

Science Engagement Strategy and Youth into
Science Strategy:
Talent Development Programme
Participants 2017-2019

May 2020

Sylvia Hannan, Fabian Arends, Charlotte Nunes
Principal Investigator: Vijay Reddy

Table of Contents

ABBREVIATIONS AND ACRONYMS	iii
LIST OF FIGURES.....	iv
LIST OF TABLES.....	iv
EXECUTIVE SUMMARY	v
THE TALENT DEVELOPMENT PROGRAMME.....	1
Phase Three: Centre for Pedagogy (SUNCEP) at Stellenbosch University	1
PART A: 2017, 2018 and 2019 COHORTS	4
Introduction	4
Methodology.....	4
2017 Baseline Survey	4
2018 Baseline Survey	4
2019 Baseline Survey (March)	4
2019 Follow-up Survey (September)	5
Who attends the Talent Development Programme?	5
Schools attended by the 2017 and 2018 TDP Populations	5
Respondent Characteristics	7
<i>Respondents per province</i>	7
Summary	12
What are the attitudes of participants towards mathematics and science?	13
Attitudes to maths and science at school and as career pathways.....	13
What are learners' perceptions of the career guidance they received?	16
What are the career choices and educational aspirations of respondents?	17
Educational attainment	17
Educational Aspirations	18
Career Aspirations.....	19
Familiarity with adults who work in STEM.....	20
Performance expectations and attendance of extra lessons	20
Summary	21
What were learners' experiences of the TDP?	21
Topic coverage in 2018 and 2019	21
TDP Experience	23
Favourite part of the TDP.....	23

What would you tell a friend about the TDP?	25
Impact of participating in the TDP	26
Suggested improvements to the TDP	27
Summary	28
PART B: QUALITATIVE COMPONENT: GIVING LEARNERS AND STAFF A VOICE	29
Introduction	29
Aim	29
Key Research Questions.....	29
Methodology.....	29
Sampling.....	29
Data collection	30
Data analysis	30
Voices of the TDP learners and staff.....	31
Learner’s perceptions and experiences of the programme.....	31
Key features that promote a positive and stronger interest in mathematics and science	32
TDP influence on career choice in mathematics and science.....	35
Challenges encountered in the TDP.....	37
What improvements could be made to the programme?.....	38
Summary	38
PART C: FINDINGS AND RECOMMENDATIONS	40
Findings	40
Recommendations	42
References	44
Appendix A: Respondents’ favourite aspects of the TDP (2018).....	46
Appendix B: What would you tell a friend? (2018).....	49

ABBREVIATIONS AND ACRONYMS

DSI	-	Department of Science and Innovation
DST	-	Department of Science and Technology
FAL	-	First Additional Language
FET	-	Further Education and Training
GIS	-	Geographic Information Systems
HSRC	-	Human Sciences Research Council
ICT	-	Information and Communication Technology
LoLT	-	Language of Learning and Teaching
NSFAS	-	National Student Financial Aid Scheme
SET	-	Science, Engineering and Technology
STEM	-	Science, Technology, Engineering and Mathematics
STEMI	-	Science, Technology, Engineering, Mathematics and Innovation
SUNCEP	-	Stellenbosch University Centre for Pedagogy
TDP	-	Talent Development Programme
TVET	-	Technical and Vocational Education and Training
UCT	-	University of Cape Town

LIST OF FIGURES

Figure 1: Phases of the TDP	1
Figure 2: TDP Beneficiary Selection Criteria	2
Figure 3: Location of schools attended by the TDP 2017 Cohort	6
Figure 4: Location of schools attended by the 2018 TDP Cohort	6
Figure 5: Type of schools attended by the 2017 and 2018 TDP population.....	7
Figure 6: Profile of 2017, 2018 and 2019 TDP Survey Respondents.....	9
Figure 7: Home resources 2017, 2018 and 2019	10
Figure 8: Extent to which English is spoken at home 2017, 2018 and 2019.....	11
Figure 9: Home language of 2018 and 2019 respondents.....	11
Figure 10: Grade 11 and 12 learners' attitudes towards mathematics and science 2017	14
Figure 11: Attitudes to Mathematics and Science 2018 and 2019 (% agree).....	15
Figure 12: Exposure to different types of career guidance at school, 2017	16
Figure 13: TDP Career guidance opportunities in the TDP 2018 and 2019	17
Figure 14: Educational Aspirations of Respondents 2017, 2018 and 2019	18
Figure 15: Career aspirations of 2017, 2018 and 2019 learners.....	19
Figure 16: Career aspirations disaggregated by broader educational categories (2017, 2018, 2019).19	
Figure 17: Respondents familiar with adults in STEM careers 2018 and 2019.....	20
Figure 18: Subject achievement expectations 2019	20
Figure 19: Topic coverage 2018 and 2019	22
Figure 20: TDP experiences in 2018 and 2019	23
Figure 21: Learners' favourite aspects of the TDP 2018	24
Figure 22: Favourite aspects/activities 2019	25
Figure 23: Some responses to "What would you tell a friend about the TDP?" (2018).....	26
Figure 24: Impact of the TDP 2019 (% agreed)	27
Figure 25: Suggested improvements 2019	28
Figure 26: Suggested improvements from the staff and learners	38

LIST OF TABLES

Table 1: Respondents per province, 2017, 2018 and 2019	8
Table 2: Parental education levels 2017, 2018 and 2019 cohorts.....	12
Table 3: Learners' mathematics and science achievement in the previous academic year (2017, 2018 and 2019 cohorts).....	18
Table 4: TDP Contact Session Venues 2019	30

EXECUTIVE SUMMARY

The Talent Development Programme (TDP), which was started in 2005, is a residential, enrichment and additional academic contact time programme currently aimed at Grade 11 and 12 learners. The TDP contributes to Science, Technology, Engineering and Mathematics (STEM) human capital development within the country through its intervention at the secondary school level. The programme provides the opportunity for learners to engage in challenging academic mathematics and science work, provides interactive social experience, and presents learners with strategies that can assist them in their higher education.

Three phases of the TDP have been undertaken thus far. The current phase, Phase 3, is running from 2017 to 2022, and is co-ordinated by the Stellenbosch University Centre for Pedagogy (SUNCEP). Phase 3 is following a more decentralised approach with one centre in each province, and are including high performing beneficiaries from working class backgrounds and families where tertiary education has not been attainable in the past. By emphasising increased female participation, the TDP wants to contribute to higher numbers of women scientists, engineers and technologists.

The role of the Human Sciences Research Council (HSRC) in this programme is to develop a system that will monitor and track participants, and to report on the outcomes of the strategy for the period of 2017 to 2022. Baseline questionnaires were developed and administered to the Grade 11 and 12 learners who attended the 2017, 2018 and 2019 TDP camps. Indicators reported on include demographic and socio-economic information, education information, and the future academic and labour market choices of the respondents.

This report presents the baseline findings from the 2017, 2018 and 2019 TDP cohorts. The 2017 cohort were administered a paper based questionnaire at the provincial camps, while the 2018 cohort completed an online baseline survey. The 2019 cohort completed an online baseline survey at the first contact session, and a follow-up survey at the final contact session of 2019. A qualitative study was also conducted during the June contact session in 2019.

Who attends the Talent Development Programme?

The TDP plays a critical role in firstly identifying high achieving learners with the talent and potential for STEM careers, and secondly in assisting these learners to harness and nurture their talent and potential. The majority of learners selected for the TDP are female and Black African. The home resources they have access to suggests that they live in poor to medium socio-economic backgrounds, have limited educational resources at home, and do not all speak the Language of Learning and Teaching (English) frequently at home. However, all were high performers in mathematics and science. The respondents come from a mix of moderately well-educated families, and families where their parents/guardians have only completed matric, not gone beyond Grade 9, or may not even have gone to school. All these factors were deemed suitable for these learners to be selected for the TDP.

What are the attitudes of participants towards Mathematics and Science, and what are their perceptions of the career guidance received?

The TDP participants had very positive attitudes towards mathematics and science and placed a great value in both subjects, as observed in their future educational and career aspirations. They enjoyed

mathematics and science, were confident in their ability to perform well in mathematics and science, and valued the importance of these subjects.

The TDP provides participants with an opportunity to engage in challenging academic work, offers social experience, and exposure to strategies to manage university life, as well as providing an environment that enables learners to formulate SET career directions. The supplementary tuition and foundational skills development sessions have the potential to encourage high-level mathematics and physical science performances from participants and develop positive attitudes towards these subjects. The TDP places emphasis on a variety of career guidance activities, particularly exposing learners to motivational speakers in the form of former participants. These types of activities will provide learners with more self-confidence to pursue the careers of their choice.

What are the career choices and educational aspirations of respondents?

The majority of TDP participants, 98%, intended studying at a University or University of Technology. On average, 86% were considering future STEM-related careers, in the fields of Medicine, Engineering, and Natural and Life Sciences. Many learners ascribe a high value to mathematics, giving them a greater scope of careers to consider, hence the small percentage of participants selecting future careers in Business and Commerce.

What are learners' experiences of the TDP?

The topics covered during the TDP are crucial in providing the foundation for the programme, and the knowledge and skills learners gain. This includes being taught how to prepare for university life, getting assistance with applications for higher education studies, working independently to solve problems, and working in groups. Respondents reported enjoying their participation in the TDP and felt the programme was well structured and well run.

Participation enabled them to improve their achievement in mathematics and science, made them more enthusiastic about the subjects, and helped them to decide on their future career path. Through the programme, learners indicated that they have learned how to better manage their time, improved their knowledge and skills in the core subjects of mathematics and science, as well as learned skills such as critical thinking, problem solving and effective communication. The TDP is therefore having an important impact on participants' confidence in their abilities to produce high quality work, achieve their goals, to work independently, to make decisions, to motivate others, and to work well with others.

