



science
& technology

Department:
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REPUBLIC OF SOUTH AFRICA

**IMPLEMENTATION EVALUATION OF THE AFRICAN INSTITUTE
FOR MATHEMATICAL SCIENCES – SOUTH AFRICA PROGRAMME**

Table of Contents

List of Figures	v
List of Tables.....	vi
List of Acronyms.....	vii
1. Introduction.....	1
1.1 Background and overview of African Institute for Mathematical Science-South Africa (AIMS-SA)	1
1.2 Purpose and scope of the evaluation	3
1.3 Focus of the evaluation.....	3
1.4 Evaluation questions.....	4
2. Literature Review	5
2.1 Science, Technology, Engineering and Mathematics (STEM).....	5
2.2 Landscape of mathematics in Africa	6
2.3 Regional mathematics programmes.....	8
2.4 DST policy mandate in relation to AIMS-SA	9
2.6 AIMS components across South Africa, Ghana, Senegal and Cameroon.....	10
2.6.1 Training	11
2.6.2 Research	11
2.6.3 Public engagement	12
2.6.4 Organisational development.....	12
2.7 Relevance, efficiency, sustainability, effectiveness and impact of AIMS programme	12
3. Logical framework and theory of change of the AIMS-SA programme in relation to DST policy	13
4. Evaluation Approach.....	14
4.1 Type of evaluation employed.....	14
4.2 Research strategy	14
4.2.1 Methodology.....	14

4.2.2	Ethical considerations.....	15
4.2.3	Collection methods.....	15
4.2.4	Unit of analysis	16
4.3	Data analysis.....	16
4.3.1	Quantitative data analysis.....	16
4.3.2	Qualitative data analysis	17
4.4	Limitations of the evaluation	17
5.	Findings	18
5.1	AIMS-SA Alumni.....	18
5.2	Current Students	23
5.3	Tutors/ Teaching Assistants	25
5.4	Visiting Researchers.....	25
5.5	AIMS-SA Governance Structure	26
5.6	The AIMS-SA programme provides services to the intended beneficiaries	26
5.7	The AIMS-SA programme responds to the mandate of the DST	27
5.8	The AIMS-SA programme has positive outcomes	27
5.9	There is a positive emerging impact of the AIMS-SA programme.....	27
5.10	Students had a vast knowledge about the AIMS-SA programme	28
5.11	The research conducted by respondents is relevant to science and technology needs in Africa	28
6.	Discussion of Findings.....	29
6.1	Discussion of the Results Chain and Findings	29
6.1.1	Research	29
6.1.2	Training	29
6.1.3	Public Awareness.....	30
6.1.4	Management of AIMS-SA Programme	30
6.2	Discussion of Evaluation Questions, Literature and Findings	31

6.2.1	Relevance.....	31
6.2.2	Efficiency	31
6.2.3	Effectiveness.....	31
6.2.4	Emerging impact.....	32
6.2.5	Sustainability.....	33
7.	Lessons learnt, conclusion and recommendations	34
7.1	Lessons learnt.....	34
7.2	Conclusion.....	34
7.3	Recommendations	36
	References	37
	Appendix.....	39

List of Figures

Figure 1: Adopted theory of change	13
Figure 2: Number of alumni as per level and field of study	18
Figure 3: AIMS-SA Alumni who were sufficiently prepared for the work place	19
Figure 4: Distribution of alumni by age group	21
Figure 5: Distribution of alumni by employment status	22
Figure 6: Current students who receive support to effectively cope with their studies.....	23
Figure 7: Students who are exposed to research publishing platforms.....	24

List of Tables

Table 1: Adopted logical framework	13
Table 2: Data collection schedule.....	15
Table 3: Unit of analysis and response rate.....	16
Table 4: Disaggregation by country of origin and gender	19
Table 5: Distribution of alumni by gender and race	20
Table 6: Tutors/ Teaching Assistants at AIMS-SA per gender distribution	25

List of Acronyms

AIMS	African Institute for Mathematical Sciences
AIMS-NEI	African Institute for Mathematical Sciences-Next Einstein Initiative
AIMS-SA	African Institute for Mathematical Sciences - South Africa
AIMSSSEC	African Institute for Mathematical Sciences School Enrichment Centre
ALC	African Laser Centre
AMCOST	African Ministerial Council on Science and Technology
AMI-Net	African Mathematical Institute Network
AMMSI	African Mathematics Millennium Science Initiative
ANSTI	Network of Scientific and Technological Institutions
AU	African Union
AUST	African University of Science and Technology
CPA	Consolidated Plan of Action
DHET	Department of Higher Education and Training
DST	Department of Science and Technology
EU	European Union
HCD	Human Capital Development
IMU	International Mathematics Union
MARM	Mentoring African Research in Mathematics
M&E	Monitoring and Evaluation
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
NM-AIST	Nelson Mandela African Institute of Science and Technology
NMI	Nelson Mandela Institute

NRDS	National Research Development Strategy
NRF	National Research Fund
R&D	Research and Development
SADC	Southern African Development Community
SANBio	Southern African Network for Biosciences
SANWATCE	Southern African Network for Water centres of Excellence
SET	Science, Engineering and Technology
S&T	Science and Technology
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation
STISA	Science, Technology and Innovation Strategy for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
SUN	Stellenbosch University
USA	United State of America

1. Introduction

1.1 Background and overview of African Institute for Mathematical Science-South Africa (AIMS-SA)

The Department of Science and Technology (DST) provides financial support to four Science, Technology and Innovation (STI) Flagship Programmes in order to contribute to South Africa's and Africa's human capital development priorities. The Flagship Programme are; African Laser Centre (ALC), AIMS-SA, Southern African Network for Biosciences (SANBio) and Southern African Network for Water Centres of Excellence (SANWATCE). The Flagship Programmes were established through the adoption of the Consolidated Plan of Action (CPA) launched by the African Ministerial Conference on Science and Technology (AMCOST) and further endorsed by the African Union (AU) Executive Council in Khartoum, Sudan in 2006 (Mugabe & Ambali, 2006). Africa is on a path of transitioning itself towards an innovation led and knowledge economy through the newly adopted Science, Technology and Innovation Strategy for Africa (STISA) 2024, which is also central to South Africa's development goals. The National Research and Development Strategy (NRDS) identifies a need for the development of STI human capital and centres of excellence. The establishment of centres of excellent forms part of the science and technology theme, New Partnership for Africa's Development (NEPAD) and Southern African Development Community (SADC); and complements the technology missions that will enhance the process of innovation (The Government of the Republic of South Africa, 2002).

The Department of Science and Technology (DST) entered into a contractual agreement with the University of Stellenbosch (SUN), granting support to AIMS-SA. The DST funds were specifically aimed at supporting the African Tutors and Researchers' Programme as well as AIMS's core functions which include support to the AIMS-SA Secretariat. The vision of AIMS is for Africa to be a leading member of the global community with a new generation of leaders who are driven by science and technology. This vision is supported by the mission of AIMS which seeks to elevate the positioning of the institute as it strives to be a world-class tertiary level

mathematical institution which encourages African talent to flourish through innovative training programmes of the highest international standards. The African Mathematical Institute Network (AMI-Net) has played a central role in achieving the AIMS' mandate through promoting the field of mathematical sciences across Africa.

AIMS-SA was established in 2003 as a partnership project between various universities and has three goals namely;

- promoting mathematical sciences in South Africa and the rest of the African continent;
- recruiting and training talented students and teachers; and
- building capacity for African initiatives in education, research and technology.

These goals are also aligned to the National Development Plan (NDP) 2030 which calls for a focus in increasing the number of knowledge producers so as to transition South Africa towards an innovation and knowledge-led economy by producing about 5000 more master's and doctoral graduates each year (The Presidency, 2012). The NDP further states that if South Africa is to be a leading innovator, most of the master's and doctorate graduates should be trained in science, technology engineering, and mathematics (STEM) (The Presidency, 2012).

The DST identified a need to evaluate the AIMS-SA programme since the three years (2012/13-2014/15) contract between the DST and AIMS-SA was coming to an end. The Policy, Programme and Project Evaluation Guidelines and Standards for Evaluation, 2014 makes provision for the DST to prioritise evaluations of interventions that are co-financed by different stakeholders or their lifespans are coming to an end. The objective is to learn and identify what works or does not work and if there is a need for an additional phase (Department of Science and Technology, 2014). The implementation evaluation of the AIMS-SA programme was incorporated in the approved DST evaluation plan for the fiscal period 2014/15-2017/18. The DST prioritised this evaluation in order to assess the operational processes and whether or not achievements of the programme are in accordance with the mandate and policy objectives of the DST.

1.2 Purpose and scope of the evaluation

The DST plays a key role in ensuring that AIMS-SA achieves its objectives of promoting access to higher education, through lecturing and studying opportunities. The DST identified a need for conducting an evaluation in order to;

- Obtain information on the progress of implementation and outcomes of key AIMS-SA programme components (research, training, public awareness and organisational development) in relation to the DST policy objectives.
- Identify practices of similar programmes, opportunities and lessons learnt.

The DST hopes that this evaluation will be utilised as a benchmark study for lesson learning as well as to influence member states in Southern Africa and the rest of the continent to provide funding to the NEPAD STI Flagship Programmes.

1.3 Focus of the evaluation

The evaluation focuses primarily on the fiscal period 2012-2014/15 and the following areas;

- DST's support towards training, research, public awareness and organisational development; and
- Success and ability to attract SA students

The evaluation was conducted at the AIMS-SA centre in Stellenbosch.

1.4 Evaluation questions

The evaluation questions include;

Relevancy:

- 1) To what extent is the AIMS-SA programme relevant in developing researchers with mathematical sciences skills?

Efficiency:

- 2) To what extent has the AIMS-SA programme been efficient in implementing its projects?

Effectiveness:

- 3) How does the AIMS-SA programme contribute to the mandate of the DST?
- 4) To what extent is the AIMS-SA programme improving the access and quality of education in mathematical sciences?

Emerging impact:

- 5) What is the emerging impact of the AIMS-SA programme?

Sustainability:

- 6) To what extent is the support by the DST sustainable and can be replicated in other NEPAD programmes?

