ownership

The vision of SI which was clearly communicated not only to the students but also to the campus community at large brought about understanding. The programme thus received more recognition as all the people understood what it stood for. Through understanding of what was intended to be achieved with the programme, and also through the realisation of how it was contributing to the success of the students, people developed a sense of ownership. This point was even clearer when it was highlighted by Ms Vrede also during the reflection session:

> *It really helped to receive clarity on the programme's vision. The understandings that we got brought us closer to one another and made us share the same sentiments of making a success of the programme.*

Ms Vrede's opinion was that their understanding regarding the SI vision gave all the participants a common goal which was to make the success of the programme for the benefit of the first-year Mathematics students whose performance was startling. The clarity, understanding of the vision and its support from the team members thus developed a strong sense of ownership amongst the people.

4.6.3 Content development

The content developmental workshops which were organised for the SI leaders provided the SI leaders with an opportunity to enhance their skills. The workshops not only increased the SI leaders' understanding of the course but also empowered them on the effective ways in which they could convey such knowledge of the content to the students. Lebo (the SI leader) agreed fully and said during the reflection meeting:

> *Understanding content made me feel confident in class. I was able to respond to all the questions that students asked and that made me feel good.*

Lebo's point here was that the content developmental workshop sessions not only enhanced their comprehension of the course content but it also increased their confidence. This restored their dignity as the SI leaders as students looked up to them. The content developmental workshops also enabled the SI leaders to respond well to the questions the students asked during the sessions. This therefore means that as a result of the developmental workshops on content, the students benefited from the sessions as they received answers and clarity on their questions.

4.6.4 Lecturers' training on SI technique

The training of the lecturers on SI techniques of collaborative learning brought about the success of the programme. The lecturers' understanding of what was required for the SI sessions to be effective contributed to the success of the intervention. After the training, the lecturers helped the SI leaders not only with the session content preparation but also with the application of the appropriate SI techniques of collaborative learning to be followed when planning for the SI sessions. All the Mathematics lecturers were happy about the training they received during the meeting:

After the training of we had meaningful plannings with the SI leaders. We would plan on content which students found challenging and then identify the techniques that will best assist the students in understanding the content.

The point made by Mr Mazibuko was that the training on SI techniques of collaborative learning contributed meaningfully to making their SI leaders' plans for SI sessions to be effective. They were able to identify the relevant techniques that would promote understanding of the Mathematics course content based on the content to be dealt with. This therefore means that the SI leaders received support from the lecturers which enabled them to effectively assist the students.

4.6.5 Effective instructional strategies and student engagement

The trainings and workshops on the effective application of instructional strategies and student engagement helped students understand the course. The effective use of these strategies by the SI leaders also contributed in improving students' performance. Mr Mokete acknowledged the successes of the effective use of the strategies:

The workshops on student engagement have been helpful. The performance of the students has improved looking at the assignments and the projects that we give them.

Ms Vrede (interrupting)*: I agree. I don't even have a doubt that the results would be much better at the end of the semester.*

Mr Mokete confirmed that the instructional strategies and student engagement workshops helped the SI leaders to effectively engage students in meaningful learning. He further pointed out that the students' performance in the assignments and the projects had improved as a result. Ms Vrede confirmed that indeed the students' performance had improved and she believed that the results would still improve at the end of the semester. Her words: *"I don't even have a doubt that the results would be much better at the end of the semester"* indicate that she strongly

believed that the results at the end of the semester would be better than the results on the assignments and projects.

From the above section it is evident that a well implemented SI for Mathematics students increases students' understanding of the course content and improves their performance. A well-implemented SI benefits all involved and helps students improve problem-solving skills, retain learned concepts and build frameworks for future learning. All these benefits agree with the findings in chapter 2.2.9.

4.7 CONCLUSION

This chapter has provided analysis, presentation and interpretation of results and findings on enhancing the functionality of SI for first-year Mathematics students. The chapter paid attention on how the data was analysed, interpreted, presented and discussed. That was in line with the objectives of the study, as mentioned in chapter one (*see* paragraph 1.2). There were extensive sources of data, including the forums and brainstorming sessions in which we jointly indicated that there was a need for the formulation of such a framework. The data identified the challenges pertaining to the implementation of SI. It also considered solutions to address the identified challenges regarding the enhancement of Mathematics SI's functionality framework.

The conditions for effective implementation of SI framework were also discussed. Likewise, the risks factors or threats that could make the framework fail were also anticipated, and the steps to evade them put in place. The chapter presented the actions and strategies that would then be developed and prioritised for implementation of the framework. These were subsequently operationalised as part of enhancing the functionality of SI for first-year Mathematics students.

The next chapter will discuss the findings in this study.

CHAPTER 5

ENHCANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The study sought to formulate the framework to enhance the functionality of SI for first-year Mathematics students at the institution of higher learning. This chapter provides a summary of the findings, draws conclusions and makes recommendations for the enhancement of the SI's functionality for Mathematics students at a higher education institution. The chapter will then report findings on the challenges that rationalised the formulation of the framework to effectively implement SI for first-year Mathematics students. It reports on the components of the solutions, the conditions that made them work and the threats that could impede the successful implementation of the envisaged framework. Lastly, the chapter will report on the evidence which shows that the framework worked.

The main purpose of the study is to respond to the research question for this study namely: ***How can we enhance the functionality of SI programme for first-year Mathematics students at a higher education institution?***

In pursuance of this purpose, five objectives were stated:

i. To explore the need to formulate a framework to enhance the functionality of a Supplemental Instruction programme for first-year Mathematics students at a higher education institution.

ii. To identify and analyse the components that constitute a functional supplemental instruction framework.

iii. To identify the conditions conducive for enhancing the functionality of such an SI framework

iv. To identify the threats that could impede the successful implementation of SI

vi. To recommend a framework that may enhance the functionality of SI for first-year Mathematics students at a higher education institution.

5.2 SUMMARY OF THE STUDY

This study sought to formulate the framework to enhance the functionality of SI for first-year Mathematics students at a higher education institution. The need to enhance the functionality of SI for Mathematics students and other steps taken in establishing a team that would enhance the functionality of SI for Mathematics students was discussed in chapter 3.3.3. The participants indicated that poor performance was a serious problem which needed to be altered. They were thus more than thrilled to be part of the project aimed at improving student performance in Mathematics. We then identified other people who were also affected by the situation so that they could also be part of the project. These were the people who we thought would share their experiences and later help us devise solutions to address the challenges (*see* paragraph 3.4.1).

This study was guided by CER as the theoretical framework that supported the argument thereof. This lens enabled me as a researcher to view the people involved in the project as capable human beings who could speak and contribute to making a difference in their own situation and not to regard them as molecules in a laboratory (Myer, 2004:111). CER made it possible for me to create a platform on which human subjects could be treated with respect and be allowed to speak regarding matters affecting them (Campanella, 2009:2). Furthermore, CER provided me as a researcher with an opportunity to play a role of interpreting other people's interpretations in trying to make sense of them. This way, I was able to search for a deeper meaning by looking into all sides of the story (Mahlomaholo, 2009:225-226). The use of CER in this study was significant since the people involved were the ones affected by the situation and they were expected to provide solutions to their own challenges, thus receiving empowerment and enlightenment. All the participants were free to share their experiences and to

propose what needed to be done to enhance the functionality of SI for Mathematics students since the values which were advocated allowed them to do so. These values were peace, hope, freedom, social justice and equity in its all forms (MCgregor 2003:4). The use of CER also helped during the conversations that we had by defusing power and preventing excess of it (Francis, Mahlomaholo & Nkoane, 2010:32). This way the participants, particularly those who were marginalised, were able to voice their opinions within a relaxed platform on which their voices were valued and embraced.

The operational concepts were also defined comprehensively (*see* paragraph 2.3). The related literature was also consulted in order to see how SI was implemented in other higher education institutions in the RSA, Nigeria and the USA. This was to enable us to learn from these institutions as we try to devise our own framework. In order to get the empirical data, the principles of Participatory Action Research (PAR) were used. According to Dwyer, Happell, Kahl, Morris, Moxham, Reid-Searl and Wheatland (2009:1314), a collaborative relationship between research team and educationists in identification of relevant challenges within the education system and potential solutions is a key feature of action research, a process that unifies theory, research and practice. In line with this, PAR enabled me as a researcher to work together with the participants in identifying the challenges and also providing solutions to them.

Kemmis and McTaggart (2000:595) argue that forums empower stakeholders by engaging them in research then collectively developing or implementing activities to alter the situation around. Therefore, in this study, data was generated through discussion forums and brainstorming sessions, later on actions implemented in order to alter the situation around (*see* paragraph 3.4.2). Critical discourse analysis was used to analyse and interpret data as discussed in chapter 3.3.5. The generated data revealed that for SI to be functional there was a need to have a coordinated plan; the vision needed to be clearly articulated and owned by all the people involved; the content knowledge of the SI leaders needed to be enhanced so that they could help students to understand the first-year Mathematics course; the lecturers' knowledge of SI techniques needed to be enhanced so that they could fully assist the SI leaders by making their sessions

productive and beneficial to the students; and the SI leaders' knowledge regarding the application of effective instructional strategies and student engagement needed to be enhanced. Based on how the study unfolded, findings were drawn, recommendations and conclusions made (*see* chapter 5). The proposed framework to enhance the functionality of SI for Mathematics students was also outlined, based on the unfolding of the study and lessons learnt thereof (*see* Chapter 6).