Giving a voice to the staff and learners: A qualitative component

The purpose of the qualitative component of the study was to examine learner and staff perceptions and experiences of the TDP. Guided by the research questions, a number of broad themes emerged. The first theme related to learner perceptions and experiences of the programme: they conveyed that the TDP content expanded on the school curriculum; and appreciated engaging with those from similar socio-economic backgrounds, which motivated them to work hard. The second theme related to key features of the TDP that promote a positive and stronger interest in mathematics and science: experienced and highly qualified tutors; exposing learners to teaching and learning strategies that enable them to better understand the content; developing learners' critical thinking skills, leadership skills, communication skills and presentation skills; and enhancing their chances to access and be

successful in higher education. The third theme related to the influence of the programme on career choice in mathematics and science, with a sub-theme related to the importance of career guidance as an aspect of TDP. This included providing learners with information about STEM careers; teaching them to access relevant career platforms; and supported them in creating e-mails, applying for bursaries, and designing their Curriculum Vitae. The main challenges identified were related to the recruitment of level 7 learners, competing intervention programmes, and the poor learning experiences in schools. A set of recommendations for improvement identified from the data are then presented.

Overall findings and recommendations

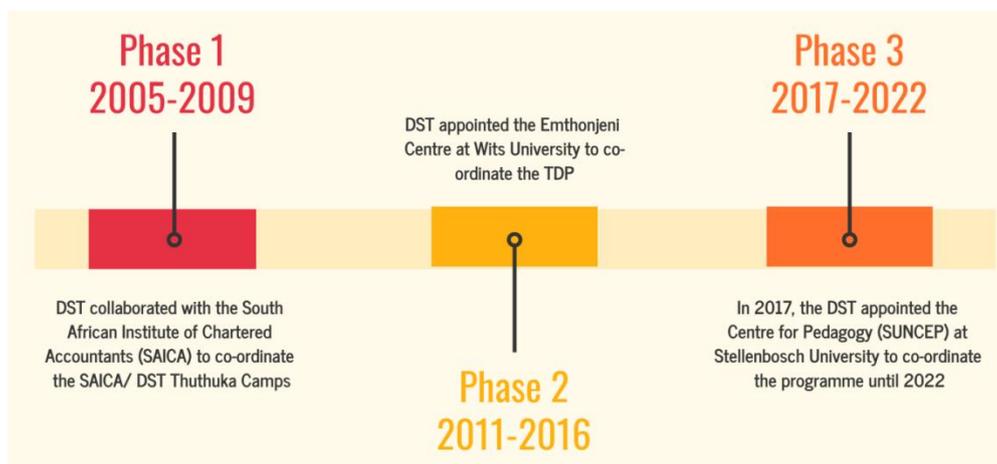
The report concludes with a set of findings based on the studies discussed. In order to enhance the impact of the TDP, a set of recommendations based on the findings of the researchers and the perceptions of the TDP stakeholders are presented. These recommendations relate to the need to remain cognisant of the backgrounds learners come from while developing the programme; improving the selection and recruitment process; expanding the reach of the programme; adding incentives for participation; the allocation of time for career guidance; the contribution made by former TDP participants; the provision of the necessary hardware and software; the establishment of partnerships or links between the TDP and stakeholders, including schools, local universities, and organisations or companies that may offer STEM bursaries; ensuring engagement between the TDP and learners' parents; and the creation of a platform for continued interaction beyond the TDP

THE TALENT DEVELOPMENT PROGRAMME

In pursuit of the goal of enhancing youth's access to science, there is a need to identify and nurture learners with talent and potential. The Talent Development Programme (TDP) serves this purpose by enhancing the prospects of participating learners to achieve higher grades in the National Senior Certificate final examination, and aiming to produce a cohort of school leavers who will be prepared for life in higher education. The programme targets the school-going youth with the intention of encouraging them to pursue the gateway subjects of Mathematics and Physical Science, participate in extra-curricular mathematics and science activities, as well as pursue science-based education studies and ultimately science-based careers.

The TDP was established in 2005 by the Department of Science and Technology¹, and has since completed two implementation phases (2005 to 2009, and 2011 to 2016). It has now entered its 3rd Phase (2017 to 2022). The three phases are shown in Figure 1. This report presents findings from the third phase thus far.

Figure 1: Phases of the TDP



Phase Three: Centre for Pedagogy (SUNCEP) at Stellenbosch University

Since 2017, the TDP has targeted learners in grades 11 and 12 from 308 public secondary schools across all nine provinces. The recruitment process was implemented by the Stellenbosch University Centre for Pedagogy (SUNCEP) and seeks to benefit 3 440 learners; so on average 580 new entrants per year over 6 academic years (2017- 2022).

SUNCEP has adopted a decentralised model with a centre in each province, using school hostels to house the learners for contact sessions during the year. They are including high performing beneficiaries from working class backgrounds and families where tertiary education has not been attainable in the past.

¹ In 2019, the Department of Science and Technology (DST) was renamed the Department of Science and Innovation (DSI).

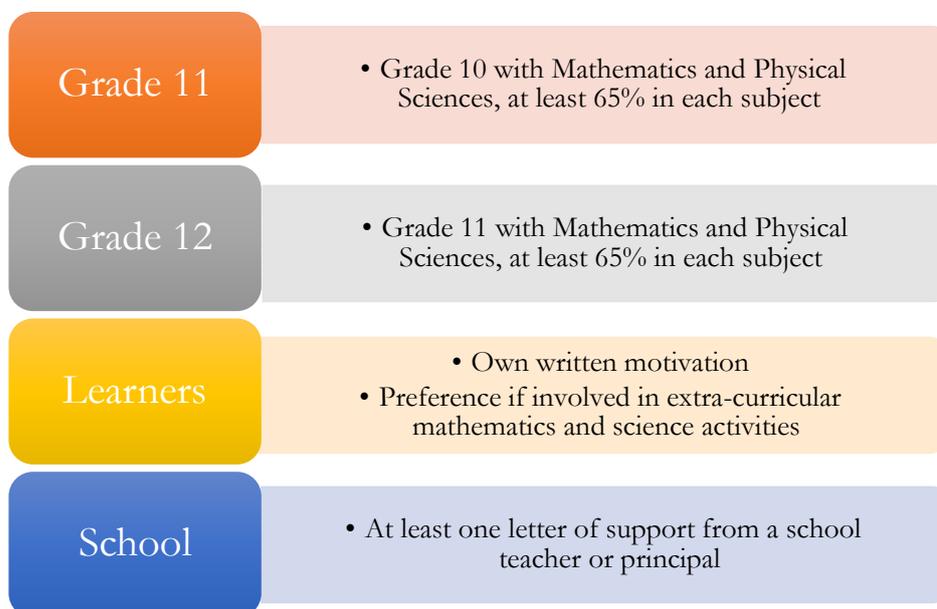
The 3rd Phase of the programme has three focus areas:

- Enhancing participants' chance to access higher education;
- Preparing participants for higher education life;
- Enhancing well-informed career decision-making by participants.

The intention is to keep the TDP as a pre-university programme with three contact sessions held each year, preferably during the March, June and September school vacation periods.

According to SUNCEP, the entire selection process of both schools and learners is done in collaboration with the provincial education authorities. The selection of learners is based on three-levels of criteria that are linked to the learners' academic performance. The selection criteria for TDP beneficiaries are shown in Figure 2. In addition, TDP beneficiaries should be South African citizens or those who have permanent residence status in the country.

Figure 2: TDP Beneficiary Selection Criteria



The beneficiaries are selected from public ordinary schools identified using any of the following criteria:

- Top performing schools from school districts in the provinces based on previous three final Grade 12 examination results;
- Schools with a history of participating in STEMI Olympiads and competitions;
- Schools located within 100km to a science centre or science activity; and
- Schools forming part of the DST's special projects or its entities' outreach programmes.

Enhancing participants' chance to access higher education is promoted through incorporating supplementary tuition in the gateway subjects of mathematics and science by focusing on sections or concepts of the curriculum that require attention. The TDP offers activity-based foundational skills development sessions aimed at developing high-level performance in mathematics and science through developing positive attitudes towards these subjects. In order to enhance well-informed

career decision-making by participants, a series of aptitude assessments and relevant instruments are used to generate the necessary information to shape participants' career directions.

The Human Science Research Council (HSRC) was commissioned to evaluate the implementation of the TDP within the Youth into Science and Science Engagement Strategy. This has been done through conducting tracking studies of the TDP participants in Phase 1, 2 and 3 (current phase). The role of the HSRC is to monitor the impact of the TDP on participants in terms of their experience, knowledge and skill gains, their educational aspirations and career choices.

This report presents the information that was collected from learners in the years they participated in the TDP. It includes a description of the 2017, 2018 and 2019 cohort's demographics, attitudes to mathematics and science, and educational and career aspirations. It also explores the TDP experiences of the 2018 and 2019 cohort. Part A of the report focuses on this information for the 2017, 2018 and 2019 cohorts. Part B discusses the findings from the qualitative study that was conducted at five of the TDP sites during June 2019, which investigated learner and staff perceptions of the TDP, and their experiences of the programme. Part C provides some overall findings and recommendations regarding the way forward.

PART A: 2017, 2018 and 2019 COHORTS

Introduction

The HSRC administers surveys to the participants of the TDP annually for the two years they attend the programme. These surveys ask questions relating to learners' backgrounds, such as their gender, race, the province they live in, their parents' education levels, as well as resources they have available at home. They are also asked questions about their attitudes to mathematics and science subjects and their career aspirations. In 2018 and 2019, participants were also asked questions about their experiences of the TDP. The 2018 baseline survey was administered at the end of the year, and the 2019 follow-up survey was administered at the end of 2019. Participants were therefore able to reflect on their experiences during the year.