2. Literature Review

2.1 Science, Technology, Engineering and Mathematics (STEM)

According to the United Nation's Human Rights Charter, access to basic education is a well-argued and well-deserved human right. In addition to science and technology, mathematics has increasingly become a vital part of basic education. Increased and quality technical competencies within specialised fields such as the mathematical sciences have emerged as the key ingredients of socio-economic development in affluent societies. Mathematical competence has been identified as one of the key characteristics necessary for active citizenship, social inclusion and employability (Bajah, 2000).

The attitudes and aspirations of government in Africa to increase the number of both undergraduates and postgraduates qualified in the mathematical sciences have been positive. The AU's CPA was adopted by African Ministers of science and technology in 2005. The CPA sets out to establish flagship Research and Development (R&D) programmes organised according to clusters with mathematical sciences (Bajah, 2000).

The CPA recognises that modern science increasingly rests on the application of powerful mathematical methods for analysing data and both developing and testing theoretical models. With this in mind, the overall programme objective of the fifth cluster on mathematical sciences within the CPA, implemented through the AIMS-SA programme, includes strengthening Africa's capacity in the mathematical sciences and in particular those aspects of greatest relevance to African development. In essence, the CPA provides both a political and policy imperative towards the promotion of both human capital development (HCD) and R&D within the field of mathematical sciences (Bajah, 2000).

A study conducted in 2005 by the Government Accountability Office in the United States of America (USA) found that 207 district federal STEM education programmes increased to approximately three billion in 2004. The study indicated that programmes are highly decentralised and require better coordination (Huenzi,

2008). The study further indicates that although degrees in some STEM fields (particularly biology and computer science) have increased in recent decades, the overall STEM degrees awarded in the USA has historically remained at about 17% of all post graduate degrees awarded (Huenzi, 2008). According to the National Science Foundation, the USA is ranked 20th amongst all nations that earn degrees in natural science or engineering (Huenzi, 2008).

2.2 Landscape of mathematics in Africa

There is political will to increase the outputs derived from mathematics training at both the level of basic and higher education. However, African government remains restricted in providing well trained teachers, lecturers, research personnel and at times a curriculum which is not relevant enough to address short and long term developmental needs (Wiśniowski, 2014).

Themes of research within the field of mathematical sciences often barely focus on traditional aspects of pure mathematics, such as algebra, geometry and analysis. According to Wiśniowski (2014) Francophone countries; teaching methods do not employ current developments in applied mathematics let alone industrial mathematics. Some tertiary institutions work with outdated curricular that does not include integrative and multidisciplinary topics.

Wiśniowski (2014) states that while an emphasis on pure mathematics has the advantage of preparing students for a deeper understanding, rigorous thinking and assessment; overemphasis of pure mathematics may not always align with the career aspirations of students and tends to be met with a high drop-out rate. The traditional mathematics curricula of many mathematical sciences programmes in tertiary institutions within Africa, do not offer the applied and multidisciplinary options that would point them in the direction of technology intensive careers (Wiśniowski, 2014).

Many tertiary institutions in Africa experience professional isolation as postgraduate and postdoctoral candidates have few or no academic peers in their field of speciality

at their own universities (Wiśniowski, 2014). Few of these students can afford to travel to enrichment conferences and workshops to meet other students, researchers and academics within their field of speciality. As such, despite the high quality of researchers, institutions like the Institute de Recherches Mathématiques in Abidjan, Ivory Coast are unable to perform at their optimum level primarily because of inadequate government funding and a small number of researchers whose specialties are increasingly remote from one another (Wiśniowski, 2014).

According to the International Mathematics Union (2009), a low public image of mathematics seems to dominate the tertiary education landscape in sub-Saharan Africa. Wiśniowski (2014) further explains that common mistaken views are centred on ill-informed perceptions including the view that mathematics is only for a few highly intelligent students or only for male students. In addition; many students have difficulty seeing the value of mathematics in society and consequently have a low opinion of mathematics as a viable career option. Part of the reason for this is poor early preparation which leaves secondary school students with a poor understanding of mathematics and a general aversion to the subject at the tertiary education level (Wiśniowski, 2014). The South African government is one of the few in the continent that has made an attempt to attach greater importance to mathematics both at the basic education and tertiary education domains (Wiśniowski, 2014).

The viable research centres established in many African countries are an indication of strength in mathematics. Countries which have one or more such centres include Algeria, Benin, Botswana, Burkina Faso, Cameroon, Ivory Coast, Mali, Morocco, Nigeria, Senegal, South Africa, Swaziland, Tanzania and Tunisia (Wiśniowski, 2014). Some of these centres are conducting world-class research, while others demonstrate the potential to do so. Morocco and Tunisia are well known for their good research centres, particularly in Tunis and Marrakech respectively. Countries in Sub-Saharan Africa such as Senegal, Benin and Cameroon have small but high-level centres (Wiśniowski, 2014). In both North Africa and sub-Saharan Africa, these centres provide mathematicians with a critical mass of human capital to support active mathematicians in various subject areas such as algebra, geometry, analysis and numerical analysis (Wiśniowski, 2014). Small multi-country networks in Francophone Africa offer exchange opportunities as well as coursework programmes

and conferences. Areas emphasised at some institutions may be considered old-fashioned (e.g. algebra, analysis), but in other cases are expanding into newly relevant areas (e.g. modelling) (Wiśniowski, 2014).

2.3 Regional mathematics programmes

Many countries, as noted above, have various elements of mathematical enterprise which although adequate for the nation as a whole, are conspicuously weak at the individual institutional level. This weakness has somewhat been mitigated over the past two decades with the emergence of collaborative networks of institutions at the national, intra and inter-regional levels which have been better placed to provide regional training and research networks linking both countries and institutions, pooling resources to support conferences, providing staff exchanges, mentorship programmes, subject matter conferences and sharing infrastructure (Shaikh, 2000).

Established in 2004 at the University of Nairobi in Kenya, the African Mathematics Millennium Science Initiative (AMMSI) is a distributed network of mathematics research and training in sub-Saharan Africa aimed at promoting mathematics through its regional offices in located in Botswana, Cameroon, Nigeria and Senegal (Shaikh, 2000). It aims to create and nurture world-class science and scientific talent by strengthening S&T capacity (Nyambi, Scott, Ketel & Guillard, 2012). The AMMSI enjoys a partnership with the London Mathematical Society to provide conference grants for postgraduate students to attend workshops and conferences in order to interact with academic seniors, meet potential mentors and gain experience in conducting scientific presentations. To date over 100 postgraduate students have benefited from this grant.

Shaikh (2000) states that from 2005 to 2008, the AMMSI offered annual research/visiting scientist fellowships to academics and researchers within the field of mathematical sciences. These fellowships were designed to support university staff from African universities to travel to other institutions within the continent in order to engage with other experts in the areas of research and participate in

postgraduate training at the host institutions. A total of 23 fellowships were awarded during the above stated period.

In 2009, nine universities had participated in the mentorship programme while more than 20 university staff and 200 postgraduate students had benefited from various AMMSI grants. With financial support of up to nine international donors and various other forms of support from ten African universities as well as the African Academies of Science, the implementation of the AMMSI has been fairly successful. However, if it is to fulfil its potential there must be great financial support from African governments as well as the AU, increased grant awards and extension of activities to promote interdisciplinary research (Shaikh, 2000).

The Nelson Mandela African Institute of Science and Technology (NM-AIST) in Arusha aims to train and develop the next generation of African scientists and engineers (Nyambi, Scott, Ketel & Guiland, 2012). The NM-AIST is a research institution for postgraduate and postdoctorate studies and research in SET.

According to Nyambi et. al, (2012) the Network of Scientific and Technological Institutions (ANSTI) embraces African institutions that provide university level research in the field of science and technology. The objective of the ANSTI is to strengthen training and research; and establishing services for intensive utilisation of science, engineering and technology. The programme supports capacity building in science and technology. The African University of Science and Technology (AUST) is a centre of excellence in science and technology. The AUST is governed by the board of the NMI and AUST. Through the Mentoring African Research in Mathematics (MARM) programme, 18 partnerships have been formed with the purpose of conducting joint research projects and promoting mentorship between African mathematicians and students within the continent (Shaikh, 2000).

2.4 DST policy mandate in relation to AIMS-SA

It is important for South Africa to be able to contribute to SADC, NEPAD and the African Union (AU) through science, technology and innovation. It is also critical that

South Africa properly resource these initiatives and create conditions that are attractive for scientists. It will not be possible to give effect to this plan without stimulating researchers from the rest of the world to come to South Africa to participate in the process of creating human capital (The Government of the Republic of South Africa, 2002).

The NRDS further makes provision for the generation of a new cadre of scientists. There is an aging scientific population of about 50% scientific outputs over the age of 50 as opposed to a mere 18% in 1990 and in the private sector there has been a 16% drop in the number of researchers in the past four years (The Government of the Republic of South Africa, 2002). There is a need of increasing skilled work force through supporting flagship programmes like AIMS-SA. The need to design programmes to attract young people to careers in science and technology depends on adoption of technology missions that are designed for a democratic, inclusive South Africa in the context of government obligations through SADC, NEPAD and the EU (The Government of the Republic of South Africa, 2002).

The establishment of the National Research Fund (NRF) aims to mentor organisations and provide funding to ensure that there is an increase in the number of black postgraduates in SET. The NRDS further makes provision for the development of specific programmes to retain science, engineering educators and mentors in tertiary education, provided they attract and develop young black and female students into postgraduate research (The Government of the Republic of South Africa, 2002). It is important that South Africa invests in the development of continental research networks to ensure that African scientists develop effective collaborations across the continent.

In response to the NRDS, the AIMS-SA programme was established. It is a pan-African centre of excellence which targets honours, master's and PhD students as well as the research centre which attracts world acclaimed mathematicians from across Africa and other parts of the globe.

2.6 AIMS components across South Africa, Ghana, Senegal and Cameroon

2.6.1 Training

The initial academic programme that was offered by AIMS-SA in 2003 was a postgraduate diploma in mathematical sciences. During the financial year 2011/12, the AIMS independent evaluation recommended that the postgraduate diploma should be converted to a structured master's degree. The South African Higher Education qualification authority designed the structured master's curriculum. This master's degree has been successfully implemented in South Africa, Ghana, Senegal and Cameroon (Technopolis, 2015). This Master's programme is offered for a period of 10 months, and covers skills courses, review courses and the research phase. According to the Technopolis (2015) the statistics show that generally, the number of applications is growing exponentially in these countries. AIMS provides students with an opportunity to get education abroad and the majority of students would have not been able to afford to enrol for a master's degree abroad. The AIMS is perceived to be a unique learning environment that encourages students to develop analytical skills and communication skills (Technopolis, 2015).