5.3 FINDINGS ON THE CHALLENGES TO THE IMPLEMENTATION OF SI

The following sections report on the findings according to the objectives of this study as mentioned in chapter 1.1.2, beginning with the challenges.

5.3.1 The absence of a coordinated plan

The deliberations we had during the forum, when challenges were identified, revealed the absence of a coordinated plan. This emerged to be one of the factors that caused SI for first-year Mathematics students to be non-functional. As a result of not having a coordinated plan SI leaders had to attend sessions not knowing what to do in class, and when or how to do what they had to do (see paragraphs 2.5.1 and 4.2.1). In some instances, SI leaders found themselves offering different topics to their respective students, thus creating confusion in the students. Moreover, due to lack of coordinated plan effective lesson plans could not be developed and the SI sessions for the students did not become as beneficial as they should have. Lack of coordinated plan also led to SI leaders' frustration as they could not calculate or identify the areas which were problematic to students which they needed to assist them with, since lecturers did not provide such information on them. Other SI leaders thus felt embarrassed as students posed questions that they did not prepare for and could not provide explicit answers to the students at the time. When all these occurred the students for whom the programme was intended did not benefit from the sessions nor did their performance. Some authors, as highlighted in chapter two (Arendale, 1994:2;

Congos & Schoeps, 1993:166; Obiunu, 2008:237) also found lack of coordinated plan to be a serious challenge to SI first-year Mathematics students' functioning.

5.3.2 Lack of an articulated programme's vision and ownership

The discourses that emerged during the forum in which the challenges were identified, indicated lack of articulated programme vision and ownership as other challenge to functionality of SI for first-year Mathematics students. According to the generated empirical data and the literature (*see* paragraphs 2.5.2 and 4.2.2), there was no clear explanation provided to the stakeholders regarding the programme's vision. As a result students did not know what the programme was envisioned for. Other students did not know when to attend the sessions or who was eligible to do so. Most regarded it as a remedial programme aimed at assisting students who were not clever, thus "stigmatising" it. What also emerged as a finding was that the lecturers who did not receive clarity about the programme's vision could not uphold it, even though literature says little about this. These lecturers thus felt that SI was an imposition on them and felt that since they were expected to be part of it they should just "*go with the flow*", meaning that they should do what they were expected to do even though they had no idea. In addition, these lecturers could not have ownership of the programme.

As documented in chapter 2, a number of authors (Bengesai, 2011:66; Bentley, 2009:144 & Malm *et al.,* 2012:39) have also found lack of articulated SI programme vision and ownership to be a challenge which causes SI for Mathematics students not to be functional. They also discovered that students who did not have ownership of the programme tended not to attend the sessions and provided poor excuses.

5.3.3 SI leaders' inability to utilise effective supplemental instruction strategies

The other challenge revealed by the discussions was the SI leaders' inability to effectively apply teaching strategies. Findings also indicate that in numerous instances the SI leaders used re-lecturing as a teaching method and thus regarded students as "clean slates". The leaders were the only ones talking, dominating the sessions and feeding students with information instead of letting them engage in problem-solving and discovering answers for themselves (*see* paragraphs 2.5.3 and 4.2.3). This created a tense atmosphere which did not contribute to student development or mastery of subject content. As a result, students could not demonstrate understanding of the course as they lacked exposure to different ideas and more ways of thinking about the different Mathematical concepts that result from shared debates. The SI leaders by so doing also created an atmosphere which could not emancipate students' minds. They set themselves as "better teachers" to the students and thus portrayed a picture which indicated that they knew more than the students themselves. Congos *et al.* (1993:166) and Hensen *et al.* (2002:250) have also found re-lecturing of students by the SI leaders to be one of the factors causing student understanding of Mathematics course content not to be improving, hence they discouraged it.

5.3.4 The SI leaders' inability to effectively engage students in meaningful learning

Under this topic, the discussions revealed that the SI leaders could not effectively engage students in their learning and that the SI leaders who could not effectively engage students in their own learning made it difficult for them to develop high order thinking skills such as analysis, synthesis and evaluation, as the guideline and the literature showed (SISMG, 2013:23; McGuire, 2006:4). Since the students were not provided with the opportunity to work in groups, the SI leaders thus could not identify gaps or students' misconceptions which they could have noted had they allowed students to freely discuss with them in their respective groups.

Consequently, they could not reflect on effective strategies that might respond to students' misconceptions about the course content. Lack of student engagement in their own learning also deprived students of opportunities to engage in a dialogue that might increase their knowledge and understanding of the course content. Due to lack of student engagement, the students' voices could not be heard during the sessions. Findings under this topic further indicate that large classes which the SI leaders had to facilitate also made it difficult for the SI leaders to conduct sessions, since they were by no means experts in the teaching of large classes. Many authors (Bengesai, 2011:62, McGuire, 2006:3; & Harding *et al.,*2011:851) have also discovered the SI leaders' inability to effectively engage students in their own learning, thus not increasing student metacognition, not developing their high order thinking skills (such as analysis, synthesis and evaluation) and not increasing their understanding of Mathematics content.

In response to objective 1 of the study, paragraphs 5.3.1 to 5.3.4 confirmed that the challenges regarding the implementation of SI in institutions of higher education existed. This is supported by the absence of a coordinated plan, lack of articulated programme vision and ownership thereof, the SI leaders' inability to utilise effective SI strategies and inability to effectively engage students in meaningful learning. These challenges thus necessitated the framework to be formulated in order to enhance the functionality of a Supplemental Instruction programme for first-year Mathematics students at a higher education institution.

5.4 FINDINGS ON THE COMPONENTS OF THE SOLUTION

The following sections present findings on the components of the solutions to the challenges experienced.

5.4.1 The establishment of a coordinated plan

The generated data indicated that for SI to be functional the coordinated plan needed to be established (*see* paragraph 4.3.5). The coordinated plan enabled

the SI leaders to know which areas they needed to address during the sessions with the students. Findings in this study also indicated that, unlike in the rest of the RSA and the USA, wherein only weekly meetings were held in order to devise a plan (*see* paragraph 2.6.1), it was also necessary to also draw a pacesetter which would reflect areas that needed to be dealt with, specify how long those areas needed to be dealt with so that all the concepts could be covered. This plan needed to be shared with all the people involved, for example, lecturers, SI leaders, SI personnel, institution administration and the students, so that they could all follow it. This way, the SI leaders would deal with the topics related to those that lecturers presented during the lectures with the students and this would subsequently eliminate student confusion. Zaritsky *et al.* (2006:29) also have discovered the establishment of a coordinated plan to be helpful in making SI for Mathematics students functional.

5.4.2 Articulation of the programme's vision and taking ownership thereof

Our discussions on this topic revealed mixed feelings amongst students on the SI programme. The empirical data however showed that clear articulation of its vision during the orientation session, by all the students for whom it was specifically designed, helped them have a clear idea of why it was envisioned (*see* paragraphs 4.3.5 and 2.6.2). Findings indicate that although the strategy seemed to be effective it was also recommended that the articulation of the programme's vision be extended to other stakeholders within the institution, not only to the students as was the case in the rest of the RSA and USA (*see* paragraph 2.6.2).

The findings indicate that awareness sessions regarding the programme needed to be frequently presented to the students and other stakeholders within the institution so that they do not lose sight of what its vision entails. The steps taken to clearly articulate the vision enabled the stakeholders to have an understanding of what the programme was intended for and what their roles were in making the programme achieve its goal. They further assisted in developing a sense of ownership by the stakeholders. Authors (Boud, Cohen & Sampson, 1999:415; Harding *et al.,* 2011:851) have found a clear articulation of the programme's vision

to be significant in ensuring understanding of it. Articulation of the programme's vision was helpful in developing a sense of ownership by the stakeholders.

5.4.3 Content capacity development for SI leaders

From the deliberations, content capacity development for the SI leaders emerged as one issue which the participants felt strongly should be tackled in order for SI for first-year Mathematics students to be functional. Findings also indicated that the subject specialists needed to be the ones providing capacity development on content. There is a need for content capacity development workshops for the SI leaders to be frequently conducted in order for their content knowledge to increase and for students to benefit from that knowledge. Although the SI guideline does not say much about this, the DoE, (2012:2) and Harwell (2003:v) have found it to be vital in improving student performance.

5.4.4 Capacity development on the effective use of teaching strategies and student engagement

The empirical data also indicates that workshops on effective use of teaching strategies and student engagement are necessary. Although literature and the guidelines emphasise the need of such skills during the SI leaders' training before the sessions commence (Jacobs *et al.*, 2008:7; SILMG, 2013:7), findings in this study indicate that such workshops need to be offered on a continuous basis by the trained SI coordinator (*see* paragraph 4.3.5).