The key research questions, which frame this study, are:

- Who attends the Talent Development Programme?
- What are the attitudes of participants towards mathematics and science?
- What are learners' perceptions of the types of career guidance they received? (In 2017, respondents were asked about career guidance at school; in 2018 and 2019, they were asked about the TDP career guidance)
- What are the career choices and educational aspirations of participants?

Methodology

2017 Baseline Survey

During 2017, the HSRC collected baseline information from 186 Grade 11 and 337 Grade 12 participants attending the SUNCEP contact sessions, 523 in total. The baseline information was collected during the March 2017 contact session, using the traditional paper-based questionnaire and was administered by the TDP personnel.

2018 Baseline Survey

A new strategy was employed for the collection of the 2018 baseline information. TDP participants were sent a link to an online baseline survey at the end of 2018. The survey was developed by the HSRC using Google Drive, and the link was sent to all 2018 TDP participants by SUNCEP at the end of 2018. Responses to the online baseline survey were received from 337 TDP participants in total: 200 of these were Grade 11 learners and 137 were Grade 12 learners in the 2018 cohort.

2019 Baseline Survey (March)

The 2019 TDP cohort consisted of only Grade 12 learners. The participants were asked to complete an online baseline survey, on Google Drive, at each of the sites during the March contact session. Some learners were mistakenly given the 2018 baseline survey rather than the 2019 survey. However most of the questions were the same in both years, so we were still able to conduct an analysis of the responses.

There was also a technical issue with the survey administration that only allowed one learner to respond from each computer during the sessions. Some learners were therefore unable to complete the survey. As a result of the low response rate, at the September contact sessions those learners who did not complete the survey in March were identified and asked to complete the baseline survey. A total of 262 responses were received for the baseline survey for 2019.

2019 Follow-up Survey (September)

A follow-up survey instrument was developed in 2019. This survey was administered online to the participants present at the September contact session, and asked questions about their experience of the TDP during the year. Time was set aside by the organisers at each site, ensuring that learners had the opportunity to complete the survey. One hundred and ninety (190) responses were received to the follow-up survey.

Who attends the Talent Development Programme?

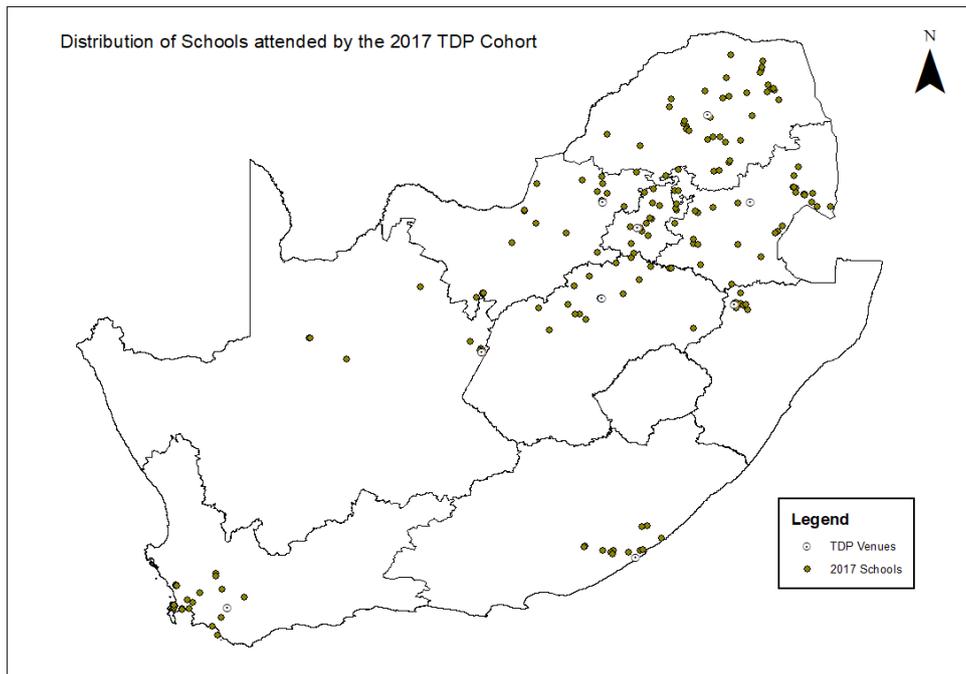
The first part of the section will provide an overview of the participants selected to attend the TDP during 2017 and 2018. Figures 3, 4 and 5 below are based on all learners included in the cohort 2017 and 2018 datasets.

Schools attended by the 2017 and 2018 TDP Populations

SUNCEP provided the HSRC with data about the 2017 and 2018 participants, which included their names, contact details, provincial distribution and the schools attended by these learners. The HSRC researchers used the school name variable to establish a link between the 2017 and 2018 cohort datasets and the latest Department of Basic Education Schools' Masterlist 2018. Additional variables were added from the Masterlist such as the unique Education Management Information Systems (EMIS) number, the school's quintile indicator and location coordinates to the TDP cohort datasets. This allowed the creation of the maps below.

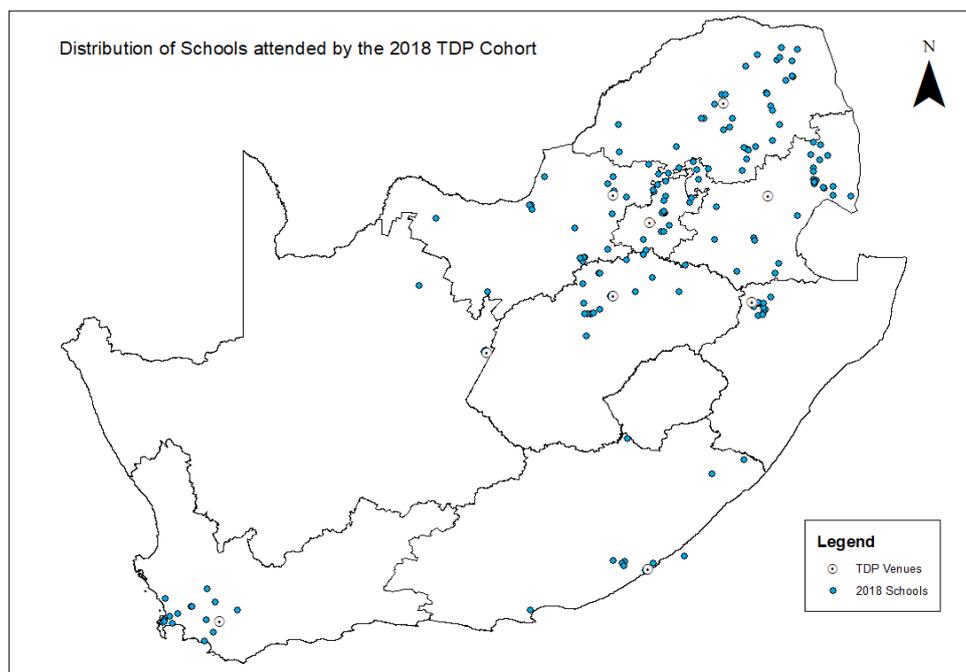
The 2017 Cohort was selected from 196 secondary schools. Figure 3 provides the distribution of these schools within the respective provinces, as well as the location of the 2017 TDP venues.

Figure 3: Location of schools attended by the TDP 2017 Cohort



The 2018 Cohort was selected from 202 secondary schools. Figure 4 provides the distribution of these schools within the respective provinces, as well as the location of the TDP venues. The 2018 cohort will also include a large number of the 2018 Grade 11 participants who continued with the TDP in 2019 as Grade 12s.

Figure 4: Location of schools attended by the 2018 TDP Cohort



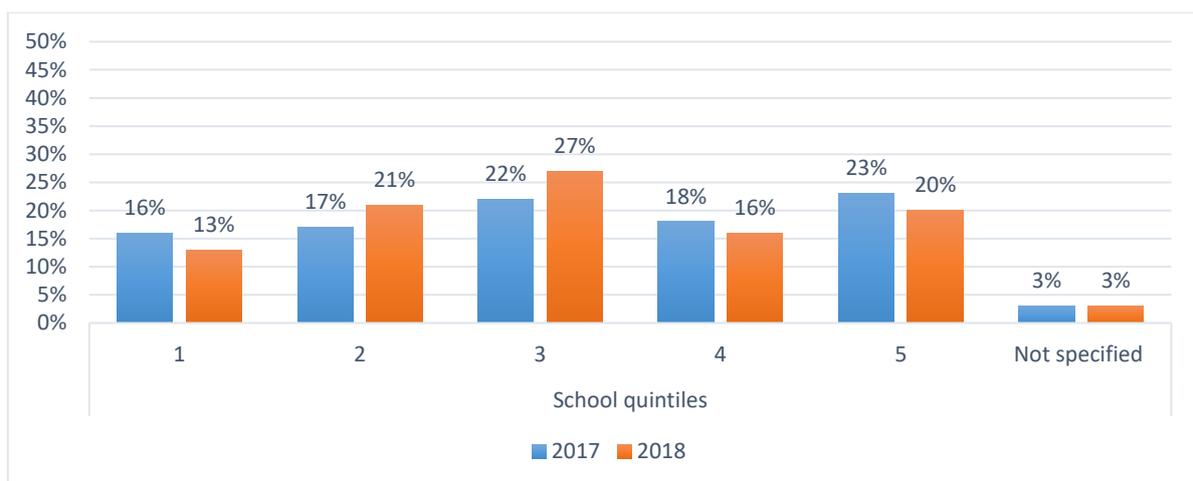
Figures 3 and 4 show a much wider distribution of schools in Limpopo, Mpumalanga, Gauteng and North West. In the other five provinces, schools are clustered closer to the TDP sites. According to the TDP proposal, beneficiaries will be selected from public ordinary schools identified using four criteria, see above. Based on the distribution of schools in Figures 3 and 4, the TDP should expand its reach to identify schools and learners eligible for inclusion. South Africa has large numbers of learners who will benefit from these types of interventions.