2.6.2 Research

The AIMS-SA research centre was launched in 2008, prior to the AIMS initiative. The purpose of the research component is to conduct and foster outstanding research in mathematical sciences. The centre is funded by the NRF. The evaluation conducted by Technopolis (2015) indicates that AIMS has succeeded to implement research centres in South Africa, Senegal and Ghana. There are prospects for setting up a research centre in Cameroon. AIMS offers exposure to research topics to students and academic staff through workshops, short courses and weekly seminars. The study further reveals that AIMS has developed links amongst its research centres to boost capacity, it has further developed links with other universities and encourage co-publications (Technopolis, 2015).

2.6.3 Public engagement

The public engagement component started with the creation of the AIMS Schools Enrichment Centre (AIMSSEC) in 2004. The aim of this component is to support teachers in their professional development. The purpose of this component is to improve teachers' content knowledge, train them as subject leaders in their field and to establish networks of support among teachers (Technopolis, 2015). In South Africa; the public engagement activities have advanced into advocacy, visibility and communication activities. In the other centres; public engagement activities are at different stages of implementation. The findings of the evaluation conducted by Technopolis (2015) reveal that there is no clear understanding of what the public engagement activities aim to achieve. However, AIMSSEC has a high demand and is recognised by the South African government. Teachers' training activities in other countries is based on an opportunistic approach.

2.6.4 Organisational development

The AIMS secretariat was launched in 2011 and is mandated by African Institute for Mathematical Science-Next Einstein Initiative (AIMS-NEI) Board of Directors which is the United Kingdom (UK) Foundation. The function was established in response to the need to create an overarching structure and provide centralised services supporting the development of new AIMS centres and network coordination (Technopolis, 2015). The AIMS secretariat is based in South Africa, Cape town but there is also secretariat staff that is based in Toronto, London and Berlin. The AIMS network is composed of all AIMS entities and the secretariat.

2.7 Relevance, efficiency, sustainability, effectiveness and impact of AIMS programme

The evaluation done across the AIMS centres in South Africa, Ghana, Senegal and Cameroon reveals that 748 graduates obtained their degrees between 2013-2014. The graduates are from pan-African countries with the majority from Anglophone countries. Women make up 36% of the graduates which shows that AIMS does contribute to the advancement of women in science (Technopolis, 2015). A majority of female graduates completed their studies at master's degree level and the majority of male graduates completed their studies at PhD level (Technopolis, 2015). 110 Alumni have co-authored two or more published international peer-reviewed journals. A majority of alumni are employed in the academic sector, only a few work in the non-academic sector. Only 10% of alumni are involved in launching innovative products and services in their current occupation (Technopolis, 2015). Most alumni return to their home country after completing their studies, this is due to the research career opportunities in many African countries. Some alumni work and continue to study in South Africa (Technopolis, 2015).

Six research chairs are funded for over three to four years and the funding is secured from Von Humboldt Foundation for the extra four research chairs in South Africa and Ghana. 11 Visiting researchers and postdoctoral fellows work under these research chairs. AIMS centres hosted 18 workshops, conferences and summer schools and 27 weekly seminars in 2014 (Technopolis, 2015).

AIMS was successful in training at least 162 teachers between 2013 and 2014, only few teachers were trained in Senegal, Ghana and Cameroon Centres (Technopolis, 2015). Efficient financial systems were implemented in June 2014. Improved reporting systems were introduced (Technopolis, 2015).

According to Technopolis (2015) the interviewees indicated that AIMS is a relevant programme including the research, training, public engagement and organisational development components. AIMS has been efficient in implementing interdisciplinary research programmes. Even though AIMS has limited resources, it has managed to attract some of the leading scientist (Technopolis, 2015). The institutions have been effective in providing postgraduate opportunities for AIMS alumni through research

chairs. AIMS has been effective in creating new centres in Senegal, Ghana and Cameroon. The institution has been effective in acquiring visibility in the African continent. Effectiveness of AIMS is also observed in teaching skills that improve employability of academic staff (Technopolis, 2015). AIMS has been effective in producing research outputs such as publications (Technopolis, 2015). There is limited evidence of AIMS' contribution on policy development and innovation in Africa (Technopolis, 2015). The impact of AIMS as a flagship initiative has been recognised. There seems to be adequate partnerships with stakeholders and donors which encourages sustainability.

An independent evaluation conducted by AIMS-SA reveal that AIMS-SA is relevant and the design of the programme has been aligned with the United Nations Educational, Scientific and Cultural Organization (UNESCO) declaration for higher education and NEPAD's Africa's Science and Technology Consolidated Plan of Action through AIMS-SA's affiliation with African Observatory for Science, Technology and Innovation (AOSTI) (Nyambi et. al, 2012). According to interviewees, survey alumni and focus group discussions; AIMS-SA programme is relevant in addressing some of Africa's challenges through research (Nyambi et. al, 2012).

The findings further indicate that AIMS-SA is run with a high degree of efficiency (Nyambi et. al, 2012). Reporting is done according to funder requires. Shared services and resources with local and international partner universities and use of volunteer international lecturers and across multiple layers of the centre all contribute to cost effectiveness (Nyambi et. al, 2012). Nyambi et.al. (2012) reveals that the AIMS-SA programme is cost-effective in implementing its projects and activities.

AIMS-SA has been effective in contributing towards the development of higher education and production of students who have obtained postgraduate degrees. AIMS has also contributed in the increase of African men and women with research skills to support Africa's development in relation to HCD (Nyambi et. al, 2012). The

institution contributes to the development African researchers and skills of Africans in mathematical sciences.

The teaching methods and approaches contribute to the long term sustainability of AIMS-SA. Alumni reported that the AIMS-SA programme contributes significantly to their current careers or educational paths. AIMS-SA has been very effective in producing young African men and women who have enhanced their academic qualifications with master's and PhDs (Nyambi et. al, 2012). All of AIMS-SA operational budget is provided by the government of South Africa. Sustainability in respect of funding has been observed (Nyambi et. al, 2012).

3. Logical framework and theory of change of the AIMS-SA programme in relation to DST policy

Table 1: Adopted logical framework

AIMS-SA Components	Training		Research		Public Awareness		Organisational Development
Impacts	Human resource with mathematical sciences skills that contribute to the productivity and growth in South Africa and Africa		Citations within South Africa	Innovative products and services within South Africa	Interest of pupils in mathematical sciences within South Africa STEM policies within South Africa		AIMS being a flagship programme within Africa
Indicators	<i>Number of employed alumni with mathematical sciences skills</i> <i>Number of employed alumni that have created innovative products and services that contribute to the change in productivity and growth in South Africa and Africa</i> <i>Change in the GDP</i>		<i>Number of citations</i>	<i>Number of innovative products and services</i>	<i>Number of pupils who enrol in mathematics</i> <i>Number of STEM policies developed</i>		<i>Number of institutions who adopt similar programmes</i>
Outcomes	Improved employment opportunities for graduates	Increased skilled staff	Increased publications	Increased patents	Enhanced teachers' skills in mathematics	Improved awareness on mathematical sciences	Enhanced visibility
Indicators	<i>Number of graduates who are employed in the mathematical sciences sector</i>	<i>Evidence of perceptions of institutions of AIMS graduates</i>	<i>Number of publications</i>	<i>Number of patents</i>	<i>Evidence of teachers' perceptions about mathematics</i>	<i>Evidence of attendees' perceptions on awareness of mathematical</i>	<i>Number of partners that contribute financially and ensure that AIMS-SA achieve the intended goals</i>

AIMS-SA Components	Training		Research		Public Awareness		Organisational Development
	<i>Evidence of perceptions of companies and institutions of AIMS graduates</i>				<i>Evidence of teachers' demonstration on understanding mathematics</i>	<i>sciences</i>	
Outputs	Skilled graduates	Skilled tutors/ teaching assistant	Completed research reports	Completed research projects	Trained and highly qualified teachers	People reached through public engagement	Well organised and managed AIMS-SA
Indicators	<i>Number of graduates in mathematical sciences</i>	<i>Number of tutors/ teaching assistant</i>	<i>Number of completed research reports</i>	<i>Number of completed research projects</i>	<i>Number of trained and highly qualified teachers</i>	<i>Number of attendees at public awareness events</i>	<i>Effective M&E system that is used</i> <i>Good quality management system</i>
Activities	International and national lectures implementing AIMS-SA academic programmes		Students and tutors/ teaching assistants conducting basic and applied research Establishing research chairs		AIMS-SA training teachers	AIMS-SA conducting public awareness programmes	Managing AIMS-SA
Inputs	Financial resource				Human resource		

Key Assumption 1: Donors including the South African government continue to support and prioritise mathematical sciences and technology

Key Assumption 2: There is infrastructure and opportunities for mathematical sciences graduates

Key Assumption 3: Continued interest of students to further their studies in mathematical sciences

Figure 1: Adopted theory of change

IF the Department of Science and Technology provides financial support to AIMS-SA, AIMS-SA will provide a platform for researchers to conduct basic and applied research, there will be skilled graduates, increased publications, increased patents and improved employment opportunities **THEN** there will be citations and human resource with mathematical sciences skills that contribute to the productivity and growth in South Africa

The study adopted contribution analysis by developing the logical framework and the theory of change which were used as guiding framework for the evaluation. Contribution analysis explores the contribution the intervention makes to observe the results. Developing the theory of change and the logic framework shows the link between inputs, activities, outputs, outcomes and impacts. Evidence was collected from various sources to test this framework. The aim is to test the results chain of the AIMS-SA programme in supporting the DST mandate.

The adopted theory of change and the logical framework unpacks the envisaged results of the key components that the DST supports through funding that is provided to AIMS-SA. The NRDS recommends that the DST should introduce programmes that ensure increased number of postgraduate students; and increased interest in mathematical sciences to enhance skilled work force (The Government of the Republic of South Africa, 2002).

In the absence of the counterfactual scenario and the comparison group, the DST considered the available collected data in establishing evidence required for the results of the AIMS-SA programme.