The frequent workshops on SI instructional strategies and student engagement would equip the SI leaders with the skills and knowledge to effectively conduct their sessions and make their sessions beneficial to the students. Moreover, it will help the SI leaders to effectively engage students in their own learning and thus increase the students' understanding of the course content. Other authors (Skinner & Belmont, 1993:572) have also found student engagement to be efficient in making students show generally positive emotions during classroom

activities (problem-solving), including enthusiasm, optimism, curiosity, and interest, which consequently helps them improve in their performance.

In response to objective 2 of the study, the abovementioned (5.4.1 to 5.4.4) provide findings on the solutions to the mentioned challenges that existed in an attempt to enhance the functionality of an SI programme for first-year Mathematics students at a higher education institution.

5.5 CONDITIONS NECESSARY FOR THE SOLUTIONS TO BE EFFECTIVE

The following sections report on the conditions that made the solutions work as indicated by the participants.

5.5.1 Conditions that made the establishment of a coordinated plan successful

The empirical data in this study indicates that before the coordinated plan could be established, meetings were held wherein the creation of strong collaboration between the SI leaders and the lecturers was encouraged. Their roles and responsibilities were also explicitly outlined in the meetings, which made it possible for the coordinated plan to be established since lecturers and the SI leaders knew what they were supposed to do together (*see* paragraphs 2.6.1 and 4.4.1). The willingness of both the SI leaders and the lecturers to work collaboratively also made it possible for the coordinated plan to be established, especially because they realised its significance in the running of the successful Mathematics SI programme. The presence of the academic head in the project and his voice in encouraging strong collaboration between the lecturers and the SI leaders made it possible for the coordinated plan to be established. The involvement of the departmental head also assisted in the establishment of a coordinated plan as he played a significant role by ensuring that all the SI leaders together with their lecturers came together and drew the plan that they would all

follow. Although other authors (Bentley *et al.,* 2009:144) encourage the establishment of a coordinated plan by the lecturers only, findings indicate a need for the head of department, lecturers, SI leaders and the students to draw up the plan as a collective.

5.5.2 Factors which made the articulation of the programme vision understood and espoused

The discourses under this topic indicate that in order to ensure the clear articulation and ownership of the programme vision the participants should apply a similar strategy to the one used in the rest of the RSA and USA (*see* paragraph 2.7.2). They communicated the vision to the students during the orientation session when every student was present and also by allowing the faculties that regarded themselves as “gate-openers” rather than “gatekeepers” to be part of the programme. These faculties promoted the SI vision to their students and encouraged them to attend sessions and to also work diligently. Findings further indicate that the platform needed to be created wherein the students’ questions could be answered in order for clarity to be established regarding the vision. The findings indicate that frequent communication about the vision increased understanding of the stakeholders and developed the sense of ownership. Other authors (Cartwright & Baldwin, 2007:6) also recommend that the vision be shared by all the people involved in order for it to do what it is meant to do.

5.5.3 Conditions that made the SI leaders’ content capacity development successful

The discussions revealed that the use of the subject specialists (lecturers) to provide the SI leaders with content capacitation enhanced the SI leaders’ Mathematics course content. The platform created for the SI leaders to freely engage in discussions and receive clarity on certain Mathematical concepts also contributed to enhancing their content knowledge. The practical exercises in which they engaged in during the workshops increased their content knowledge and thus

made it possible for the students to acquire knowledge from the SI leaders. Their confidence was elevated, which contributed significantly to enhancing their facilitation skills. The first-year Mathematics students thus benefited from the sessions offered by the SI leaders. Empirical data further indicates a need for frequent attendance of first-year Mathematics content capacity development by the SI leaders. Tsotetsi (2013:218) endorses regular attendance of the Mathematics SI leaders' content capacity development programme.

5.5.4 Conditions necessary for successful implementation of supplemental instruction strategies and student engagement

Discussions also revealed that frequent encouragement to the SI leaders not to act like lecturers during the sessions promoted student debates in class. The SI leaders allowed students to sit in small groups, which allowed them to interact. They refrained from "spoon feeding" the students by giving them answers, but they acted as mere coaches and facilitated the students' problem-solving discussions. In this way they created a platform on which students could open up and to discuss freely, commit mistakes and learn from such mistakes within an environment that was not intimidating and there was no figure of authority (lecturer). Findings indicate that although it was important for these issues to be encouraged during the SI leader training session, it was also of vital importance that frequent workshops on student engagement be offered from time to time by the teaching and learning champion (TLC), who is an expert, so as to make SI leaders aware of its significance in the teaching and learning arena.

In response to objective 3 of the study, the abovementioned conditions (5.5.1 to 5.5.4) indicate the conditions which made the solutions work in an effort to enhance the functionality of a Supplemental Instruction programme for first-year Mathematics students at a higher education institution.

5.6 THREATS TO THE SUCCESSFUL IMPLEMENTATION OF SI

The following sections report on the findings of the threats which were anticipated and measures put in place to counter them.

5.6.1 Findings on students' lack of motivation

Both literature and the empirical data indicated that students' lack of motivation was one of the factors that caused first-year students not to perform well in Mathematics (*see* paragraphs 2.8. and 4.5.1). Findings in this study also indicated that as long as students lack motivation to take Mathematics their performance will not improve. The findings also show that students who lack motivation usually come to sessions unprepared. The SI leaders thus find it difficult to engage such students in their own learning. Furthermore, the findings indicate that when students regularly come to sessions unprepared, the SI leaders become demotivated and also see no reason to prepare for the sessions.

Although lack of motivation caused students not to perform well, empirical data indicated that it could be addressed by using interesting programmes such as "hey math". This programme, amongst other benefits, would provide students with an opportunity to play Mathematical games while learning content. Another solution suggested by the participants was to invite a career counsellor who would provide students with valuable information regarding exciting careers in the field of Mathematics. Another solution as noted by both literature and the empirical data was to allow the subject specialist to show students relevance by relating Mathematical concepts to real-life situations (*see* paragraphs 2.8.1 and 4.5.1).

5.6.2 Scarcity of potential and qualified Mathematics SI leaders

Another finding that emerged from this study as indicated by both the empirical data and literature was the shortage of the qualified and potential SI leaders since the selection was usually made from the third-year Mathematics level. Although that seemed to pose a threat, since there was a limited pool from which to select

the potential Mathematics SI leaders to assist the large number of first-year students, it was therefore suggested that selection be made from other cohorts in which the students have also done well in similar Mathematics course (*see* paragraphs 2.7.2 and 4.5.2). Empirical data also indicates that finding other potential SI leaders from other cohorts assisted in lessening the workload of the SI leaders and also afforded them a chance to pay sufficient attention to their studies.

5.6.3 Students' insufficient prior knowledge as a threat to the successful implementation of SI for mathematics students

Both the literature and the empirical data indicated student insufficient prior knowledge to be also one of the threats to the successful implementation of SI. Even if the students could attend sessions regularly, if they have insufficient prior knowledge they would not learn easily (*see* paragraphs 2.8.3 and 4.5.4). They would not even be able to build new knowledge. Both literature and the empirical data further indicated that students who had insufficient Mathematics prior knowledge experienced difficulties also in other courses which required Mathematics as a prerequisite (*see* paragraphs 2.8.3 and 4.5.4). Although that was the case, problem based learning was recommended by the participants as a solution that could address insufficient prior knowledge as a challenge. The other finding from this study was that the DoE needed to be made aware of students who came to institution of higher education with insufficient prior knowledge. The finding thus indicated the need for the DoE to work closely with the institutions of higher learning since the students that they teach enrol with these institutions after grade 12 (*see* paragraph 4.5.4).

5.6.4 Students coming to class unprepared

One of the findings that emerged from this study was that the first-year Mathematics students usually attended the SI sessions unprepared. Although the guideline encourages SI leaders to come to class prepared (SILMG, 2010:13), findings from this study indicate that as soon as the SI leaders realised that the

students came unprepared more often to the sessions, they became discouraged. They saw no reason for coming to the sessions prepared when the students did not. This then led to a situation wherein sessions were not productive or beneficial for students (*see* paragraph 4.5.2). In response to objective 4 of the study, the aforesaid factors (5.6.1 to 5.6.4) were anticipated as threats to the successful implementation of an SI programme for first-year Mathematics students at a higher education institution.

5.7 INDICATORS OF THE PROGRAMME'S SUCCESSES

There follow findings on the indicators of successes for the envisaged framework.

5.7.1 The presence of a coordinated plan

Findings indicate that the establishment of a coordinated plan helped in ensuring that both the lecturers and the SI leaders knew, *inter alia*, which topics they needed to address in class. The pacesetter also helped in ensuring that similar concepts were dealt with by the lecturers and the SI leaders simultaneously and that nobody deviated from the plan. Through the establishment of a coordinated plan student confusion was eliminated as all the lecturers and the SI leaders followed a common plan, thus dealing with similar concepts at all times. The plan thus ensured synchronisation of the activities and eliminated clashes and overlaps (*see* paragraph 4.6.1).