School poverty index

South African schools are categorised according to socio-economic quintiles, which are based on school resources and the socio-economic status of the area surrounding the school. Each school in the TDP cohort dataset, where possible, was allocated a socio-economic quintile. Figure 5 shows the schools attended by the TDP participants by quintile.

Poor schools that are ranked in quintiles 1, 2 and 3 are categorised as no-fee schools, and are allocated a higher state subsidy than the more affluent schools in quintiles 4 and 5. Therefore, information about where schools belong among these quintiles is important in understanding the school characteristics, particularly its resources.

Figure 5: Type of schools attended by the 2017 and 2018 TDP population²



The majority of schools attended by the 2017 and 2018 cohorts were quintile 1, 2 or 3 schools; however, a substantial proportion were categorised as quintile 4 and 5 schools.

Respondent Characteristics

The rest of the section provides demographic and household information about the TDP participants who completed the 2017, 2018 and 2019 baseline questionnaires.

Respondents per province

Table 1 provides the number of Grade 11 and Grade 12 respondents in 2017 and 2018, and the Grade 12 respondents in 2019. During 2017, Grade 11 learners were selected from only five provinces: Free

² The 2019 Grade 12s were TDP learners that were in Grade 11 in 2018.

State, Gauteng, Mpumalanga, Northern Cape and the Western Cape. The selection strategy for 2017 was linked to available funding, which only allowed for 560 beneficiaries. In 2018 and 2019, learners were selected from all 9 provinces.

Table 1: Respondents per province, 2017, 2018 and 2019

Province	2017			2018			2019
	Grade 11	Grade 12	Total	Grade 11	Grade 12	Total	Grade 12
Eastern Cape		39	39	30	13	43	44
Free State	36	40	76	15	13	28	25
Gauteng	38	37	75	11	7	18	44
KwaZulu-Natal		40	40	22	17	39	3
Limpopo		32	32	26	22	48	42
Mpumalanga	39	30	69	27	20	47	0 ³
Northern Cape	37	38	75	27	10	37	44
North West		37	37	18	13	31	36
Western Cape	36	44	80	24	22	46	24
Total	186	337	523	200	137	337	262

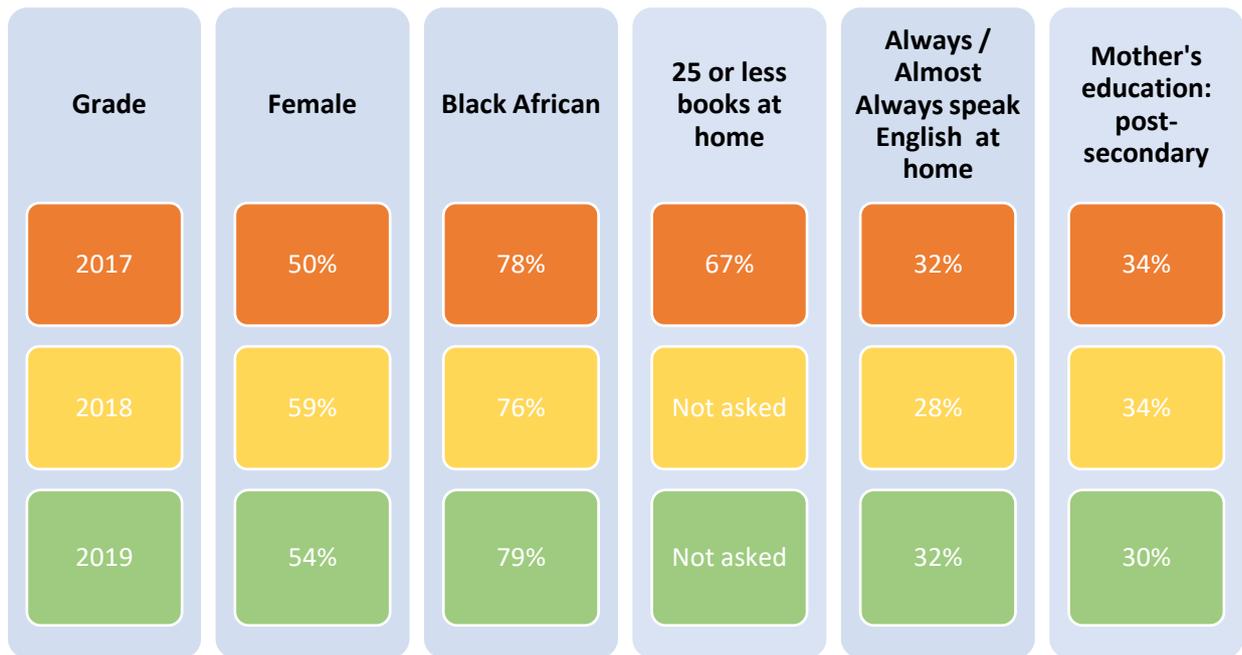
The TDP intends to increase the number of beneficiaries from a working class background and families where tertiary education has not been attainable in the past. In addition, the organisers want to increase and maintain the ratio of female to male participants to 60:40. This rest of this section will measure whether SUNCEP is achieving this goal, when we discuss the findings in terms of learner demographics, and the type of households learners come from.

Figure 6 provides a summary of the important demographic information of the 2017, 2018 and 2019 respondents. All learners in each cohort were asked to complete the survey. At least half of the TDP respondents in each year were female. The majority of participants are Black African, more than two-thirds had less than 25 books at home; less than 40% spoke English at home; and only about a third reported that their Mothers had a post-secondary education qualification. The similarity of trends across cohorts shows the consistent application of the selection criteria across the three years.

The profile of beneficiaries shows that SUNCEP is achieving its goal of selecting beneficiaries from working class backgrounds and families where tertiary education has not been attainable. This is discussed in detail below.

³ Learners were selected in Mpumalanga in 2019; however, no responses from these learners were received to the survey.

Figure 6: Profile of 2017, 2018 and 2019 TDP Survey Respondents



Home Resources

Figure 7 shows the extent to which learners had access to a range of household resources. The purpose of this question was to get a sense of the socio-economic background of the participants. The resources in the graph are sorted from lowest to highest percentage, using the responses of the 2019 cohort.

On average, more than half of the respondents had access to the majority of the resources shown in Figure 7. This does not necessarily imply that the majority of these learners are from medium to high socio-economic areas, but that more households are now able to afford these resources, and in addition, the government is providing electricity and water to most South Africans.

Nine out of ten participants reported having running tap water, and nearly all have electricity in their homes. More than 50% had access to home and educational assets that contribute immensely to their studies. For example, 6 out of 10 participants have their own room and a study desk that would provide them with required privacy to conduct their schoolwork and studies uninterrupted. Similarly, in 2018 and 2019, six out of ten participants reported having Internet access, and owning a computer or tablet, which should enable them access to online educational resources.

Figure 7: Home resources 2017, 2018 and 2019

Asset Type	Household Resources	2017	2018	2019
Home Assets	Car	55%	59%	62%
	Own room	64%	61%	62%
	Your own cell phone	88%	96%	95%
Educational Assets	Own computer or tablet	42%	60%	58%
	Internet connection	59%	64%	58%
	Study desk for own use	66%	68%	61%
	Dictionary	93%	90%	88%
Services	Water flushed toilet	78%	75%	80%
	Running tap water	91%	88%	90%
	Electricity	97%	99%	98%

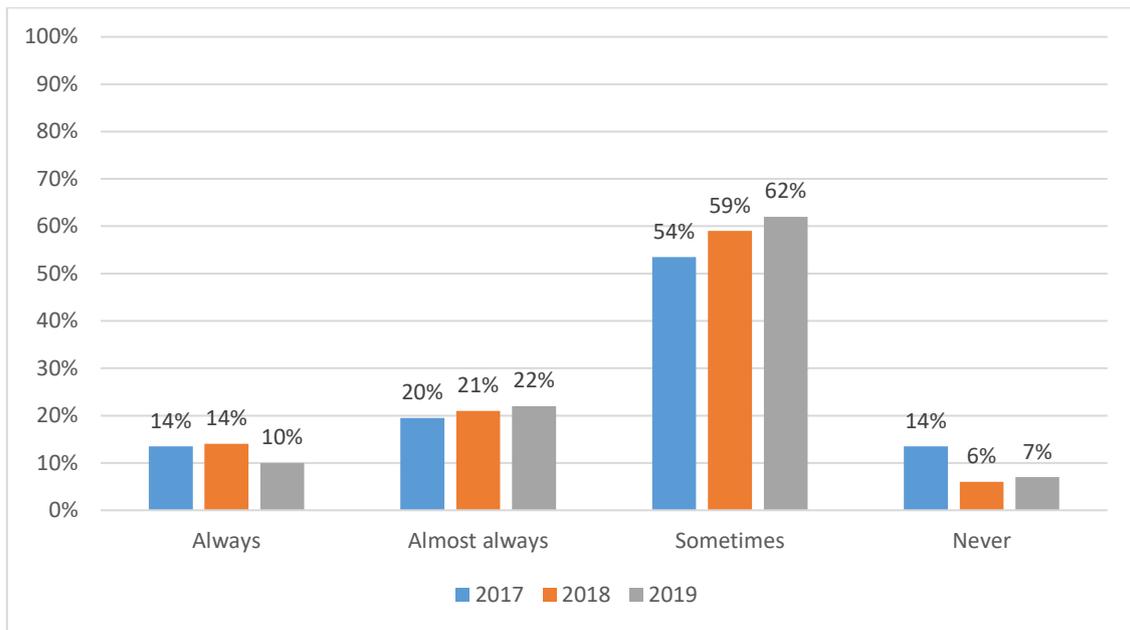
In 2017, participants were asked about the number of books they had at home. This question was not repeated again in the 2018 and 2019 baseline questionnaires. On average 40% of Grade 11 and 12 participants reported having none or few books at home (10 or less), and another 27% reported having between 11 and 25 books at home. This is a good indication that the majority of these learners are dependent on the education system in general, and their schools in particular, to provide them with the necessary resources to successfully engage with their studies.