4. Evaluation Approach

4.1 Type of evaluation employed

The type of evaluation that was employed is the implementation evaluation. Implementation evaluation assesses the processes of implementation and outcomes of the programme. Implementation evaluation was adopted in order to assess if the AIMS-SA programme has achieved the intended DST objectives. The evaluation provides an opportunity for the programme beneficiaries to share their experiences and perceptions which will be used to inform future planning for both AIMS-SA and the DST. The evaluation was conducted in order to ascertain relevance, efficiency, effectiveness, sustainability and the emerging impact of the AIMS-SA programme.

4.2 Research strategy

4.2.1 Methodology

The method employed in this evaluation is the mixed method approach. Mixed method approach is a combination of qualitative and quantitative data collection techniques. The use of multiple data collection methods was chosen to draw meaningful conclusions and recommendations. The qualitative method was used to obtain detailed information of specific needs in question. The DST used this technique to gather experiences of the unit of analysis. The evaluation used the quantitative method to obtain data such as the number of beneficiaries based on age and gender distribution; employment status and country of origin.

4.2.2 Ethical considerations

The DST applied ethical considerations when collecting data. Applied ethical considerations include; informed consent and right of privacy. The DST explained and informed the participants about the purpose of the evaluation. Participants were assured that their identity will remain anonymous.

4.2.3 Collection methods

Data collection methods used to obtain information in this evaluation are interviews and on-line surveys. Interviews were conducted with key informants which are; AIMS-SA Director, Academic Director and; Research and Administration Manager. The on-line surveys were conducted and specific questionnaires were forwarded to the alumni, tutors/ teaching assistants, current students and visiting African researchers

Table 2: Data collection schedule

Date	Activities	Participants
11 February 2015	Conducting interviews	AIMS-SA Director, Academic Director and; Research and Administration Manager.
12 February 2015	Piloting questionnaires	Current students, alumni, visiting African researchers and tutors/ teaching assistance
14 February - March 2015	Completion of on-line survey	Current students, alumni, visiting African researcher and tutors/ teaching assistance

4.2.4 Unit of analysis

The DST conducted on-line surveys and interviews to the targeted unit of analysis (as categorised in table 3 below). There was no need to sample because the DST had access to a limited number of AIMS-SA beneficiaries.

Table 3: Unit of analysis and response rate

Unit of Analysis	Response Rate
Alumni	67
Current Students	16
Tutors/ Teaching Assistants	8
Visiting African Researcher	4
AIMS Officials	3

4.3 Data analysis

4.3.1 Quantitative data analysis

The data obtained from the on-line surveys was analysed using Microsoft excel. The variables analysed include; gender, age, employment status and country of origin of respondents.

4.3.2 Qualitative data analysis

Qualitative data was analysed through content analysis. Content analysis identifies the presence of words or phrases within the text. Interviews were transcribed into written text for analysis. Responses were then quoted to indicate exact words extracted from the text.

4.4 Limitations of the evaluation

The DST had access to a limited number of AIMS-SA beneficiaries. There were instances where very few participants responded. There was limited literature to be considered since the DST only had access to google scholar. It should be noted that the findings and conclusion are solely based on the data collected.

5. Findings

5.1 AIMS-SA Alumni

One of the DST's policy objectives is to promote and strengthen human capital in the S&T sector. The findings contribute to this objective and evidence shows that numerous alumni have degrees in mathematical sciences, applied sciences, fundamental and finance mathematics.

Figure 2: Number of alumni as per level and field of study

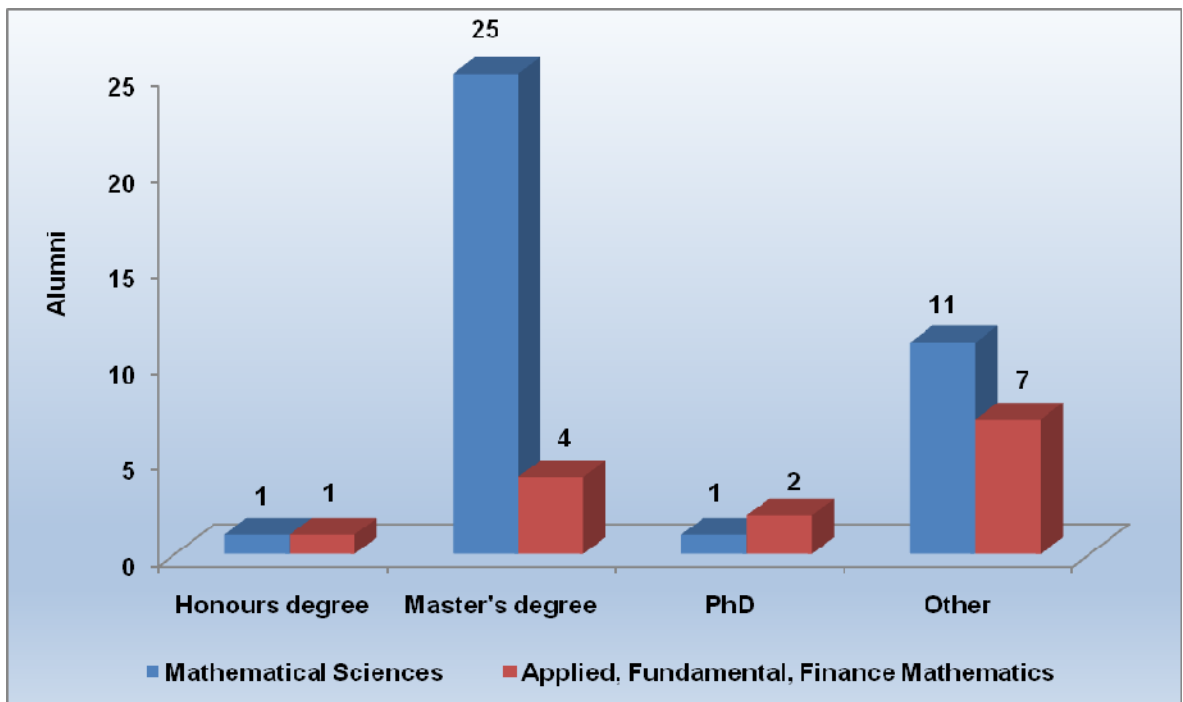


Figure 2 above shows that out of 67 alumni who responded on the on-line survey, 25 completed their master's degree in Mathematical Sciences. Only one completed his PhD degree in Mathematical Sciences, while four completed their master's degree in pure mathematics, applied sciences and finance mathematics. Only two PhD alumni completed their degrees in Applied Mathematics.

Table 4: Disaggregation by country of origin and gender

Country of origin	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
South Africa	6	11%	1	8%	7	10%
Other Southern Africa (excluding SA)	4	7%	0	0%	4	6%
East Africa	15	28%	4	31%	19	28%
Western Africa	12	22%	4	31%	16	24%
Northern Africa	4	7%	3	23%	7	10%
Middle Africa	11	20%	1	8%	12	18%
Unspecified	2	4%	0	0%	2	3%
Total	54	100%	13	100%	67	100%

According to table 4 above, out of 11 alumni from the Southern African countries who participate in the AIMS-SA programme, seven were from South Africa. The AIMS-SA programme contributes towards human capital development and research development.

Figure 3: AIMS-SA Alumni who were sufficiently prepared for the work place

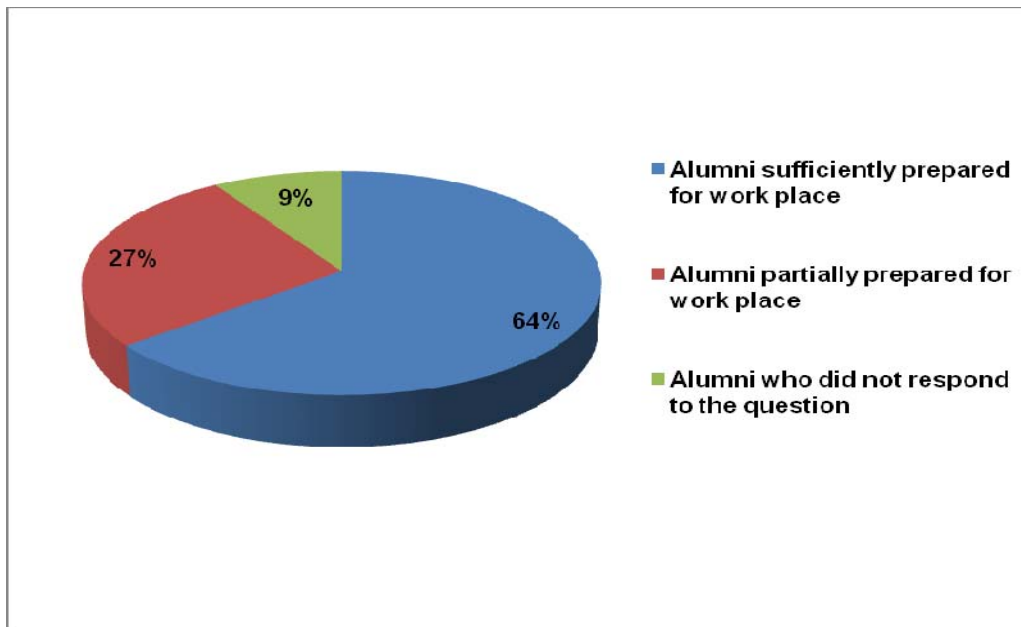


Figure 3 above shows that the outcomes of the AIMS-SA programme are immense since most of the alumni (64%) who participated in the evaluation feel that the