5.7.2 The articulation of the vision and taking ownership thereof

Findings indicate that frequent articulation of the programme's vision to the students and to all the other structures within the institution enlightened the people, with the result that they began to uphold this vision. Findings also indicate that when the programme's vision is clearly articulated and owned by everybody involved, including the lecturers and the SI leaders, they will try their best to

ensure that they work towards the attainment of the programme's goals. For instance, the lecturers will help the SI leaders prepare for the SI sessions to enhance its effectiveness, the students will regularly attend the sessions and the SI leaders will be available for all the sessions with the students (see paragraph 4.6.2).

5.7.3 SI leaders' content capacity development

The findings that also emerged from this study indicate that content capacity development enriched the SI leaders' Mathematics knowledge. The students thus benefited from the knowledge which they acquired from the SI leaders. The planned SI sessions were thus prolific to the students and their performance improved. Moreover, the findings indicate that the confidence of the SI leaders also improved as a result of receiving content capacity development (*see* paragraph 4.6.3).

5.7.4 Lecturers' capacity development on SI techniques

The discourses that emerged indicate that the capacity development on SI techniques of collaborative learning enabled the lecturers to effectively assist the SI leaders with the preparations for the sessions. The lecturers fully supported the SI leaders by making their sessions productive since they were able to refine their material and also suggest the appropriate and effective instructional strategies that would respond to the student' needs (*see* 4.6.4).

5.7.5 Effective teaching strategies and student engagement

Findings from this study indicate that the SI leaders' teaching strategies which were centred around the active collaborative learning principles allowed students to discuss the course material and to practice the skills necessary to master the first-year Mathematics content. All these happened because the SI leaders did not

dominate the sessions but rather guided and facilitated the discussions during the sessions and helped in clarifying the concepts with which students struggled. Engaging students effectively in their own learning helped students to better comprehend the course material, to develop more cognitive processing of material and through intense discussions in class, to become exposed to new ideas and more ways of thinking about things (*see* paragraph 4.6.5).

In response to objective 5 of the study, the abovementioned successes (5.7.1 to 5.7.5) serve as evidence that the strategies worked in terms of enhancing the functionality of a Supplemental Instruction programme for first-year Mathematics students at a higher education institution.

5.8 RECOMMENDATIONS

A recommendation that could be made from this study is that for SI to be functional, it should be the responsibility not only of the lecturers and SI leaders who are regarded as the primary stakeholders, but also of the institution at large. This means that other stakeholders who are involved must also be allowed to voice their opinions in doing so. For instance, in this study, in providing the solutions to the challenges which were faced by the Mathematics students, lecturers and students from other faculties whose SI was effective were able to share their successes and through those shared debates were able to learn. The Mathematics teachers from high schools also shared their experiences together with the learning facilitators and their contributions contributed greatly to making the envisaged framework successful.

All these therefore suggest that SI must be the entity that is owned by everybody since it is aimed at improving the performance of the students about whom we are all concerned. Teamwork in this regard is thus of vital significance since it can make it possible for the stakeholders to succeed in enhancing the functionality of SI for first-year Mathematics students.

5.9 LIMITATIONS OF THE STUDY

As this study was conducted, there were times when we could not meet on the scheduled dates due to high school teachers' schedules being tight since they had to conduct extra classes for their matriculants. In certain instances we could not meet due to our schedules clashing, whereby less than ten participants would show up for the meeting. In these instances we rescheduled for the weekends, when everybody was available. We did that by reaching a consensus about the venue, date and time for the meeting.

Although this study was conducted at an institution of higher education, it should be noted that the findings cannot be applicable to all institutions since they operate differently under different circumstances. However, in institutions where similar challenges are experienced under similar conditions to those of the one under study, the findings of this study could apply.

5.10 RECOMMENDATIONS FOR FURTHER RESEARCH

This study was aimed to enhance the functionality of SI for first-year mathematics students. In an endeavour to do that, several issues were debated amongst the participants and solutions arrived at. Even though the study addressed challenges experienced with regard to the implementation of SI, issues pertaining to the creation of sustainability SI groups of students and the extent to which they become learning communities that continue even outside the SI supported course (Fayowski *et al.,* 2008:853) were not addressed and thus require further research. The other recommendation for further research is for the researchers to look into effective ways of tutoring which enhance students' understanding of the mathematics content.

5.11 CONCLUSION

This chapter has presented the findings of the study according to the objectives of the study as mentioned in chapter one (*see* paragraph1.2). The summary of the

study also received attention in this chapter. Furthermore it provided the recommendations made in the light of the findings of the study. The limitations of the study also received attention.

The next chapter will present the proposed SI framework for enhancing the functionality of SI for Mathematics students as informed by the lessons learnt from the unfolding of the study.

CHAPTER 6

A PROPOSED FRAMEWORK FOR ENHANCING THE FUNCTIONALITY OF SI FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

6.1 THE PILLARS

There are five pillars of SI, namely, the students, SI leaders, lecturers, SI supervisor and the institution administration, as indicated in Table 7.1 (below). The four pillars, SI leader, lecturer, SI supervisor and the institution administration need to effectively exercise their roles in order to help students improve on their performance.

6.2 TEAMWORK

Table 7.2 (below) indicates that for student performance to improve, teamwork needs to prevail between the pillars (SI leader, lecturer, SI supervisor and institution administration). *Inter alia*, the team needs to have open and clear communication, be committed to a common purpose, be provided with clear expectations and have regular meetings that will encourage new ideas. It further needs to have an idea of who performs what so that they can complement each other and not encroach on each other's territory. The study indicates that in instances wherein these pillars seem not to be working collaboratively it is important that teamwork be strengthened. Amongst other matters, the team will work on the identified problems by establishing the solutions, especially in instances of students experiencing challenges with Mathematics course content. Again, the team should hold frequent meetings pertaining to SI for Mathematics students so that they can discuss matters together. During these meetings the members will make suggestions that could benefit the students and the programme. Teamwork will make it possible for effective common lesson plans to be developed and this will bring an element of consistency between all the lecturers and the SI leaders who are responsible for the Mathematics course. The

idea behind teamwork is also supported by George (2014:Online), that when a team works well together the members will feel more comfortable in offering suggestions, and in doing so the programme will benefit from the variety of suggestions that come from an effective team. An important element shown by the framework is the importance of students also being part of the conversations when challenges are experienced, since they are the ones who are being taught. The framework thus indicates that the voices of the students are equally important in the conversations aimed at enhancing the functionality of SI for Mathematics students.

6.3 ROLE CLARIFICATION

Table 7.2 also details the roles of each pillar in ensuring that student performance ultimately improves. The study however indicates that these roles need to be clearly defined so that they can be understood by the other pillars. Each one's understanding of the role that they need to play is crucial in that they will know when they have moved beyond their boundaries and scope. Clarification of roles will also help in maintaining good relations as they will know how their roles are interrelated and realise how their working together can contribute to the overall success of SI for Mathematics students.

6.4 SHARED VISION (TEAM)

Table 7.2 further indicates that in order for the SI for Mathematics students' learning to be enhanced it is vital that the pillars share a common vision. This must be formulated by the whole team in order for them to have its ownership. The vision will thus serve as a reminder of what the team anticipates achieving. Again, this vision will help bind the efforts of the team in achieving its goal of improving Mathematics students' performance. In the process of the team arriving at a common vision that they will all share, even though it might be lengthy, it is important to pursue it because it will ensure that all the SI stakeholders have ownership, are geared in the same direction and work towards making it a reality

(Tsotetsi, 2013:185). It is however important that the vision is not only verbally communicated but also written down so that everybody can see and read it. Tibane (2007:33) is in agreement that the vision should be written down so that, “those that see it will run with it”, meaning that those who see it, and mentally see themselves in it, will support or be part of it.

6.5 PROGRAMME VISION

Lastly, the table indicates that the programme’s vision also needs to be clearly articulated so that all the people involved can understand it. It is only then that they will understand the vision, uphold it and claim ownership.

6.6 SI LEADERS’ CONTENT CAPACITY DEVELOPMENT

Since the SI leaders facilitate sessions with the students, Table 7.3 (below) indicates that it is vital that their Mathematics content knowledge be advanced. Apart from being trained on small group facilitation as literature and the guidelines stipulate (Arendale, 1994:4; SILMG, 2013:6), it is equally important that they also receive capacity development on content so that their knowledge of the course can be enhanced. Shangase (2013:87) supports the idea of content capacity development for the SI leaders in order for their knowledge to be enriched. Since their knowledge of the content would be improved, the students would then benefit from the SI sessions and their academic performance would consequently improve. In order for the content capacity developmental workshops to be successful in terms of enriching the SI leaders’ content knowledge, lecturers need to conduct these developmental workshops as experts in the field. During such workshops, the SI leaders need to be engaged in practical exercises that involve problem-solving and be allowed some time to ask questions or discuss aspects amongst each other in their respective groups.