Home language

The language of learning and teaching (LoLT) is an important and complex aspect of mathematics and science education. TDP lessons and tutorials are presented in English. The 2017, 2018 and 2019 baseline respondents were therefore asked how often they spoke English at home (Figure 8).

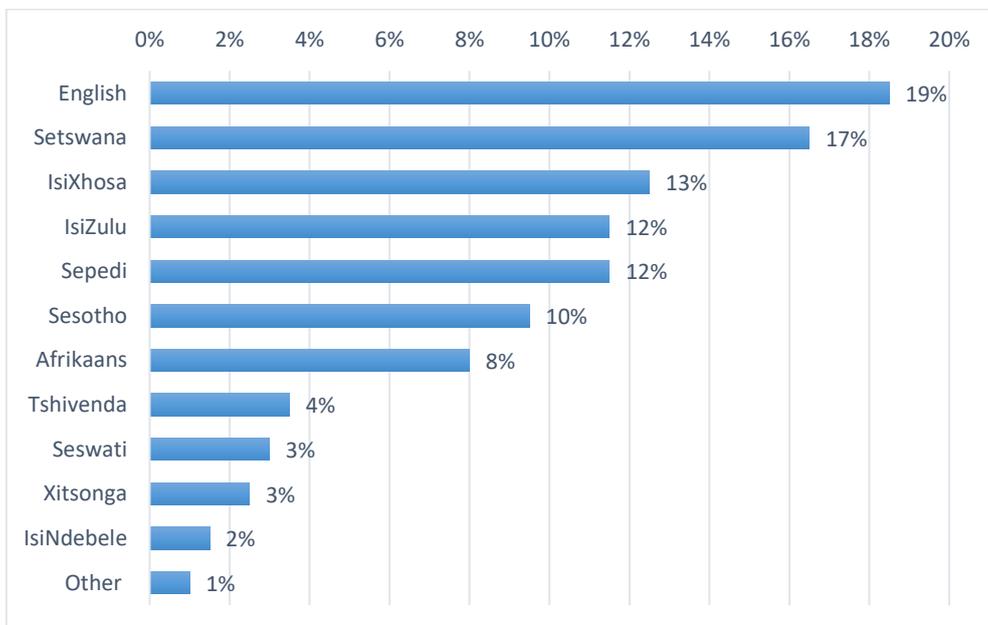
Less than 16% of respondents reported always speaking English at home, with slightly more (21%) reporting usually speaking English at home. Very importantly however, is that more than 60% of respondents reported only sometimes or never speaking English at home. Many of these learners speak English as a second or even third language, and most likely only at school during lessons. This has implications for the TDP, as English is the language in which classes and tutorials are delivered. It is therefore important to bear in mind that some learners may struggle with the material in English and may need extra assistance to grasp the material.

Figure 8: Extent to which English is spoken at home 2017, 2018 and 2019



In 2018 and 2019, respondents were asked about the languages most commonly spoken at home (Figure 9). The most common were English, Setswana and IsiXhosa, followed by IsiZulu and Sepedi. Although English was the most common, less than a quarter of respondents reported it as their home language. Therefore more than three quarters of these respondents were participating in the TDP in their second language.

Figure 9: Home language of 2018 and 2019 respondents



Parental Education

The TDP participants were asked about the level of education achieved by their mother (or stepmother or female guardian) and by their father (or stepfather or male guardian)⁴. The education levels for each of these categories are presented in Table 2. Information provided by learners about parental education levels needs to be read with caution.

A substantial proportion of respondents, about a third in most cases, were not sure of the level of education achieved by their father (or stepfather or male guardian), and less than 20% were not sure of the level of education achieved by their mother (or stepmother or female guardian). However, the majority of respondents could provide information on this question. A quarter indicated that their mothers have completed Grade 12 (matric), and over a third of participants estimated that their parents/guardians had obtained a post-secondary school qualification.

Table 2: Parental education levels 2017, 2018 and 2019 cohorts

	Mother's Education			Father's Education		
	2017	2018	2019	2017	2018	2019
Did not go to school	4%	6%	7%	5%	7%	4%
Finished primary school	8%	9%	6%	5%	6%	2%
Finished lower secondary	12%	13%	4%	7%	6%	5%
Finished upper secondary (matric)	27%	29%	31%	16%	24%	23%
Finished post-secondary (not university)	18%	19%	14%	15%	16%	13%
Finished university or equivalent or higher	17%	20%	16%	18%	23%	17%
Not sure	16%	6%	17%	36%	20%	35%

These results show that some of the TDP participants come from moderately well-educated families; while others do not, having indicated that their mother/father had not gone beyond Grade 9, or may not have gone to school. It is positive that many learners have achieved well in mathematics and science, even though their parents may not have completed their high school education. It does however mean that some learners may not have the necessary support at home in terms of educational capital. These learners should be focused on to ensure they are able to thrive both at school and at home.

Summary

The intention of Phase 3 of the TDP is to continue with the programme in order to prepare and enhance participants' chances of accessing higher education, promote well-informed career decision-making by participants and to increase the access of females to science, engineering and technology careers. The study found that those learners selected for the first intake of Phase 3 were largely Black African individuals, with more than half of participants being female. Learners were selected from a range of schools representing poor resourced and well-resourced environments, in terms of infrastructure and resources.

⁴ These categories will be referred to as "mother" and "father" hereafter.

Nearly half of these learners can be considered coming from a medium socio-economic background, when considering the number and type of household resources they have access to. However, this statistic should be interpreted with caution. On average 60% of participants have access to home and educational assets such as an own room, a study desk, Internet access, and a computer or tablet. These assets not only provides them with privacy when studying but also enables them to gain access to additional educational resources that will further enhance their own studies.

More than 60% of respondents reported only sometimes or never speaking English, which is the language in which classes and tutorials are delivered during the contact sessions. It is therefore important to bear in mind that some learners may struggle with the material in English and may need extra assistance to grasp the material.

A third of participants' parents have achieved a post-secondary qualification, but the majority have only achieved a matric qualification or lower. If we consider this then it seems the organisers have achieved the goal of targeting high performing beneficiaries from lower to medium SES or working class backgrounds and families where high levels of tertiary education have not been attained.

Research studies have shown that South African learners whose parents are better educated and more likely to be employed tend to have better educational outcomes (Branson and Zuze, 2012; Case and Deaton, 1999). Families with greater socioeconomic resources can pass this advantage to their children by providing them with the material resources to support schooling (Roksa and Potter, 2011). In contrast, children from high poverty homes may have less assistance with schoolwork, especially when they are in higher grades (Caro, McDonald and Willms, 2009).

Children who are surrounded by hardship can struggle to see that education can make any difference to their future. This is not to say that less educated parents cannot support their children's education. There are many ways in which parents from different backgrounds can remain engaged in their children's schooling careers, and there is evidence to show that socioeconomically disadvantaged parents can do so effectively (Watt, 2016). However, high achievers from lower socioeconomic circumstances remain the exception rather than the norm, owing to the many obstacles that these learners must overcome (Harris and Robinson, 2016).

What are the attitudes of participants towards mathematics and science?

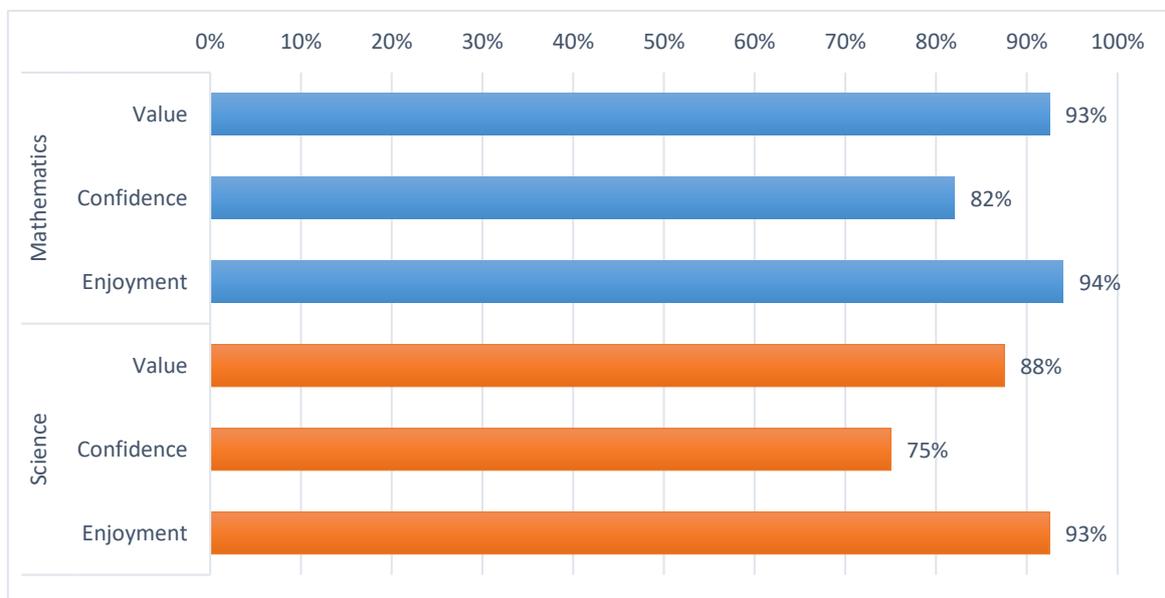
Attitudes to maths and science at school and as career pathways