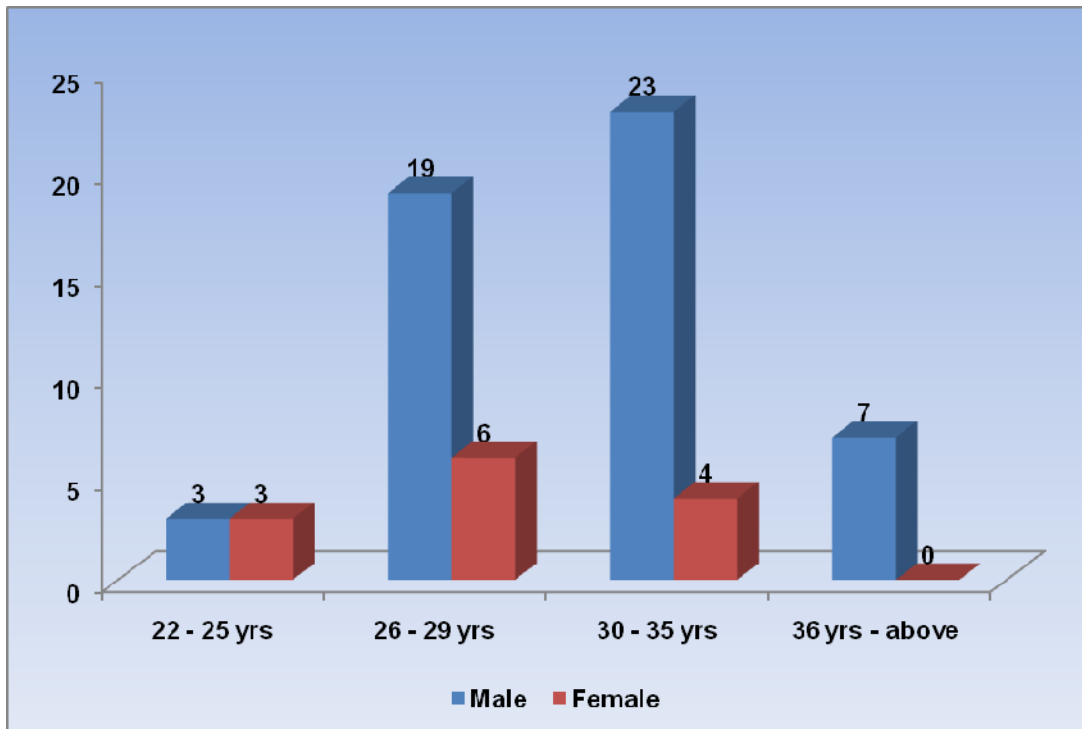
programme sufficiently prepared them for the workplace. At least 27% of the alumni were partially prepared for the workplace. None of the alumni felt that the AIMS-SA programme did not adequately prepare them for the work place. About 9% of alumni did not respond to this question.

Table 5: Distribution of alumni by gender and race

Race	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Black African (South Africa)	6	11%	1	8%	7	10%
Black African (from other countries)	38	70%	9	69%	47	70%
Arab	1	2%	2	15%	3	4%
Middle Eastern	1	2%	0	0%	1	1%
Nusantara (Indonesia)	1	2%	0	0%	1	1%
Sudanese	1	2%	0	0%	1	1%
Unspecified	6	11%	1	8%	7	10%
Total	54	100%	13	100%	67	100%

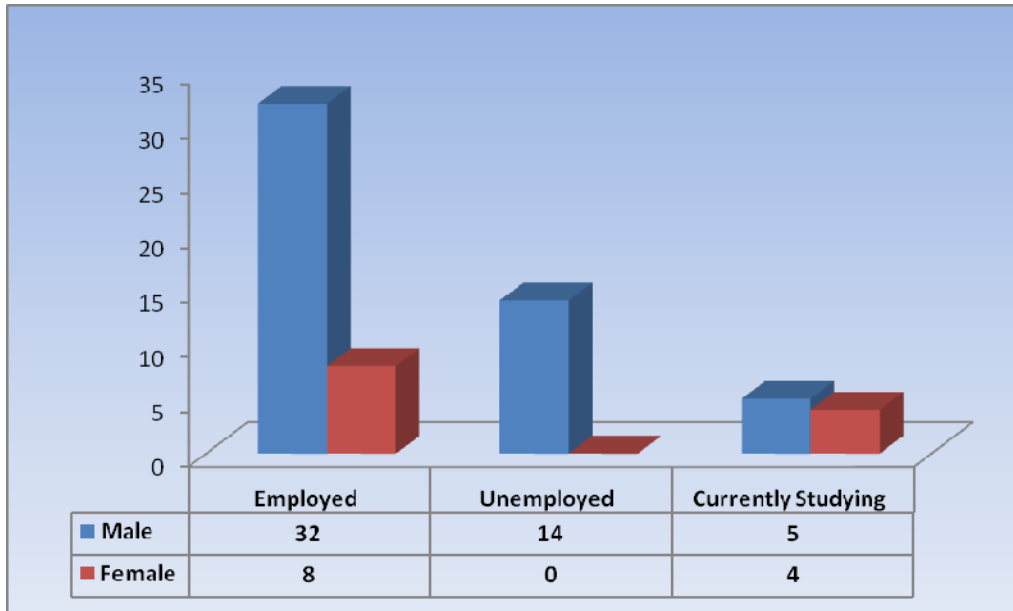
Table 5 above illustrates that most alumni are black African. South African alumni are only seven, whilst most alumni (47) are black Africans from other African countries. Middle Eastern, Nusantara and Sudanese are the least alumni. Six male alumni did not specify their race and only one female alumna did not specify her race.

Figure 4: Distribution of alumni by age group



The above figure shows that most alumni still fall within the category of youth. Their age is between 30-35 years, of which 23 are male and four are female alumni, followed by those who are between the ages of 26-29 years of which 19 are male and six are female alumni. Two male respondents did not specify their age. It should be noted that none of the respondents were between the ages of 18-21 years.

Figure 5: Distribution of alumni by employment status



Out of the total of 67 alumni who responded, 32 male and eight female indicated that they are employed. A majority of alumni were employed immediately after completing their studies while only a few indicated that it took about six months and above to get jobs. Five male and four female alumni opted to continue with their studies. Four alumni did not specify their employment status or whether they are currently studying. Most alumni indicated that the academic programme contributed positively towards preparing them for the workplace. A majority of alumni are employed by universities and colleges in South Africa, Kenya, Rwanda, Nigeria and Canada. Some are employed by AIMS-SA.

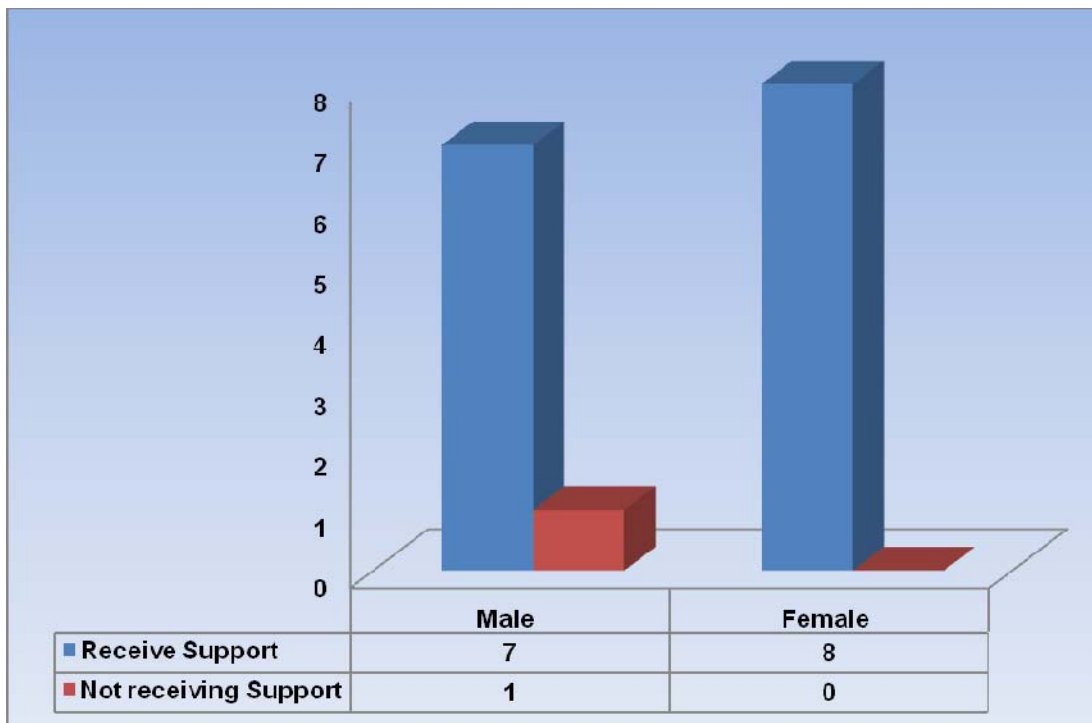
According to the alumni on-line survey; 36 research papers have been published. Two female and 14 male alumni have published research papers.

5.2 Current Students

According to the interview with the Programme Manager and document review, the 2014/15 January intake statistics show that; only 11 students are South Africans. The AIMS-SA introduced the January intake to attract local students. The 2014/15 August intake statistics show that only one male current student is from South Africa and 44 students are from other African countries. The statistics further reveal that 26 are male students and 19 are female students.

“AIMS wants to be a Pan African organisation, we would like to have up to 30% of local country participation and we hope that we are gradually getting there”.

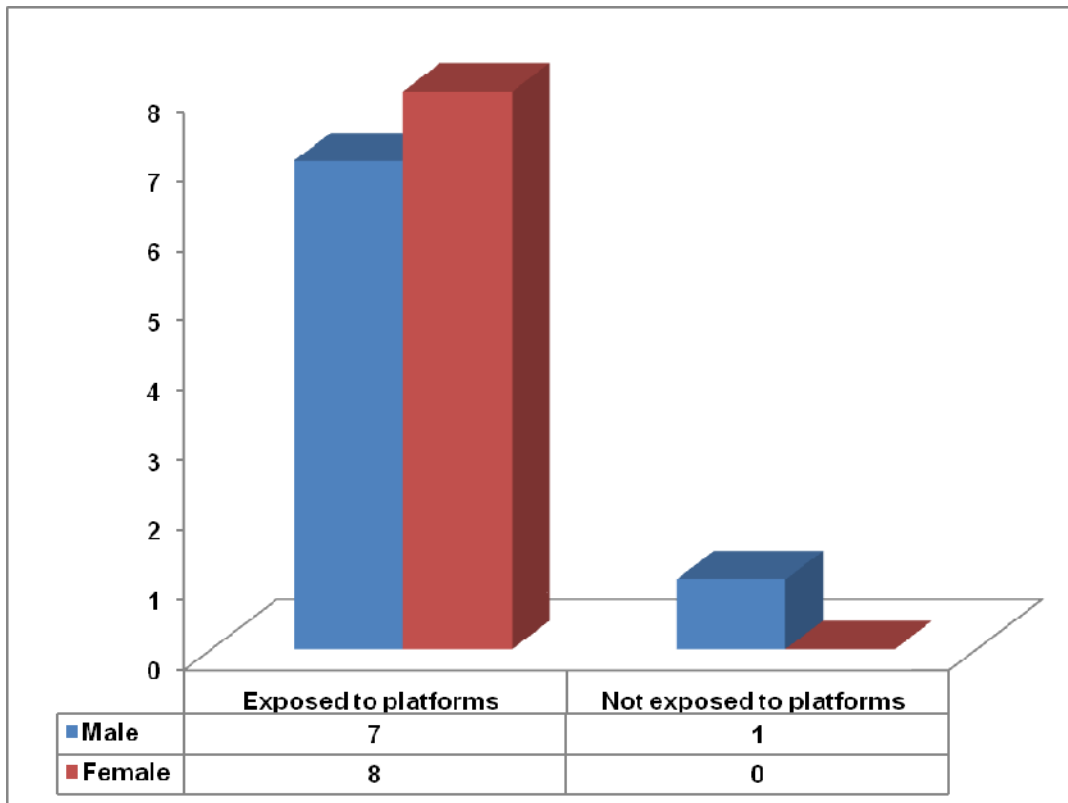
Figure 6: Current students who receive support to effectively cope with their studies



Out of the total of 16 students, seven male and eight female students indicated that they received effective support to cope with their studies and only one male indicated that he does not receive support. 15 Students indicated that they received financial support such as bursaries and scholarships, academic support such as tutorials,

extra lessons, career guidance, feedback sessions and training workshops. Students also indicated that they utilise resources such as information technology facilities, AIMS-SA laboratory and AIMS-SA research center to better equip themselves with study materials. About 10 students out of the total indicated that they often use information technology facilities.