As the SI leaders become engaged in practical ways of solving mathematical problems and also asking questions and seeking clarity on mathematical problems

from the experts during the workshops, they would eventually become exposed to different ways of solving mathematical problems and this will subsequently advance their comprehension of the course content. The idea of content capacity development serves as a contribution this study is making since literature and guidelines place more focus on SI techniques of small group facilitation than on SI leaders' content knowledge enhancement

6.7 LECTURERS' CAPACITY DEVELOPMENT ON SI TECHNIQUES

Although literature and guidelines emphasise the need for SI leaders' training on small group facilitation, the table also indicates that it is important for the lecturers as the SI leaders' mentors to be provided with such capacity development that they can fully support the SI leaders. This therefore means that as the lecturers shape the SI leaders' preparations/lesson plans for the SI sessions to become appropriate to the course material they would also be able to help them identify the appropriate SI strategies of active collaborative learning that will help students better comprehend Mathematics course content. The lecturers would assist the SI leaders not only with content to be delivered but also with the identification of the relevant instructional strategies that may benefit students by making it easy for them to understand the course. The idea of expanding the lecturers' knowledge of SI techniques is also supported in the literature, wherein in the USA the lecturers who were involved in the programme were provided with the SI material in order for them to acquaint themselves with the SI techniques by reading for themselves (Zaritsky *et al.*, 2006:29). However, in this study, even if they can be provided with the material to read it is also important that the lecturers be fully engaged in the practical training by the SI expert who will provide them with the necessary capacity development.

The lecturers' knowledge of SI techniques of active collaborative learning will thus improve and they will subsequently be able to fully support the SI leaders. The idea behind the practical training of the lecturers is important since they will get a sense of how SI for Mathematics students is supposed to be implemented in class and also know what the SI leaders require from them in terms of the support that

they need to give them. The DoE (2003:33), in line with these recommendations, encourages the capacity development on methods of teaching since they make it easy for students to learn and understand mathematical content and concepts.

6.8 SWOT ANALYSIS

Table 7.4 (below) indicates that the common vision makes it possible for the team to conduct a SWOT analysis. This will help the team to identify the valuable resources that the team has in an attempt to achieve the goal and the weaknesses that might impede successful implementation of the envisaged framework. It will point out opportunities that can make the programme successful and identify threats to it. Pointing out the weaknesses and threats in advance will thus make it possible for measures to be put in place to evade such impediments that might hamper the successful implementation of the envisaged framework. Shangase (2013:81) is in agreement with the above notions, encouraging the organisations to carry out a SWOT audit because it provides a framework for educational administrators to focus more closely on serving the needs of the students.

6.9 DETERMINATION OF PRIORITIES

As we implement SI, there are many challenges that can be experienced. These sometimes cannot all be solved at the same time or in the stipulated timeframes. Table 7.4 indicates that in such situations it is therefore significant to prioritise these challenges so that those that are “crucial” could be addressed first. It is also imperative that the team agrees on the selection of the key challenges to be addressed from the list of the identified ones. These priorities, as indicated in Table 7.5, must then be included in the strategic plan in order to be detailed on how they are going to be addressed. In line with these views, Moloi (2010:158) and Monyatsi (2006:152) endorse the prioritisation of the needs so that those that are crucial can be attended to, before the other ones which are not crucial.

6.10 STRATEGIC PLAN

Shangase (2013:81) advises that the strategic plan be formulated and it should be in line with the identified priorities. In line with this advice, therefore, if we need SI for Mathematics students to be functional, the strategic plan needs to be formulated and the key priorities incorporated into it. Table 7.4 indicates that this strategic plan must indicate in detail how the priorities are going to be addressed. The strategic plan should further indicate the person(s) responsible for executing certain activities, timeframes as to when the activities should be finished, the resources needed to execute the activities and how the evaluation is going to be made. According to Tsotetsi (2013:233), this is important because then the participants will avoid a situation whereby meeting the agreement is reached in terms of which activities need to be performed, but in the next meeting the task/activity has not been carried out. On its own it would also give person(s) responsible for executing activities time to prepare and to consult. The strategic plan will thus ensure that the team remains focused since it relates to the team vision. It will also ensure that other items linked to the vision are not disregarded

6.11 MONITORING AND EVALUATION

Since the strategic plan indicates how prioritised challenges are going to be addressed and which activities are going to be implemented in order to achieve the goal, it is also important that monitoring and evaluation be conducted, as indicated in Table 7.6 below. According to Hunter (2009:6), monitoring and evaluation will enable the implementers to identify the problems and their possible causes and to allow the implementers to recommend solutions. Furthermore, by conducting monitoring and evaluation, we are able to know whether we are meeting our objectives (as outlined in the strategic plan). Based on these, therefore, as the strategic plan is being executed it is important that monitoring is carried out constantly, so that any challenges, deviations or discrepancies experienced during SI implementation can be detected at an earlier stage and steps taken to address them.

It is again important that at the end of the execution of all the activities, as reflected in the strategic plan, evaluation be conducted in order to see if the overall plan has worked or not. The challenges would then be noted so that when the plan is re-executed or carried out again in the next stage/phase, the corrective actions could also be incorporated so that the overall plan becomes successful. Through monitoring and evaluation, therefore, lessons can be learnt and we will be empowered to improve our SI implementation for Mathematics students.

7. A PROPOSED FRAMEWORK FOR ENHANCING THE FUNCTIONALITY OF SI FOR FIRST-YEAR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

OUTLINE OF THE PROPOSED FRAMEWORK

Pillars/SI participants	**Action(s)**	**Objective(s)**	**When?**
Students	Attend SI sessions regularly	To gain knowledge and skills that will enable them to pass Mathematics course at the end of the year	From the commencement of the lectures until the lectures cease
	Ask clarity seeking questions		Every week when they attend a session
	Practice Mathematics regularly		Every week when they attend a session
SI leaders	Regularly attend the class	To assist students with Mathematics course content	From the commencement of the lectures until the lectures cease
	Take class notes	To integrate study skills with the course content	Every time they attend the lecture
	Read all the assigned materials		Every week (prior to the session)
	Prepare the lessons for the sessions		Every week (prior to the session)
SI Supervisor	Coordinates the programme	To ensure that the programme runs smoothly	From the commencement of the lectures until the lectures cease
	Selects the SI leaders		At the beginning of the year before the lectures commence
	Trains the SI leaders		Once per semester before the lectures

			commence
	Monitors the programme		Daily
	Evaluates the programme		End of semester
	Conducts follow up trainings		Once a semester
	Provide leadership and oversight necessary to support the other three pillars		Continuously
Lecturer	Screen SI leaders for content competency	To ensure that the SI leaders gain knowledge that is necessary to help students improve in their performance	End of the year (for next year)
	Meet with the SI leaders to provide guidance and support (lesson plans, identifies instructional strategies and clarifies content to the SI leaders)		Weekly
Institution administration	Assist with the payments of the SI leaders	To ensure that the SI leaders receive payment for their work	Once per term
	Analysis of data	To ensure that the SI leaders receive payment for their work	End of each semester

Table 7.1

Action	**Who?**	**When?**	**Objective**
Teamwork	Student SI leader SI supervisor Lecturers	Continuously	To ensure that the pillars work together in order to make the programme a success

	Institution administration		
Role clarification	Supplemental Instruction head	The beginning of the year prior to the commencement of the lectures	To clarify the roles of each pillar so that all the people involved in the programme can know what is expected of them
Shared vision	Student SI leader SI supervisor Lecturers	Continuously	To help all members set goals to advance the programme To motivate and empower the people involved.
Programme vision			To ensure that people understand where the programme is heading

Table 7.2

Pillar	Capacity development	Objective	When?
SI leader	Content capacity development	To increase the SI leaders' knowledge of Mathematics content	Once per term
Lecturer	SI techniques of collaborative learning capacity development	To increase the lecturers' knowledge of SI techniques of collaborative learning	Once per semester

Table 7.3

Action	Who?	Objective	When?
SWOT analysis	Team	To identify the strengths, weaknesses, opportunities and threats	At the beginning of the semester
Identification of priorities	Team	To select the main challenges that need to be addressed	At the beginning of the year
Strategic plan	Team	To indicate how the priorities are going to be addressed	At the beginning of the year

Table 7.4

Priorities	Who?	Objective	Deliverable
Coordinated plan	Mathematics lecturers, SI leaders, students, departmental head	To develop a common plan that would be followed	A detailed coordinated plan which indicates activities to be dealt with, time-frames, strategies to be applied to facilitate learning etc.
Articulation of vision	Team	To ensure that all the people understand what the programme is envisioned for. To ensure that the people take ownership of the programme	A clearly articulated vision which is understood and owned by all the people
Content development	Lecturers	To empower the SI leaders by increasing their Mathematics content knowledge	A Mathematics content development programme which is facilitated by an expert which provides the SI leaders with content capacity development
SI technique development	SI head	To empower the lecturers by increasing their knowledge of SI techniques of active collaborative learning	The SI technique developmental programme which is facilitated by an expert which increases the lecturers' knowledge of active collaborative learning principles of SI.
Instructional strategies	SI coordinator	To empower the SI leaders by increasing their knowledge of the appropriate application	An instructional strategy developmental programme which facilitates the application

		of the instructional strategies that will respond to student needs	of effective SI instructional strategies