Participants were asked about their attitudes to Mathematics and Science to gauge their attitudes towards these as school subjects, as well as possible future career pathways. Figure 10 shows the responses of the 2017 cohort, and Figure 11 the responses of the 2018 and 2019 cohorts. Learners' motivation to learn can be affected by whether they find the subject enjoyable, the extent of the value placed on the subject, and their self-confidence in the subject (self-efficacy). Attitudes (enjoyment, confidence and valuing) towards mathematics and science were investigated for the 2017 participants and measured by creating three attitudinal indices for enjoyment, value and confidence in each

subject area respectively⁵. In the 2018 baseline questionnaire, the number of questions relating to participants attitudes towards mathematics and science were reduced. The 2017 attitudinal information is therefore presented separately.

In general, the learners participating in the TDP programme enjoyed mathematics and science, were confident in their ability to perform in the subjects, and valued the importance of these subjects. Developing positive attitudes towards mathematics and science is an important goal of the curriculum. Figure 10 shows that learners attached a very high value on the importance of the subjects and indicated high levels of enjoyment when engaging with the subjects. The confidence levels in mathematics and science were generally lower than the other attitude indices in both subjects. Their self-confidence or self-efficacy is considered to be a more realistic measure of their abilities to perform specific activities related to the subject areas. Learners attached a higher value to mathematics than to science, and their confidence levels were also higher in mathematics than for science.

Figure 10: Grade 11 and 12 learners’ attitudes towards mathematics and science 2017



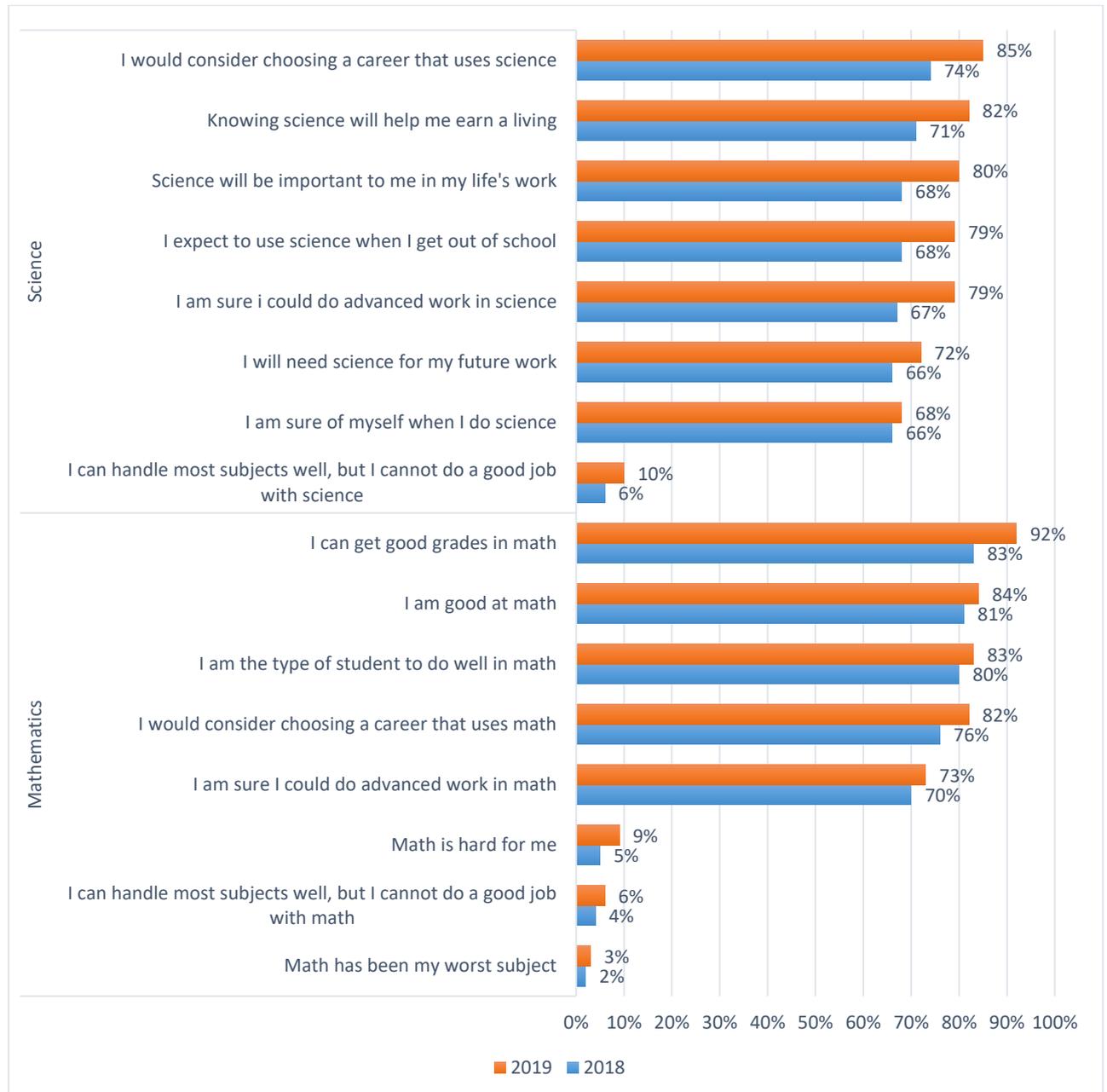
In 2018, participants were again asked about their attitudes to Mathematics and Science to gauge their attitudes towards these as school subjects, as well as possible future career pathways (Figure 11).

The 2018 and 2019 respondents’ attitudes towards mathematics and science were positive overall, as both school subjects and possible career choices, as would be expected from the group that constitutes the TDP (Figure 11). The majority agreed to the positive statements regarding mathematics, such as “I am good at math” and “I can get good grades in math”, highlighting their confidence in doing the subject. More than three quarters also indicated that they would consider

⁵ Enjoyment refers to the intrinsic value or interest learners have in a subject for example whether the subject is interesting or enjoyable. Confidence assesses learners’ self-confidence or self-concept in their ability to learn mathematics or science. Value refers to extrinsic or external motivation because it leads to a desirable outcome for example being accepted into a good university or having a successful career.

choosing a career using mathematics. Their attitudes to science were also quite positive. Two thirds agreed that they are sure of themselves when they do science, and acknowledged the importance of science in their future careers. More than 70% noted that they would consider choosing a career that uses science.

Figure 11: Attitudes to Mathematics and Science 2018 and 2019 (% agree)



Even though participants were very positive towards mathematics and science, they seem to attach a higher value to mathematics than to science, and exhibit higher levels of confidence in mathematics. Results from the TIMSS 2011 and 2015 found that learners who had positive attitudes about mathematics and science achieved better average test scores, even when other factors such as gender and SES were taken into account (Juan, Reddy, Zuze, Namome and Hannan, 2016; Zuze, Reddy, Visser,

Winnar and Govender, 2017). It is therefore important to cultivate a positive attitude towards these subjects, and the TDP can play an important role in this regard.

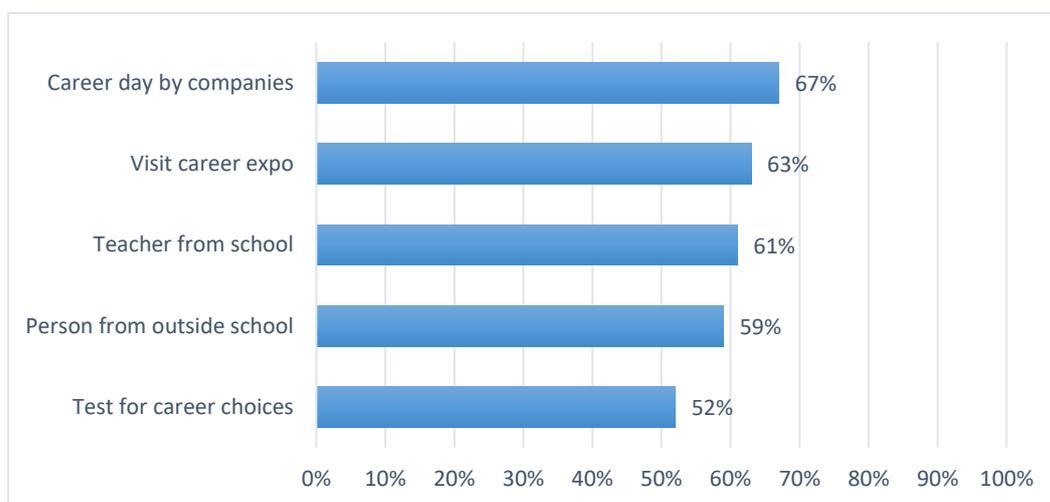
What are learners' perceptions of the career guidance they received?

The purpose of career guidance is to prepare learners for their future education and career trajectories. In the 2017 baseline questionnaire, the focus was on the type of career guidance activities offered by the schools learners attended. In the 2018 and 2019 questionnaires, the focus shifted to career guidance activities offered during the TDP.