Figure 7: Students who are exposed to research publishing platforms



The figure above depicts that three male and four female students are exposed to research publishing platforms while five male and three female students indicated that there are no platforms to publish research. The only challenge which was highlighted regarding the research publishing platforms is that there are no software packages. Students also indicated that they receive financial support and use computer facilities from AIMS-SA. Only one female student out of those who participated in the evaluation indicated that she has already published two research

papers. Only one female student did not indicate whether she was exposed to research publishing platforms or not.

5.3 Tutors/ Teaching Assistants

Table 6: Tutors/ Teaching Assistants at AIMS-SA per gender distribution

Tutors/Teaching Assistant			
Currently Studying		No longer Studying	
Male	Female	Male	Female
2	2	2	1

Out of the total of eight tutors/ teaching assistant who responded, four are current students at AIMS-SA. They enrolled at Johannes Kepler University and Heroit Watt University studying Mathematical Finance, Mathematical Biology and Physics respectively. Two male students and one female are no longer students at AIMS-SA. They completed their studies at the University of Stellenbosch and University of Areiro Portugal specialising in Mathematics, Cosmology and Physics respectively. The highest level of qualification for these tutors/ teaching assistants is PhD degree. One female did not indicate if she is a current student or not.

5.4 Visiting Researchers

Three male and one female African visiting researchers responded to the questionnaire. Two researchers are from Switzerland, one from Ethiopia and the other from South Africa with ages ranging between 30 years and above. The researchers indicated that they enrolled for the PhD degree at AIMS-SA and are based in Bahir Dar University in Ethiopia, North-West University in South Africa, University of Geneva as well as the Swiss Federal Institute of Aquatic Science and Technology in Switzerland. Their area of expertise includes bio-fluid dynamics, water resources, operations research, mathematics, physics and cosmology.

5.5 AIMS-SA Governance Structure

The AIMS-SA centre consists of a governance structure with SA and international members, partner universities, members of NEPAD and three external universities. The management team consists of; Information Technology (IT), logistics, finance, human resource and administration personnel. There is also an executive team which consists of members from the local partner universities which assists in the selection of students. The current donors include; the DST (through the NRF), Government of Canada through the International Development Research Centre (IDRC), University of Ottawa, University of Victoria, University of British Columbia, Avery Tsui Foundation, University of Witwatersrand (Centre of Excellence in the Mathematical and Statistics Sciences), German Academic Exchange Service (DAAD), Department of Higher Education and Training (DHET) (through National Skills Fund), Government of the United Kingdom (through AIMS-NEI), Fulbright Specialist programme, Neil Turok Scholarships, Paul G Allen Family Foundation, Peter Kellner-Richmond Management, Robert Bosh Foundation, University of Illinois and Victor Rothschild Memorial Fund Scholarship.

Mechanisms that have been put in to monitor the implementation of the AIMS-SA programme include regular reporting and evaluations conducted every five years by AIMS-SA independent evaluators.

“ AIMS-SA programme has been cost-effective relative to the number of degrees awarded and outputs, also taking into consideration that we have few staff”

5.6 The AIMS-SA programme provides services to the intended beneficiaries

The beneficiaries of the programme include; AIMS-SA bursaries candidates, visiting researchers from African countries and tutors/ teaching assistance. The AIMS-SA programme also uses part of the funding provided by the DST for core running costs. Although the intended beneficiaries participate in the programme, AIMS-SA is struggling to reach 30% local country participation.

The respondent identified this challenge:

“It has been a struggle to fund postdoctorate from the SADC region. Advertising of postdoctorate from SADC has increased. Certain students have been approached as well as academics from neighbouring countries”.

5.7 The AIMS-SA programme responds to the mandate of the DST

The student indicated that she has published two research reports. Other students indicated that they are in a process of publishing their research reports. The interviewee indicated that Biomathematical research chair and Square Kilometre Array (SKA) research chair have been established. The research centre is used to host high-level workshops in mathematical finance, mathematical modelling of diseases and cosmology.

5.8 The AIMS-SA programme has positive outcomes

Most respondents indicated that the programme has influenced their lives in different ways. They indicated that they had an opportunity to continue with academic studies and gain more experience in scientific research. Their communication skills, interpersonal skills, computing skills and research skills were improved.

“I had a chance to network with experts from various countries for example... visitors from Germany”

“Even my level of thinking was improved and I learned to work independently”

5.9 There is a positive emerging impact of the AIMS-SA programme

The perceived emerging impact of the programme is that AIMS-SA alumni return to their country of origin, they acquire jobs and contribute towards productivity and economic growth. This evidence shows the AIMS-SA programme contributes to the development of STI human capital.

According to the documents reviewed, Botswana has embarked on a process to benchmark AIMS-SA model. This evidence shows that AIMS-SA is a flagship programme within Africa.

5.10 Students had a vast knowledge about the AIMS-SA programme

The majority of students indicated that they obtained knowledge about AIMS-SA through advertisements. This shows that although there is a limited number of local AIMS-SA beneficiaries, the programme is visible through media to ensure that ordinary people are informed about bursary opportunities.

5.11 The research conducted by respondents is relevant to science and technology needs in Africa

The students indicated that they are currently embarking on;

- Direct application of research results to the Square Kilometre Array project; and
- Training of cosmology group members at AIMS-SA

All the respondents expressed that the environment at AIMS-SA is conducive to conduct research as it enables them to engage in critical discussions related to their research projects.

6. Discussion of Findings

6.1 Discussion of the Results Chain and Findings

6.1.1 Research

The logic framework and the theory of change adopted in this evaluation gives an indication that the impacts of the AIMS-SA programme are citations; and innovative products and services. The alumni on-line survey reveals that 38 research papers have been published. One female current student has published two research papers. It can be concluded that the outcomes of the research component have been met and the AIMS-SA programme contributes to the DST policy objectives. There is no evidence that published reports were cited.

6.1.2 Training

Human resources with mathematical sciences skills that contribute to productivity and growth in South Africa is the perceived impact that is assumed by the adopted logic framework for the purpose of this evaluation. The outcome of the training component is improved employment opportunities for graduates, while skilled graduates are the outputs of the component. The on-line survey with the alumni reveals that after completion of studies, the graduates return to their country of origin to seek employment opportunities. The on-line survey further reveals that a majority of alumni are employed. This evaluation gives an indication that the AIMS-SA programme through the mandate of the DST contributes to the productivity and growth in South Africa and Africa.

6.1.3 Public Awareness

Part of the mandate of the DST as stipulated in the NRDS, 2002 is to increase the number of skilled people in mathematics, science and technology and also promote science and technology in schools. Interviews conducted with the AIMS-SA Programme Managers reveal that the centre provides public awareness activities which aim to enhance interest of pupils in mathematics and science. Part of the public awareness component includes execution of road shows to reach the public and improve interest in mathematics, science and technology and also encourage South African students to enrol for the AIMS-SA programme. According to the adopted logical framework, the outputs of the public awareness component include trained and highly qualified teachers. Part of the outcomes of this component is to reach ordinary people and enhance their interest in mathematics, science and technology.

6.1.4 Management of AIMS-SA Programme

This evaluation partly assessed the management of the AIMS-SA programme focusing on its sustainability. The perceived impact of the AIMS-SA programme is AIMS-SA being a flagship programme within Africa. The outcome is enhanced visibility and outputs include well organised and managed AIMS-SA. Interviewees indicate that the programme is well management and receive funding from the DST, DHET and other external donors. According to document review AIMS can sustain itself and is established in other countries. AIMS Cameroon was launched in February 2014, with 36 students from 15 African countries who enrolled in the programme. Therefore, the AIMS centres have increased to three and include; AIMS Cameroon, AIMS Ghana and AIMS Senegal. Document reviewed revealed that Botswana has embarked on a process to benchmark AIMS model.

6.2 Discussion of Evaluation Questions, Literature and Findings

6.2.1 Relevance

African Institute for Mathematical Sciences is perceived to be a relevant programme since it contributes to human capital development. A strong human capital development base is critical as a key economic driver in developing the STEM sector. Responses from the on-line survey give an indication that the AIMS-SA programme is relevant and support offered cater for students' needs. The programme caters for the intended beneficiaries which are students from the continent.

6.2.2 Efficiency

Although the purpose of this evaluation was not to assess the financial aspect of AIMS-SA, the review of secondary data reveals that the AIMS-SA model is implemented with a high degree of efficiency. It should be noted that efficiency based on return on investment for beneficiaries of AIMS-SA was not established during the time of this assessment.

6.2.3 Effectiveness

Findings reveal that the AIMS-SA programme has positive outcomes as discussed in Section 5 above. Concluding from the document review, there is a record of excellent achievement of master's and PhD students who graduate in the field of mathematical sciences. Existence and increase in the number of publications demonstrates that the programme is effective. 14 Alumni have published 38 research papers; a majority of current students are in the process of publishing research papers, while one current student has already published two research

papers. Document review reveals that there is a significant improvement on the grades of learners whose teachers participate in the AIMSSEC. The AIMS-SA programme is seen to be contributing to the mandate of the DST of increasing human capital development and research development through its academic programme targeted at honours, master's and PhD level that attracts students from across Africa and other parts of the globe.