Table 7.5

Action	**Who?**	**Objective(s)**	**When?**
Monitoring	SI coordinator Lecturers	To see if the activities are carried out as outlined in the strategic plan To be able to identify the challenges experienced so that the corrective measures could be put in place	Continuously
Evaluation	SI coordinator SI head Lecturers	To assess the overall functioning of the programme in order to see if the goals were achieved	End of the semester

Table 7.6

**********END**********

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APPENDIX A: REQUEST TO CONDUCT RESEARCH

UNIVERSITY OF THE FREE STATE

UNIVERSITEIT VAN DIE VRYSTAAT

YUNIVESITHI YA FREISTATA

CENTER FOR TEACHING AND LEARNING

☐ Private Bag X13 PHUTHADITJHABA 9866

E-mail: mohlakoanamm@qwa.ufs.ac.za

☐ +27(0)58 718 5066

02 February 2012

The Principal (Qwaqwa campus)

University of the Free State

Private Bag X13

Phuthaditjhaba

9866

Dear Sir

Re: Application to conduct research on campus

I am a Masters student at the University of the Free State and I hereby request permission to conduct research here on campus. The research will be in a 'Participatory Action Research' form and will last for eighteen months. This will

take place every two weeks. My focus will be on supplemental instruction's functionality enhancement.

Yours sincerely,

M.M. Moleko (Ms)

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

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Ethics Office

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23 May 2012

APPENDIX B: ETHICAL CLEARANCE LETTER

Ethical clearance

ENHANCING THE FUNCTIONALITY OF SUPPLEMENTAL INSTRUCTION FOR MATHEMATICS STUDENTS AT A HIGHER EDUCATION INSTITUTION

Dear Ms M mohlakoana

With reference to your application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research, with the following stipulations (as determined by external reviewers):

- This is a study clearly in the field of Higher Education. This needs to be discussed with the study supervisor.
- The study will focus on university students, but how access will be gained is not clear (this section of the form on intentional involvement is incorrectly done.
- Valuable data can emerge - ensure the involvement of a person who is an expert on student success

Please submit the above changes to the ethics office before

commencement of your research. Your ethical clearance number, to

be used in all correspondence, is:

UFS-EDU-2012-0026

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

We request that any changes that may take place during the course of your research project be submitted in writing to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise. At the conclusion of your research project, please submit a project report stating how the research progressed and confirming any changes to methodology or practice that arose during the project itself. This report should be under 500 words long and should contain only a brief summary focusing primarily on ethical considerations, issues that may have arisen and steps taken to deal with them during the course of the research.

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

Yours sincerely,

Andrew Barclay

Faculty Ethics Officer

APPENDIX C: CONSENT BY TEACHER

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are an expert in mathematics, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX D: CONSENT BY LECTURER

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are an expert in mathematics, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX E: CONSENT BY STUDENT

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are a mathematics student, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX F: CONSENT BY SI LEADER

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are facilitating mathematics SI sessions with the students, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX G: CONSENT BY THE SOCIAL WORKER

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are responsible for the social welfare of the students, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX H: CONSENT BY PSYCHOMETRIST

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you understand the needs of the students, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX I: CONSENT BY THE CAREER COUNSELLOR

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you know more about the exciting careers in mathematics, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX J: CONSENT BY THE PARENTS' REPRESENTATIVE

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are an expert in mathematics, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX K: CONSENT BY THE ACADEMIC HEAD

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are responsible for academia on campus, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX L: CONSENT BY THE SI HEAD

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are involved in the day to day running of the SI programme, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX N: CONSENT BY THE SI OFFICE ASSISTANTS

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are involved in the day to day running of the programme, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

APPENDIX N: CONSENT BY THE SI SUPERVISOR

Dear Participant

I am currently doing research with UFS on enhancing the functionality of Supplemental Instruction for first-year Mathematics students at a higher institution. Since you are the SI expert and also involved in the day to day running of the programme, you are therefore requested to take part in this research in order to give it credibility. Participation is not compulsory and if you decide not to participate, that will not be held against you. Confidentiality, anonymity and legality issues about this project will be discussed with you, as it is imperative that you fully understand the nature and purpose of this study. You are free to withdraw from this study at any stage.

This project will comply with the rules and regulations of conducting a research.

If you would like any additional information, you are welcome to contact me on 058-7185066 or at the following e-mail address: mohlakoanamm@qwa.ufs.ac.za.

If you would like to participate in this research, sign below by giving consent.

Thank you

_____

M.M. Moleko

Name _____

Signature _____

Date _____

Contact details _____

ANNEXURE A: Mathematics 1 Success rates table

MATHEMATICS 1 SUCCESS RATES

Module code	**Campus**	**2009**	**2010**	**2011**
		Success rate	Success rate	Success rate
WTV 154	*****	25.2%	19.1%	27.6%
WTV 164	*****	25.9%	30.6%	0.0%

ANNEXURE B: First forum agenda

Agenda

1. Opening and welcome

2. Purpose of the meeting

3. Introductions

4. Problem and way forward

5. Background and objectives of the study

6. Role of the team

7. Logistics

8. Convenient venue and time

9. Frequency of the forums

10. Facilitations of the subsequent forums

11. Planning of the next forum

12. Closure

ANNEXURE C: Brainstorming agenda

BRAINSTORMING SESSION

Agenda

1. Opening and welcome
2. Apologies
3. Minutes of the previous meeting
4. Adoption of the minutes
5. How can the SI for mathematics students be enhanced?

(What is the winning strategy to increase the students' chances of success? How can we refine the current situation? What could be our contribution towards the attainment of the objectives of the study?)

6. Planning of the next forum
7. Closure

ANNEXURE D: Meeting agenda

MEETING

Agenda

1. Opening and welcome

2. Apologies

3. Minutes of the previous meeting

4. Adoption of the minutes

5. Discourses around SWOT analysis

6. Planning of the next forum

7. Closure

ANNEXURE E: SWOT analysis document

Strengths, Weaknesses, Opportunities & Threats (SWOT analysis document)

Strengths	Students have: i. access to motivational speaker ii. access to Psychometrist who provides both the study and developmental skills through workshops scheduled for every Wednesday on a fortnightly basis. iii. Access to a Psychologist who is able to asses and treat emotional problems through psychotherapy. Appointments are secured for students (one-on-one as well as group consultation). iv. access to Social worker who provides social support by identifying social factors that affect academic performance. E.g. family problems, domestic violence, drug abuse, financial matters etc. Appointments are secured for students (one-on-one as well as groups consultations) v. access to Career officer who provides career development, guides students towards making transition through personal branding, job hunting skills and interviews skills. vi. access to lecturers who frequently monitor and report back on the students' progress vii. access to the SI programme which provides necessary material that enable students to grasp mathematical concepts viii. Access to high school teachers who provide basics in the specific topics. ix. Access to SI training and workshops that equip SI leaders with the skills necessary to better facilitate their sessions. Programme: Provides:

	i. platform for SI leader academic development. ii. platform for students to do presentations. iii. students with the latitude to do work on their own – to become independent learners iv. students with the opportunity to learn to work as a team. v. extra tuition for the betterment of students' academic performance. vi. students with the opportunity to commit mistakes and to learn from them in a more relaxed environment. vii. the platform for students to develop self-confidence
Weaknesses	i. Lack of parental involvement and engagement. ii. Lack of student motivation. iii. Alcohol and substance abuse. iv. No stringent measures put in place to monitor class attendance. v. Lack of resources (for example; mathematics computer programs that stimulate students' mathematical interest. Computer programmes that students use for playing but learning at the same time) vi. Production of poor results.
Opportunities	The programme provides: i. The platform for the development of future mathematicians and potential teachers. ii. Different career paths that require Mathematics as a prerequisite. iii. An opportunity where students get to meet different people thereby exchanging information that unleashes their potential and that prepares them for the outside world.

	iv. The platform for building strong student leadership v. Students with the platform to work collaboratively in the accomplishments of the tasks. vi. The time for students to identify the problems that they experience in class vii. Students with the opportunity to interact with the potential SI leaders viii. Attention to the courses which are perceived to be difficult and which have high attrition rates with the intention to enable such students to cope. ix. The students with the opportunity to earn money for themselves at an earlier stage. In this way, students (SI leaders) learn at a very young age, to budget and to prioritise. x. Lecturers with the opportunity to refine their mentorship skills. **The programme:** i. Provides the platform to do partnership with teachers from the reputable schools as well as the subject advisors
Threats	i. Limited number of venues to be used for holding SI sessions. ii. Finding potential and qualified SI leaders with good personal qualities and strong leadership skills necessary to lead SI sessions from the limited pool of students who have done Mathematics at a higher level. iii. Lecturers who do not believe that SI can be beneficial iv. Budget constraints; especially in cases where groups have to be made smaller and intimate for the SI leaders to easily facilitate. v. Majority of mathematics lecturers who are not employed on a permanent basis – students cannot consult them from time to time. vi. Lack of student participation in class. vii. Lack of student motivation to attend classes