In 2017, 86% of grade 11 learners and 81% of grade 12 learners reported receiving career guidance in Life Orientation. The majority of learners (more than 75% per grade) considered the career counselling they received as useful, but on average two out of ten learners did not consider the career counselling they received at school as useful.

Figure 12 shows the career guidance activities learners were exposed to during their time at school. The type of career guidance less frequently applied was aptitude testing, with only five out of 10 learners being exposed to this method in the preceding two years. Schools must increasingly expose more learners to the different types of career guidance activities to prepare them for their future educational and career aspirations.

Figure 12: Exposure to different types of career guidance at school, 2017



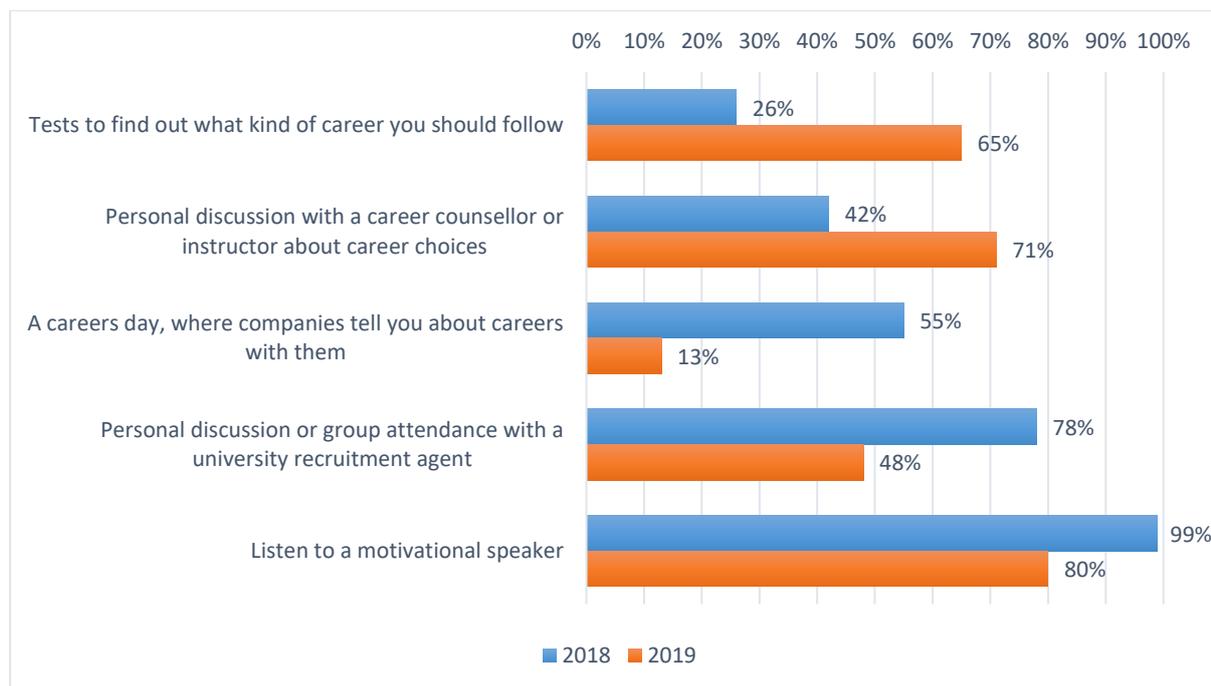
The provision of career guidance is a core element of the TDP. Therefore, it is important to determine the extent to, and ways in, which this is provided. Figure 13 shows the percentages of respondents who indicated that they had been exposed to each form of career guidance in 2018 and 2019.

In 2018, 99% of respondents reported having the opportunity to listen to a motivational speaker during the TDP, while 78% attended a personal discussion or group attendance with a university recruitment agent, and 42% had personal discussion with a career counsellor or instructor about career choices. In 2019, 80% of respondents reported having the opportunity to listen to a motivational speaker during the TDP, while 71% attended a personal discussion with a career

counsellor or instructor about career choices, and 48% had a personal discussion or group attendance with a university recruitment agent.

Even though the majority of respondents still had the opportunity to listen to and engage with motivational speakers during the 2019 contact sessions, the career counsellors were ultimately responsible for guiding participants in terms of their educational and career ambitions. This is reflected in the increasing percentage of participants who reported undergoing aptitude tests during 2019. These tests are important in assessing what the participants’ capabilities are or to predict what they are able to learn or do given the right education and instruction.

Figure 13: TDP Career guidance opportunities in the TDP 2018 and 2019



The fact that not all learners are exposed to career guidance at school may be seen as a missed opportunity to make learners aware of STEMI careers. The challenge here is that learners need to be aware of different careers related to their subject choices. This is critical because the objective of career guidance is to inform and influence the learners so that they make good career choices.

The TDP places emphasis on a variety of career guidance activities, particularly exposing learners to motivational speakers in the form of former participants. These types of activities will provide learners with more self-confidence to pursue the careers of their choice.

What are the career choices and educational aspirations of respondents?

Educational attainment

We asked learners to provide their mathematics and physical science examination results from the previous academic year (Table 3). This information shows that higher performing mathematics and science learners are selected from the majority of lower quintile schools. Learners’ subject results are also a very good indicator of the type of educational pathways they can follow in STEM.

The higher performance of learners in mathematics is also understandable when taking into account that slightly more than three-quarters of learners placed a very high value on mathematics and were more confident in the subject, see discussion above. Mathematics provides learners with more opportunities in terms of their educational and career ambitions.

Table 3: Learners’ mathematics and science achievement in the previous academic year (2017, 2018 and 2019 cohorts)

	Mathematics			Science		
	2017	2018	2019	2017	2018	2019
A. 80-100%	51%	55%	54%	32%	34%	28%
B. 70-79%	30%	35%	28%	45%	48%	37%
C. 60-69%	13%	8%	12%	16%	8%	23%
D. 50-59%	6%	2%	3%	5%	8%	8%

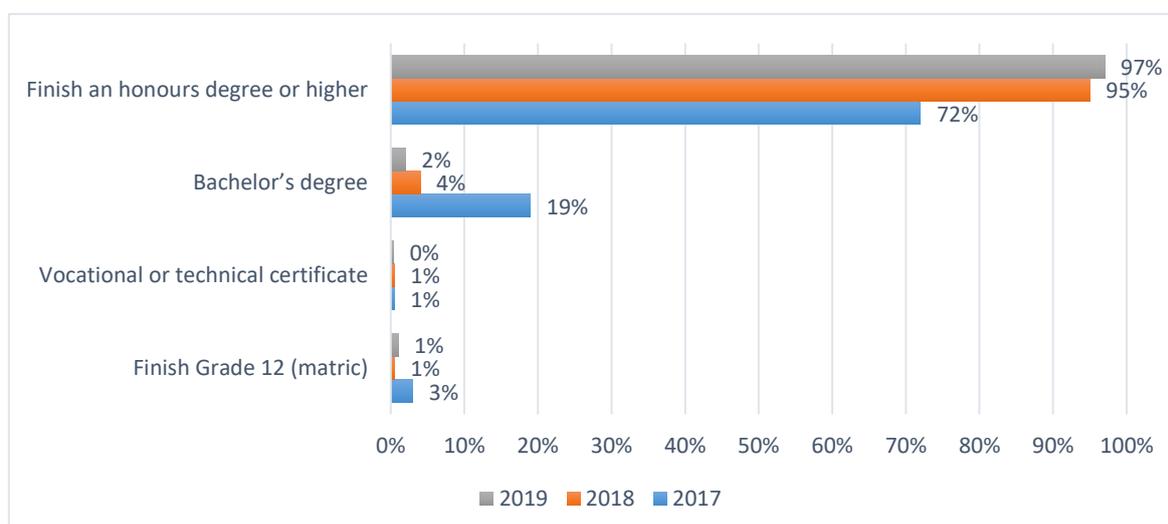
Educational Aspirations

Participants were requested to give details about their post-secondary educational and career destinations. The educational aspirations of learners are shown in Figure 14. Their educational and career aspirations reflect the purpose of the TDP, namely to encourage learners to focus on SET career pathways, thereby contributing to the development of SET human capital in the country.

Nearly all TDP participants intended to study at a University or University of Technology (UoT): 98% on average. This has important implications for both the impact of the TDP in terms of enhancing Mathematics and Science education in the country, and for the status of STEM careers in the country.