6.2.4 Emerging impact

Section 3 outlines the logical framework and the theory of change which shows that the perceived impact of the AIMS-SA programme is AIMS-SA being a flagship programme in Africa. Evidence from documents reviewed show that the model is being replicated in other countries. For example; it is evident that the Botswana government is in a process of setting up a similar institution and Cameroon has recently launched the AIMS programme.

According to documents reviewed it was not clear whether there has been a significant change in the results of students who are beneficiaries of the AIMSSEC project. The analysis of the on-line survey shows that there is no evidence of students whose work has been cited. Document review did not also provide this kind of information.

Students who have completed their degree return to their country of origin in order to contribute to productivity and growth. Section 5 above mentions that alumni who responded to the survey indicated that the programme has influenced their lives in different ways. They had an opportunity to continue with academic studies and gained experience in scientific research. Their communication skills, interpersonal skills, computer skills and research skills were improved.

6.2.5 Sustainability

The support received from the DST is a valuable component of the AIMS-SA programme. However, sustainability of the AIMS-SA programme in terms of funding seems not to be a major risk due to willingness of the DHET and other donors to support AIMS-SA programme and centres of excellence within AIMS-SA. Documents that were reviewed reveal that in addition to funding provided; students participate in the exchange programme and enrol for short courses. Another key factor seen to enhance sustainability of the AIMS-SA programme is the partnership that has been established by universities that implement the AIMS-SA programme. AIMS-SA can sustain itself since has established a strong partnership with universities and other donors. According to interviews conducted and documents reviewed; staff retainment remains a challenge since there are limited resources to ensure that AIMS-SA personnel and scientists are offered permanent jobs.

7. Lessons learnt, conclusion and recommendations

7.1 Lessons learnt

Key lessons learnt from literature;

- The AIMS model consists of three key areas; the postgraduate diploma, which was then converted into a master's degree programme, outreach reach programme (public awareness) was then introduced which was then followed by the research centre; and
- Incorporation of programmes targeting gender mainstreaming should be in place throughout the implementation of key AIMS activities.

Key lessons learnt emerging from this evaluation include;

- There is strong partnership between local and international universities;
- There is strong support from government departments;
- There is a need to establish more programmes that support capacity building in science and technology;
- There is a limited number of AIMS-SA alumni who contribute to human capital development; and productivity and growth in Africa; and
- AIMS-SA needs to keep a record of the alumni network.

7.2 Conclusion

The literature reviewed confirms that the AIMS-SA programme has been effective in contributing towards the development of higher education and production of students who have obtained postgraduate degrees. The multi-donor institution addresses the need for mathematical sciences and offers an opportunity for the youth to be empowered and be equipped in mathematical sciences skills. The relevance of AIMS-SA is clear and it is an appropriate model for South Africa. The AIMS model has created partnerships between various education institutions, government

departments and donors. The AIMS programme depends on external funding since students do not pay tuition fees. The programme is effective and evidence shows that it has positive outcomes and research outputs have been produced.

The AIMS-SA programme has contributed to the DST objectives through increasing human capital in mathematical sciences and increasing the number of publications. Evidence that exists shows that the AIMS-SA programme is a flagship programme. The AIMS-SA programme has been replicated in other countries. The AIMS-SA programme is perceived to be sustainable since there is strong partnership established between AIMS-SA, universities and donors. The NRF; as recommended by the NRDS provides funding to ensure that there is an increase in the number of black postgraduates in SET. The findings show that only 12 current students are from South Africa but AIMS-SA has introduced the January intake programme to attract more South African students. Only seven South African alumni have participated in the AIMS-SA programme.

It can be concluded that the outcomes and the emerging impact of the programme have been achieved to a certain degree but more work still needs to be done and a cohort of alumni need to be tracked. Whilst the AIMS-SA programme's contribution to the DST policy is visible, it should be noted that there also other contributing factors that lead to the achievement of outcomes and emerging impact.

Overall, the AIMS-SA programme has responded to the NRDS objectives. The AIMS-SA centre has introduced activities to attract South African students. However, there is a need to develop strategies to recruit female students. The AIMS-SA programme also responds to the NDP 2030 vision which calls for a focus in increasing the number of knowledge producers so as to transition South Africa towards an innovation and knowledge-led economy.

7.3 Recommendations

The study recommends that;

- The DST should develop an effective DST monitoring and evaluation system in order to effectively monitor the AIMS-SA programme and to define the inputs, activities, outputs, outcomes and impact of the programme; and
- There should be mechanisms to attract South Africans, especially female students to participate in the AIMS-SA programme.
- There is a need for AIMS-SA to create women's network for promotion of mathematics and science.

Generally, the students recommended that the AIMS-SA programme needs to be improved.

The programme should be improved as follows;

- The duration of the programme should be extended and a full research master's degree be awarded. The structured master's programme should be completed in two years. The first year should entail course work and the second year should entail research;
- Extend the essay phase to allow more feasible studies;
- Introduce more of the industrial orientated programmes;
- Provide funds to attend workshops or conferences or summer school abroad (in Europe or America); and
- Exams should be taken at the end of the year like the normal academic environment which would entail expanding the scope of the research which might last more than the expected 10 months of the academic session.

References

- African Union Commission. 2014. *Science, Technology and Innovation Strategy for Africa (STISA) 2024*. Addis Ababa, Ethiopia
- Bajah, S.T., 2000. The State of Science, Technology and Mathematics Education (STME) in Africa, *UNESCO International Science, Technology and Environmental Education Newsletter*, 25(3): pp5-7
- Department of Science and Technology, TechnoScene. 2013. *A review of DST Support Provided to the NEPAD Science and Technology Flagship Programme*
- Department of Science and Technology. 2014. *Policy, Programme and Project Evaluation Guidelines and Standards for Evaluations*. Pretoria
- Heunzi, J. J. 2008. *Science, Technology, Engineering and Mathematics (STEM) Education: Background, Federal Policy and Legislative Action*. Congressional Research Service, <http://digitalcommons.unl.edu/crsdocs/35>
- International Mathematics Union. 2009. *Mathematics in Africa: Challenges and Opportunities*. www.mathunion.org
- Mugabe, J and Ambali, A, 2006. *Africa's Science and Technology Consolidated Plan of Action*, NEPAD Office of Science and Technology, www.nepad.org.
- Nyambi, D., Scott, H., Ketel, B., & Guillard, R. 2012. *AIMS South Africa Independent External Evaluation*
- Shaikh, K., 2000. Science, Technology and Mathematics Education: A Global Perspective, *UNESCO International Science, Technology and Environmental Education Newsletter*, 25(3): pp3-4.

Technopolis Group. 2015. *Mid-term evaluation of the AIMS-IDRC/DFID programme 2010-2014*, www.technopolis-group.com

The Government of the Republic of South Africa. 2002. *South Africa's National Research and Development Strategy*. Pretoria: Government Printers

The Republic of South Africa. The Presidency. National Planning Commission. 2012. *National Development Plan (NDP) 2030 vision*. Pretoria: Government Printers

Wiśniowski, W., 2014. *The importance of Mathematical Education in Today's Complex Society*, *Young Digital Planet*, www.ydp.eu

Appendix

Appendix A: Interview schedule for AIMS-SA Research and Administration Manager



Implementation evaluation for the AIMS-SA programme

The Department of Science and Technology (DST) is conducting the evaluation for the AIMS-SA programme. The evaluation seeks to assess the implementation of the AIMS-SA programme and the outcomes of the programme. The purpose of this interview session is to gather information from the AIMS-SA Programme Managers on the implementation processes and outcomes of the AIMS-SA programme.

QUESTIONS

1. How does AIMS-SA create awareness about its academic programme?
2. How do students go about applying for admission at AIMS-SA?
3. What criteria used to select tutors?
4. What criteria used to select students?
5. How do students receive feedback concerning their academic performance?
6. What measures are in place to assist students who struggle to cope with their studies?
7. Do all students registered at the AIMS-SA centre receive scholarships or bursaries?
8. Would you say that the contributions from the DST are provided to the intended beneficiaries?

9. Does AIMS-SA have networks with other African and international academic institutions? **(please explain)**
10. What systems have been put in place to ensure that AIMS-SA achieves its mandate?
11. Do AIMS-SA students get an opportunity to publish their research?
12. Would you say the AIMS-SA Academic Programme has enhanced the employability of students that have graduated?

Appendix B: Interview schedule for AIMS-SA Academic Director



Implementation evaluation for the AIMS-SA programme

The Department of Science and Technology (DST) is conducting the evaluation for the AIMS-SA programme. The evaluation seeks to assess the implementation of the AIMS-SA programme and the outcomes of the programme. The purpose of this interview session is to gather information from the AIMS-SA Programme Managers on the implementation processes and outcomes of the AIMS-SA programme.

QUESTIONS

1. How is the academic programme structured?
2. What measures have been put in place to attract students, tutors and researchers?
3. What mechanisms are in place to facilitate student-teacher engagement?
4. How do students receive feedback concerning their academic performance?
5. What measures are in place to address poor academic performance?
6. What happens when students fails?
7. How long does it take for students to complete their academic programme?
8. What measures have been put in place to ensure that admitted students are able to cope with the AIMS-SA Academic Programme?
9. What roles do tutors and African researchers play at AIMS-SA? *Probe: Have tutors and African researchers enhanced the academic performance of students?
10. Does AIMS-SA have networks with other African and international academic institutions?
11. How would you rate the pass rate at AIMS-SA in comparison to the pass rate of other academic institutions in Africa?

12. How effective has AIMS-SA been in contributing to the development of the basic sciences and in particular the mathematical and computational sciences?
13. How does AIMS-SA Academic Programme aid students and researchers to contribute to South Africa and Africa's knowledge base?
14. What would you say AIMS-SA researchers benefit from their partnership with AIMS-SA? *Probe: Do they return to their home countries once they have completed their studies?
15. How has the AIMS-SA Programme contributed to building human capital within the field of mathematical sciences in South Africa? ***Probe: what is the change that has been established since the establishment of AIMS-SA?** Are there more master's and PhD graduates in the field of mathematical sciences than before?
16. Would you say the AIMS-SA academic programme has enhanced the chances of employment for students that have graduated?