ANNEXURE F: Meeting agenda

Agenda

- Opening and welcome
- Apologies
- Minutes of the previous meeting
- Adoption of the minutes
- Business of the day
- Identification of priorities
- Drawing of the action plan
- Planning of the next forum
- Closure

ANNEXURE G

Action Plan document

Priorities	Activity(ies)	Objective(s)	Resources	Responsible people	Timeframes	Monitoring	Evaluation
Coordinated plan	Designing of the common pacesetter. Designing of the common lesson plans.	To ensure that a common plan is followed in terms of presenting lessons to the students To ensure that different topics are allocated specific time frames so that all those that teach can know when to finish with the specified topics	Lesson plan sheets	Lecturers , SI leaders and the departmental head	At the beginning of the semester before the classes and the SI sessions commence	Class visits and observations	Students improved performance Completion of all the activities - reflected in the portfolio
Articulating the vision and ensuring its	Establish awareness sessions in which the SI vision	To ensure that all the SI participants understand	Lecture halls	SI supervisor Lecturers	Beginning of each semester	Meetings' attendance registers	Feedback from awareness sessions

ownership	could be articulated Engage all the SI participants in all the SI activities	what the programme is all about To promote ownership of the SI programme	University articles and brochures	SI leaders		Responses that we are going to get from the SI participants SI session attendance registers	Increased number of students attending the SI sessions
SI leaders' course content capacitation	Workshops on content development	To increase the SI leaders' knowledge of the course content	Textbooks and course manual Score cards	Lecturers SI supervisor	Quarterly	Portfolios Class visits and observations	Students' enhanced performance Delivery of content during the sessions
Methods of teaching (SI techniques)	Workshops on classroom practices Training on SI techniques (Active collaborative learning and student engagement)	To help SI leaders use the appropriate methods of teaching in class. To enable the SI leaders to	SI training manual	SI supervisor	Once per Semester	Class visits and observations	Students exchanging ideas meaningfully during the session The use of participative activities in class

	Follow up trainings on SI techniques	engage the students meaningfully in their own learning					
Lecturers' capacity development on SI techniques	Workshops on SI techniques of active collaborative learning and student engagement	To equip lecturers with the knowledge of SI techniques so that they can fully support the SI leaders	SI training manual	SI head	Once per semester	Meeting visits	SI leaders' ability to apply SI techniques
Feedback	Analysis of the results Meetings with the lecturers, SI leaders & the students	To make feedback available in the setup so to keep every stakeholder abreast	Analysis report	SI supervisor	Semester		Stakeholders demonstrating knowledge of what is happening

ANNEXURE H

Roles and responsibility document

Forum: Team

Agenda

Please show **respect** to the SI coordinator

Responsibilities of LECTURERS	Responsibilities of SI LEADERS
1. Have regular meetings with the SI leaders	1. Attend regular meetings with lecturers
2. Prepare SI leaders on the subject content	2. Study the subject content
3. Provide SI leaders with worksheets/exercises for tutorial activities	3. Keep attendance register in every class
4. Do regular class visits for quality assurance (QA)	4. Prepare properly
5. Evaluate SI leaders' performance once per term	5. Maintain good discipline in class
6. Give empathetic feedback to SI leaders in your office	6. Report directly to the lecturer for all academic activities and problems
7. Submit all assessments' marks to the SI office 3 days prior to the start of the main exam	7. Mark only SI session worksheets and activities
8. SI sessions should reflect on the academic time table	8. Report any absentees (your own & the students) to the lecturer

SI Office responsibilities:

1. Provide effective administrative support to lecturers & SI leaders.
2. Handle SI leaders' applications & appointments timely (in conjunction with lecturer)
3. SI leader training should start prior to commencement of lectures. Warn SI leaders about training for the next year before they leave the Campus in November.

4. Give lecturers' a d-date for submission of study material for next semester.
5. Arrange with Xerox timely for copying
6. Supply study material well in time.
7. Monitor and report on the effectiveness of the Programme.
8. Responsible for pro-active arrangements for the next year.

ANNEXURE I

Pace-setter

WTV 154: Pacesetter											
TERM 1											
WEEKS	1	2	3	4	5	6	7	8	9	10	11
TOPICS	Number Patterns, Sequences and Series			Functions: Formal definition: Inverses			Functions: Exponential and Logarithmic	Finance, Growth and Decay		Trigonometry	
ASSESSMENT	Test				Investigation or Project			Assignment			
DATE COMPLETED											

TERM 2											
WEEKS	1	2	3	4	5	6	7	8	9	10	11
TOPICS	Trigonometry	Functions: Polynomials	Differential Calculus	Analytical Geometry							
ASSESS-MENT	Test		Mid-Year Exams								
DATE COMPL											

ETED				

TERM 3										
WEEKS	1	2	3	4	5	6	7	8	9	10
TOPICS	Geometry		Statistics		Counting and probability		Revision			
ASSESSMENT	Test									
DATE COMPLETED										

TERM 4		Examination Paper: 3 hours First opportunity	Examination Paper: 3 hours	Second Opportunity
WEEKS 1 2 3 4	Algebraic expressions and equations (and inequalities) Number patterns Functions and graphs	10 10		

5 6 7 8 9 10	Finance, growth and decay Differential calculus Counting and probability Euclidean Geometry and measurement Analytical geometry Trigonometry Statistics	10 10 10 10 10 10 10 10		

TOPICS	Revision			FINAL EXAMINATION					Admin	Total Marks	100		
ASSESSMENT													
DATE COMPLETED													

TRANSCRIPTS

Pule: The most frustrating thing is that we do not get to meet with the lecturers to discuss what needs to be done during the sessions. Our lecturers do not make time for us to meet with them in order to prepare for the sessions. When we personally go to ask them about what needs to be done, they tell us that they do not have time as they are busy with other stuff. We do try our level best to attend the sessions in order to help the students but most of the time we do not get the support from our lecturers.

Dineo: That's true. I also encountered the same problem. I always find myself having to go to class not knowing what to do. Mhhhhm! But then what can we do? We have to attend sessions anyway!

Lerato: To me, this is problematic because sometimes students ask questions which I am not prepared to answer at that time. I feel embarrassed and useless because it then looks like I do not have what it takes to be an SI leader. Students also doubt my ability and do not respect me as their SI leader. I feel very bad about this.

Pule: We can do whatever we want, for as long as we do not plan together, I don't see bad mathematics results changing anytime soon. We really need to have a plan in place.

Ms Nala: I have been listening to all the things that you guys have been saying and I agree with you although my case is different. I provide specific topics to my SI leaders in order to help students with, on a weekly basis and ask them to provide me with feedback. They have never done that until today! I have been preaching this for a long time and I do not know what to do anymore. I think they are not serious about their work.

Dika: I think I am getting confused now because we were told about the SI programme at the beginning of the year and later on we were told that we can attend sessions when we encounter the challenges. Hmmm! To be honest, I still do not

understand who should attend and who shouldn't. Is it possible that we could perhaps get clarity on this matter?

Jabu: To be honest, I also do not fully understand what the programme is all about and I think this is the reason why other students do not attend even though some provide other reasons for not attending. They are probably confused as I am. I think you are right Dika, we need more clarity.

Ms Nala: I used to offer statistics and when Mr Ndlovu left for another post, I had to take over his responsibilities. I was told that he was also involved in the programme and that I also have to be involved. I must just be honest with you guys, I do not know much about the programme. My SI leaders do come to my office and we do preparation together. I don't even know if we prepare correctly or not. I am certainly not sure if I am doing things in line with what SI is all about.

Phenyo: My name is Phenyo and I am the SI office assistant. I am involved in the day to day running of the programme and one of the things that I do is to assist the coordinator with the class visits and observations. Just recently, I visited some classes just to check how the sessions were conducted and in most cases I found the SI leaders providing students with the solutions and not giving them direction or guidance.

Lesedi: I agree with you on that one! Our SI leader comes to class with the problems that have already been solved and then write them on the board. Although he explains how he arrived at a solution, I find it difficult to understand.

Lebo: I attend sessions regularly and one thing that I have noticed is that every time we attend the sessions, we do what we were doing with the lecturer and this does not benefit us and I think that is why other students end up not attending…"

Mr Ndimande: We have a large number of students who attend our lectures and these students also attend SI sessions. We divide them according to the number of the SI leaders we have but others later on decide not to attend sessions offered by their SI leaders and attend other SI leaders' sessions. When there are many students

in the class it is not easy for the SI leaders to allow the students to discuss and solve problems in groups. I think that is our biggest challenge that we are facing and we need to deal with it.