Appendix C: Interview schedule for AIMS-SA Director



Implementation evaluation for the AIMS programme

The Department of Science and Technology (DST) is conducting the evaluation for the AIMS-SA programme. The evaluation seeks to assess the implementation of the AIMS-SA programme and the outcomes of the programme. The purpose of this interview session is to gather information from the AIMS-SA Programme Managers on the implementation processes and outcomes of the AIMS-SA programme.

1. What are the primary objectives of AIMS-SA?
2. How is AIMS-SA ensuring that it achieves these objectives?
3. Some of the key objectives of the DST are to promote and strengthen human capital development and research and development in South Africa and other parts of the continent, how does the AIMS-SA Programme contribute to these objectives?
4. What outcomes does the AIMS-SA programme intend to achieve through receiving support from the DST?
5. How has AIMS-SA contributed to the development of the basic sciences and in particular the mathematical and computational sciences?
6. How is the governance structure of AIMS-SA constituted?
7. How long has this governance structure existed for?
8. Have there been any changes to the method of governance since it was created?

9. How does the governance structure promote the implementation of the AIMS-SA mandate?
10. What mechanisms have been put in place to monitor the implementation of the AIMS-SA programme?
11. Would you say these mechanisms have resulted in an efficient implementation?
12. How much does AIMS-SA receive from the Department of Science and Technology?
13. What aspect of the AIMS-SA Programme do these funds cover?
14. Would you say these funds have contributed towards the implementation of AIMS-SA?
15. What measures have been put in place to monitor the implementation of the AIMS-SA programme?
16. Would you say that these mechanisms have resulted in efficient implementation?
17. How much does AIMS-SA receive from the Department of Science of Science and Technology?
18. What aspect of the AIMS-SA programme do these funds cover?
19. Would you say these funds have contributed towards the implementation of AIMS-SA?
20. Apart from the DST, which other stakeholders provide funding to AIMS-SA?
21. What measures have been put in place to ensure the sustainability of the AIMS-SA Programme?
22. What would you say African researchers derive from their partnership with AIMS-SA? ***Probe: Do they return to their home countries with new specialist skills? Do they go back home to implement academic courses/programmes similar to what they encountered at AIMS-SA?**
23. How has the AIMS-SA Programme contributed to building human capital within the field of mathematical sciences in Africa? ***Probe: what is the change that has been established since the establishment of AIMS-SA? Are there more master's and PhD graduates in the field of mathematical**

sciences than before?

24. Would you say the AIMS-SA Programme has enhanced the employability of students that have graduated?

Appendix D: Questionnaire for alumni

Department of Science and Technology (DST) implementation evaluation of the AIMS programme

Dear Alumni

The DST is conducting an implementation evaluation of the AIMS-SA programme. The evaluation seeks to assess the implementation processes and the outcomes of the AIMS-SA programme. You were selected as a possible participant because you were a beneficiary of the AIMS-SA programme.

The questionnaire should take approximately 5 minutes to complete. The survey is anonymous and voluntary. You will not be required to submit any personal identification information, and your responses will be treated confidentially.

Should you choose to participate, please submit your responses by afternoon, Friday 06 March 2015. Should you wish to confirm the authenticity of this survey, please contact me at lindokuhle.khumalo@dst.gov.za or Tinyiko Mushwana at Tinyiko.mushwana@dst.gov.za

Thank you for your time.

Sincerely,
The Department of Science and Technology

Demographic Information

1. Which gender classification best describes you?

Female

Male

2. Please indicate your race

3. Please indicate your country of origin

4. Please indicate your age

18 years - 21 years

22 years - 25 years

26 years - 29 years

30 years - 35 years

36 years and above

5. Which level of study did you complete recently at AIMS-SA?

Honours Degree

Master's Degree

PhD

Other

6. Please indicate your recent completed field of study

(e.g. Mathematical Sciences)

7. Please indicate your employment status

Employed

Unemployed

Outcomes of the AIMS Programme

8. During your time at AIMS did you publish any research papers?

Yes

No

9. How many research papers did publish?

10. What percentage did you receive for your final year of study at AIMS?

(Please select the relevant box)

50% - 59%

60% - 69%

70% - 79%

80% - 89%

90% - 100%

11. Did you find employment after you had completed your studies?

Yes

No

13. How long did it take you to find employment?

13. Did the programme you completed at AIMS-SA sufficiently prepare you for the workplace?

Yes

No

Partially

14. What is the name of the organisation where you are currently employed?

15. In which country is this organisation based?

Appendix E: Questionnaire for visiting African Researcher

Department of Science and Technology (DST) implementation evaluation of the AIMS-SA programme

Dear Visiting African Researcher

The DST is conducting an implementation evaluation of the AIMS-SA programme. The evaluation seeks to assess the implementation processes and the outcomes of the AIMS-SA programme. You were selected as a possible participant because you are a beneficiary of the AIMS-SA programme.

The questionnaire should take approximately 5 minutes to complete. The survey is anonymous and voluntary. You will not be required to submit any personal identification information, and your responses will be treated confidentially.

Should you choose to participate, please submit your responses by afternoon, Friday, 06 March 2015. Should you wish to confirm the authenticity of this survey, please contact me at lindokuhle.khumalo@dst.gov.za or Tinyiko Mushwana at Tinyiko.mushwana@dst.gov.za

Thank you for your time.

Sincerely,
The Department of Science and Technology

Demographic Information

1. Which gender classification best describes you?

Female

Male

2. Please indicate your race

3. Please indicate your country of origin

4. Please indicate your age

- 18 years - 21 years
- 22 years - 25 years
- 26 years - 29 years
- 30 years - 35 years
- 36 years and above

5. Please indicate the highest level of your qualification

- Honours Degree
- Master's Degree
- PhD
- Other:

6. Apart from AIMS-SA, at which academic institution are you based?

7. In which country is this institution?

8. What is your field of expertise/ specialisation?

9. How long have you been lecturing?

Knowledge about the AIMS-SA Programme

10. How did you find out about the opportunity to be a visiting lecturer at AIMS-SA?

Approached by AIMS-SA
Staff exchange programme
Adverts on the AIMS-SA website
Call for proposal
National Research Foundation (NRF)
Government departments
Academic institutions
Other:

Relevance of qualifications and experience

11. Would you say your experience is relevant to the Academic Programme at AIMS-SA?

Yes
No

12. Would you say your qualifications are relevant to the requirements of the Academic Programme at AIMS-SA?

Yes
No

Experience of visiting lecturers at AIMS-SA

13. For how long did you visit AIMS-SA?

14. Please indicate your responsibility at AIMS-SA

Lecturing
Conducting research
All of the above

15. What was the title or subject matter of the course/ research you conducted?

16. How many students did you lecture?

17. How many research studies did you conduct?

18. Please indicate if you supervised;

You can select more than one option

Master's candidates

PhD candidates

19. How many candidates did you supervise?

20. What are the topics of the postgraduate research projects that you supervised?

General Questions

21. Please indicate if your research is relevant in addressing science and technology needs in South Africa?

(Please elaborate)

22. Would you say that the environment at AIMS-SA is conducive for you to conduct your research effectively?

Appendix F: Questionnaire for AIMS-SA current students

Implementation evaluation for the AIMS-SA programme

Dear Student

The DST is conducting an implementation evaluation of the AIMS-SA programme. The evaluation seeks to assess the implementation processes and the outcomes of the AIMS-SA programme. You were selected as a possible participant because you are a beneficiary of the AIMS-SA programme.

The questionnaire should take approximately 5 minutes to complete. The survey is anonymous and voluntary. You will not be required to submit any personal identification information, and your responses will be treated confidentially.

Should you choose to participate, please submit your responses by afternoon, Friday, 06 March 2015. Should you wish to confirm the authenticity of this survey, please contact me at lindokuhle.khumalo@dst.gov.za or Tinyiko Mushwana at Tinyiko.mushwana@dst.gov.za

Thank you for your time.

Yours sincerely,

Department of Science and Technology

Demographic Information

1. Which best describes you?

Female

Male

2. Please indicate your race

3. Please indicate your country of origin

4. Please indicate your age

18 years - 21 years

22 years - 25 years

26 years - 29 years

30 years - 34 years

5. What is your level of study?

Honours Degree

Master's Degree

PhD

Other:

6. Please indicate your field of study?

7. Did you know about the AIMS-SA programme before you registered?

Yes

No

8. How did you find out about AIMS-SA?

(You may choose more than one option)

Government departments

Internet

Friends

Advertisement

Experiences of Students on the AIMS-SA Programme

9. Do you receive academic support?

- Yes
- No

10. If yes, what kind of academic support do you receive?

(NB: Enrichment conferences are conferences that contributes to student's field of study and research interest) You can choose more than one option.

- Tutorials
- Extra lessons
- Career guidance
- Enrichment conferences
- Training workshops
- Feedback sessions

11. Please indicate the resources that are accessible to you

(NB: You can choose more than one option)

- IT laboratory
- Research center
- Library

12. Is the material at the research centre relevant to your field of study?

- Yes
- No

13. Is the material at the library relevant to your field of study?

- Yes
- No

14. On a scale of 1 - 5, how would you rate your usage of the IT laboratory?

(NB: 1 - being never, 2 - not often, 3 - sometimes, 4 - often and 5 - very often)

1 2 3 4 5

Never	()	()	()	()	()	Very often
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15. On a scale of 1 - 5, how would you rate your usage of the research centre?

(NB: 1 - being never, 2 - not often, 3 - sometimes, 4 - often and 5 - very often)

1 2 3 4 5

Never	()	()	()	()	()	Very often
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16. On a scale of 1 - 5, how would you rate your usage of the library?

(NB: 1 - being never, 2 - not often, 3 - sometimes, 4 - often and 5 - very often)

1 2 3 4 5

Never	()	()	()	()	()	Very often
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Outcomes of the AIMS-SA Programme

17. Are there platforms for you to publish your research?

Yes

No

I do not know/ not sure

18. Are you aware of processes required for publishing for research?

Yes

No

19. If yes, have you used these platforms?

Yes

No

20. Based on your perceptions, how has the programme assisted you?

General

22. If you were given a chance, how would you improve the AIMS-SA programme?