Mr Dlomo: The programme has been running for some time now and I am sure that the office has got the results of the students by now! The thing is, that we expect to be briefed on the progress that students are making. However, we have not received anything thus far from the SI office. I am not sure if other people have received that information yet!

Mr Chikuka: We once received a progress report a while back although it was never discussed in a formal meeting. We were sent an email with all the details. A promise was also made that after every semester we will receive feedback. However, that has n't been happening. Just last week myself and Ms Molete were talking about this issue. Ms Molete indicated in our conversation how that information was important for us to know how students perform in our modules and I think I agree with her.

Dodo: After we have conducted a number of sessions we get evaluated. Someone would just come in during the sessions and distribute the forms to the students. The students will then complete those forms. Eeerr!! The problem is that we do not know what the students were saying about us. We do not even know what we need to do in order to help these students based on that…"

Mrs Motsoeneng: I know that for a fact! We also experience it in our schools. It is really not nice to work without receiving feedback especially when you have been evaluated or monitored. Just to make an example, as teachers we are expected to undergo IQMS process whereby an HOD together with a peer would go to class to see what the other teacher is doing with the aim to help the teacher to improve in certain areas. The challenge that we have is that we also do not get feedback which is why we are not improving.

Bonolo: This thing of evaluation is really a problem. For instance, we complete the evaluation forms every semester but our SI leaders still do the things we indicated

that we don't like. Sometimes we get the new SI leaders who also repeat the same mistakes. I don't see any point of doing it if the SI leaders keep doing what we indicated that we don't like.

Ms Dikobe: We are aware that students' performance is poor and it is our wish to see it altered.

Mr Ndimande: We really need to work hard on this because the academic head is also not pleased by this poor performance. He even complained about students' poor performance two weeks back during the academic forum.

Ms Nala: I would suggest that we invite these people to a meeting so that we can share the ideas we have with them.

Mr Mazibuko: The students are not doing well and we are deeply concerned about that. We called you to this meeting in order to ask you to help us in the project that we will be engaging on in attempt to curb this poor performance. We strongly believe that if we could join hands we will be able to turn the situation around… For the better of course!

Mr Tau: I agree to be part of this beautiful project that's aimed at improving the performance of the students. I think it is a wonderful initiative.

Thandaza: We can alter this situation by working together, striving towards a common goal. An individual can never alter this situation.

Mr Chikuka: Ladies and gentlemen, perhaps we should also discuss the roles and responsibilities of the team members so that at least everybody knows what is expected of them

Mr Mokoele: I think we need to have a common vision since we are a team. It will help guide us towards our goal of enhancing the functionality of SI for mathematics students. It will remind us of where we would like to see the programme.

Mr Skepers: We can do whatever we want to do or think it is best for the programme to be successful using our own individual experiences and efforts, but for as long as we work individually we are not heading anywhere. Therefore, for SI to flourish, you need to work together. Working together will ensure that the coordinated plan becomes established and this should be the starting point in making the SI sessions effective.

Mr Lehasa: I think we will need to design a pacesetter which will ensure that we do the same activities simultaneously. This will help us manage our time as we need to treat all the concepts in the module for the whole year.

Mrs Van Tonder: This is just a step further to a meeting we had with the academic head to ensure that you as the main drivers understand exactly what you are expected to do.

Mr Chikuka: I am glad that as a team we were able to explain what the programme is all about. I am also glad that we were able to respond to your questions and I am sure that now we are on the same page. However, this is not the last time we are talking to you as we plan to keep you posted with the developments around the programme as we go along. We also plan to communicate this to the entire institution so that everyone knows about the programme.

Mr Mazibuko: When we teach students we are not doing that for ourselves but for the students that we are teaching. We therefore ought to have their best interest at heart…yes you can have content knowledge, but you must make sure that students also receive that knowledge. This therefore means that you need to make sure that the students understand if they have to pass the course.

Mr Mazibuko: In promoting student understanding of the course, you need to relate the content to real life situation. This way the students will see relevance and that will interest them..."

Mr Mazibuko: It also helps when you understand the content to be creative so that you can establish ways in which you could help students understand content

Mr Taku: I feel honoured to have attended this kind of training. I think the knowledge I have acquired on SI techniques specifically for mathematics will assist me in fully supporting my SI leaders. What makes me happy is that I can still utilise certain techniques in my own lectures so to encourage active collaborative learning

Ms Mokoena: It is important that you apply effective instructional strategies and also engage students in their own learning so that their understanding of the course content can be enhanced.

Ms Mokoena: When you try to engage students in their own learning, make sure that students sit in small intimate groups. Be careful when you form groups that you do not group capable students together and those that are less capable together as that can discourage those who are less capable. Allow them some time to engage in problem-solving. Also make sure that the activities that you prepare make it possible for them to participate or engage in problem-solving.

Ms Dlala: "...these students do not like mathematics and for as long as they remain like that, there won't be any improvement in terms of performance. Emm! The question I keep asking myself is; how are we going to motivate them?...How are we going to make them love mathematics...?"

Mr Dinala: It is true, most of the students do not like mathematics, but I think a lot could be done in order to make students like the subject. For instance, we have programmes such as "Hey Math" which could be loaded on the computers. I like these programmes because students get to learn and understand mathematical concepts while playing and having fun!

Mr Chikuka: (Adding to what was said)"... We could also invite the career counsellor in some of our meetings so that he could inform our students about the exhilarating career prospects in mathematics..."

Ms Lerole: (Also adding to what was said) "...I think we could also invite the specialist who could show students how what they are doing is related to what is happening in real world..."

Ms Dikobe: If students are not motivated, surely they won't come to sessions prepared. I could just imagine how the poor SI leaders cope when students come to sessions unprepared and yet they are expected to engage them in collaborative learning? Even if the SI leader could come to class prepared, for as long as students are not prepared, there won't be an improvement.

Mr Mnguni: "...If they get to class and find that the students are not prepared, they might also be demotivated and next time come to sessions also not prepared. They would see no point in coming to the sessions prepared when students don't..."

Poloko: "...the number of students who are majoring with mathematics is so small and this makes it hard for the lecturers to appoint capable SI leaders who can effectively help students master the course."

Sibahle: "...I think the other challenge pertains to the kind of SI leaders we have. Some were just appointed on the basis that the lecturers know them and not necessarily because they are capable and I think that must be corrected..."

Mr Chikuka: I would suggest that we do not only focus on third year students when we appoint the SI leaders, but that we also consider the second year students and also those who are not majoring in mathematics, but who have also completed the modules to be tutored from other cohorts.

Ms Vrede: We can come up with this beautiful initiative in assisting students to pass mathematics. However, if students come to class having no clue about certain concepts, the sessions would not be productive.

Boipelo (the Mathematics SI leader, interrupting)*: " I agree with you on that. Sometimes I go to sessions fully prepared and when I get there, I would find students in a state in which they do not understanding anything! I would sometimes even refer to a grade 12 textbook just to help them understand and that wastes a lot of time..."*

Mr Chikuka: "...Aha! I always complain about this. You see! These students also give us a hard time even in economics. You ask them a simple question sixteen divided by

three, and they will not give you an answer! They stand up in a class and look for a calculator. I think it is high time that we make the department of education aware of the challenges that we come across. We cannot let the high school polish and pass things onto us just like that. Otherwise we are going to shoot ourselves in the feet. You see! When we also get tired of them, then we will also give them their fifty and let them go. Then they become the employers' headache and then they get fired and come back home and become the parents' headache and then this becomes a vicious circle..."

Mr Mokone: I would suggest that we use problem based learning. I'm not sure how many of you know about it. It is just another way of teaching students by first presenting them with a problem and then the students can then use whatever they know to try to solve the problem. What is interesting about it is that the students who think that they do not know would then realise that they could still solve the problem anyway.

Ms Vrede: (interrupting the subject advisor)*: It sounds interesting I know, but then I wonder if the SI leaders are familiar with it.*

Pule: (also interrupting) *It is for the first time I hear about this, but I must indicate that it sounds interesting and I believe that it could assist a lot.*

Theko: We knew all what we were supposed to do with the students during our sessions. We planned in advance and our plan made it possible for us to be on top of our game. No wonder why students performed well.

Boipelo: Our plan worked perfect for us. Had it not been because of it, I think we would have still be talking about student poor performance.

Ms Vrede: It really helped to receive clarity on the programme's vision. The understandings that we got brought us closer to one another and made us share the same sentiments of making a success of the programme.

Lebo: Understanding content made me feel confident in class. I was able to respond to all the questions that students asked and that made me feel good.

Mr Mazibuko: After the training of SI techniques we had meaningful plannings with the SI leaders. We would plan on content which students found challenging and then identify the techniques that will best assist the students in understanding the content.

Mr Mokete: The workshops on student engagement have been helpful. The performance of the students has improved looking at the assignments and the projects that we give them.

Ms Vrede (interrupting): *I agree. I don't even have a doubt that the results would be much better at the end of the semester.*