Figure 14 shows the highest level of education participants expected to complete. More than 90% intended enrolling for a first degree and intended completing an Honours degree or higher. These results highlight the high educational aspirations of the TDP participants. The tracking of the TDP learners post-school will show whether their actual choices match their aspirational choices

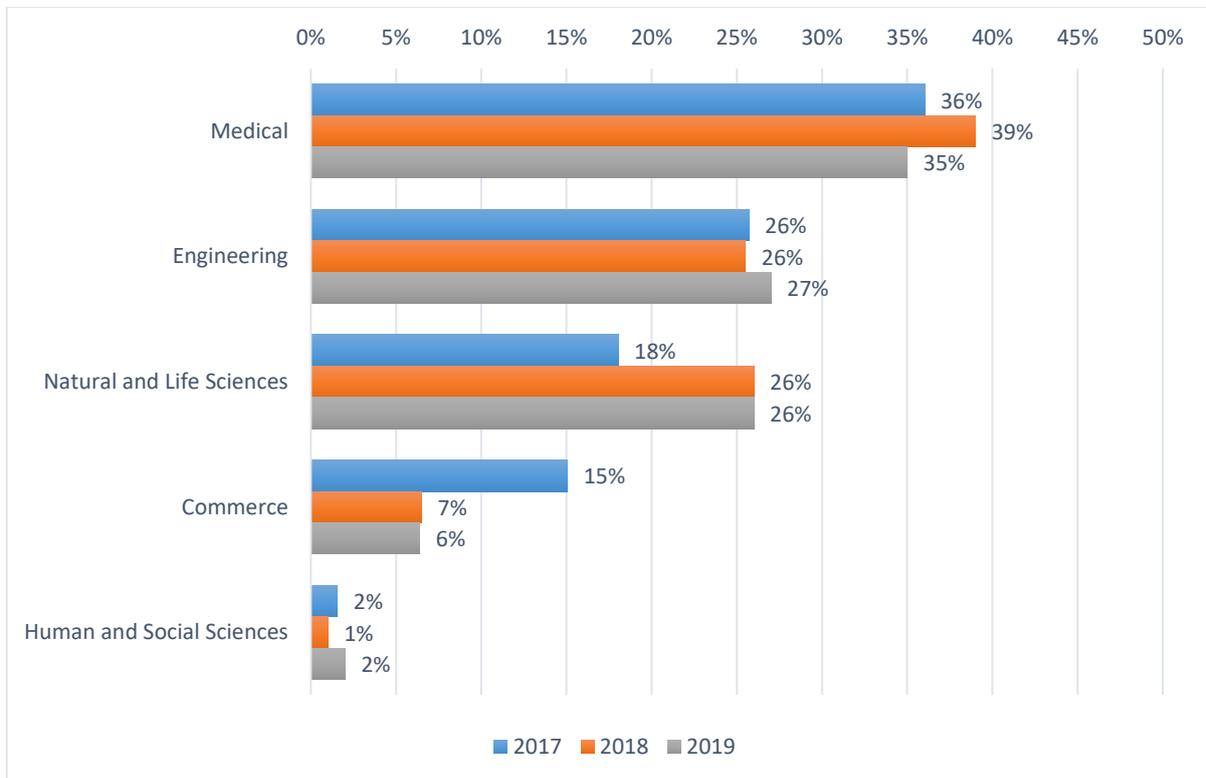
Figure 14: Educational Aspirations of Respondents 2017, 2018 and 2019



Career Aspirations

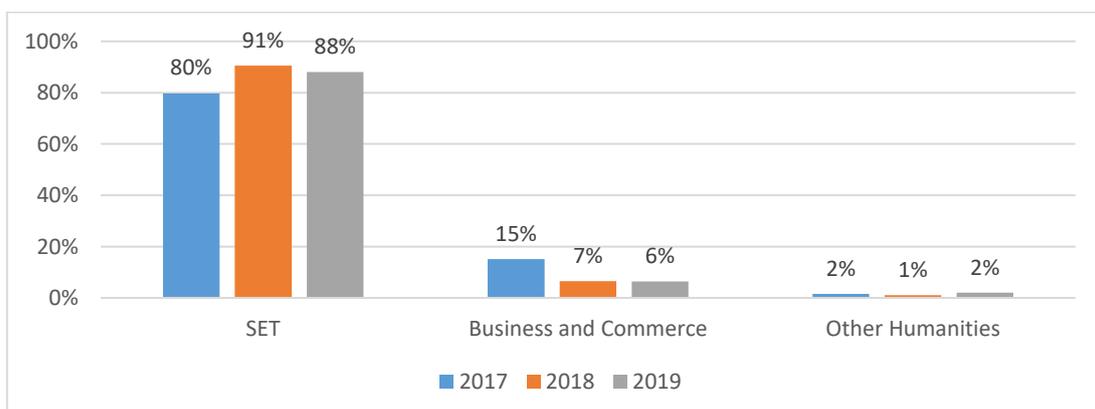
The TDP aims to assist learners in Mathematics and Science at school, but also hopes to guide them into STEM studies and careers. Respondents were asked what work they expected to be doing when they are 30 years of age. Figure 15 shows that the most popular intended career choices of learners are in the medical and engineering fields, followed by Natural and Life Sciences, and Commerce.

Figure 15: Career aspirations of 2017, 2018 and 2019 learners



The information in Figure 15 was aggregated into the following categories: STEM, Business and Commerce, and the rest of Humanities (Figure 16). On average 86% of TDP participants were considering a future STEM related career. Many learners also ascribe a high value to mathematics, resulting in some of them selecting programmes in Business and Commerce. This is a positive finding and suggests that interest is being stimulated in STEM subjects and careers.

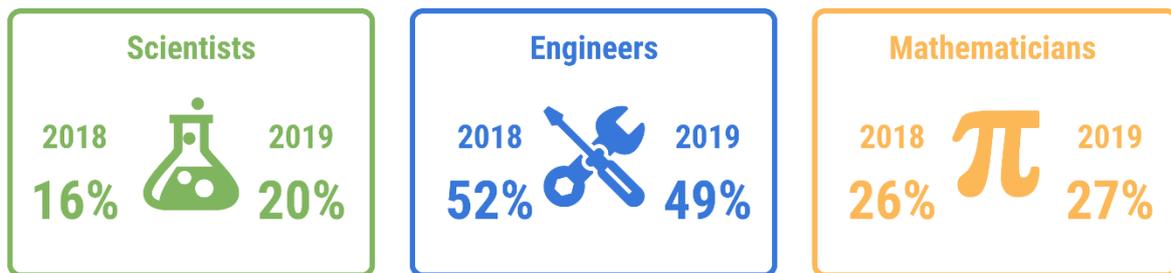
Figure 16: Career aspirations disaggregated by broader educational categories (2017, 2018, 2019)



Familiarity with adults who work in STEM

In 2018 and 2019, learners were asked whether they know any adults who worked in STEM careers. This may have a bearing on the careers they choose to pursue, and is important in terms of their familiarity with those in professions that could serve as STEM role models. In 2018, more than half (52%) knew adults who worked as Engineers, 26% knew Mathematicians, 19% knew someone who worked as a Technologist, and only 16% knew adults who worked as Scientists. In 2019, 20% knew adults who worked as Scientists and 27% knew of Mathematicians, while almost half (49%) knew adults who worked as Engineers.

Figure 17: Respondents familiar with adults in STEM careers 2018 and 2019



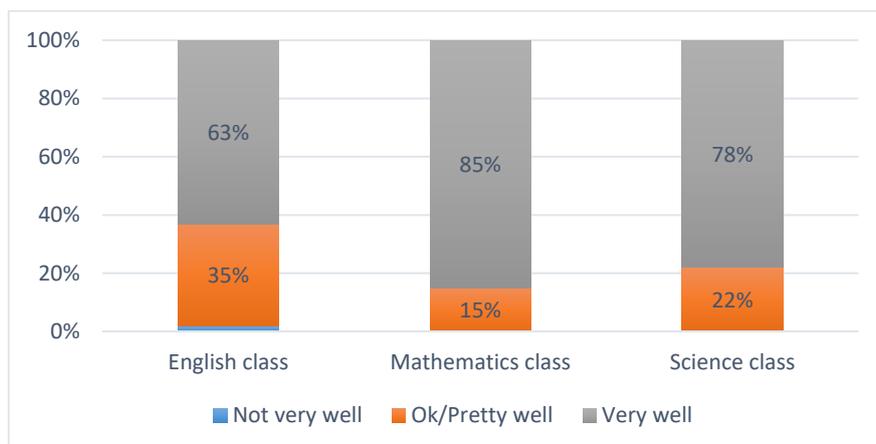
Performance expectations and attendance of extra lessons

In 2019, learners were asked about how well they expected to perform during the year in their English, Mathematics and Science classes. They were also asked whether they had attended any extra mathematics or science lessons in the preceding 12 months.

Subject performance expectations

Figure 18 shows the responses of participants when asked how well they expected to do in English, Mathematics and Science in Grade 12.

Figure 18: Subject achievement expectations 2019



For all three subjects, most of the respondents were confident that they were going to do very well in the current year. For English, 63% felt they were going to do very well, while for Mathematics and Science the percentages were 85% and 78% respectively. The results for English may reflect that as

not all learners speak English at home, they may not be as confident in the subject; or that they are more confident in their ability in subjects such as Mathematics and Science. However, overall the respondents were quite confident in the abilities and the likelihood of their success.

Extra lessons

In 2019, respondents reported on whether they attended extra Mathematics or Science lessons in the preceding year and whether it helped them to excel in class or helped them keep up in class. For Mathematics 44% had attended extra lessons to help them excel, while a further 18% had attended extra lessons to help them keep up in their Mathematics classes. For Science, the results were similar, with 41% having attended extra lessons to help them excel, while 20% required extra lessons to help them keep up in their Science class. Therefore the majority that attended extra lessons did so to help them improve their achievement, while a smaller percentage required assistance in order to be able to keep up in class. It is a positive sign that many of the respondents attended extra lessons, whether to help them keep up or to help them excel. This again shows their commitment to working hard, and the support of their parents/teachers in encouraging them to attend extra lessons.

Summary

The TDP participants expressed positive attitudes towards mathematics and science and placed great value in both subjects as observed in their future career choices. Even though three quarters and more of participants considered career counselling useful, more should be done at the school level to expose learners to different forms of career counselling outside the school environment, particularly in STEM fields. The majority of learners were planning to attend a University or a University of Technology to pursue their studies, with an average of 96% of Grade 12 learners considering a future career in a STEM discipline. This includes careers within the Commerce fields. This has positive implications for the future of STEM in the country, particularly as these learners are high achievers who are committed to working hard and achieving success. They also exhibit high levels of confidence in their expected performance in key subjects, and many of them have attended extra lessons to improve their performance in mathematics and science.

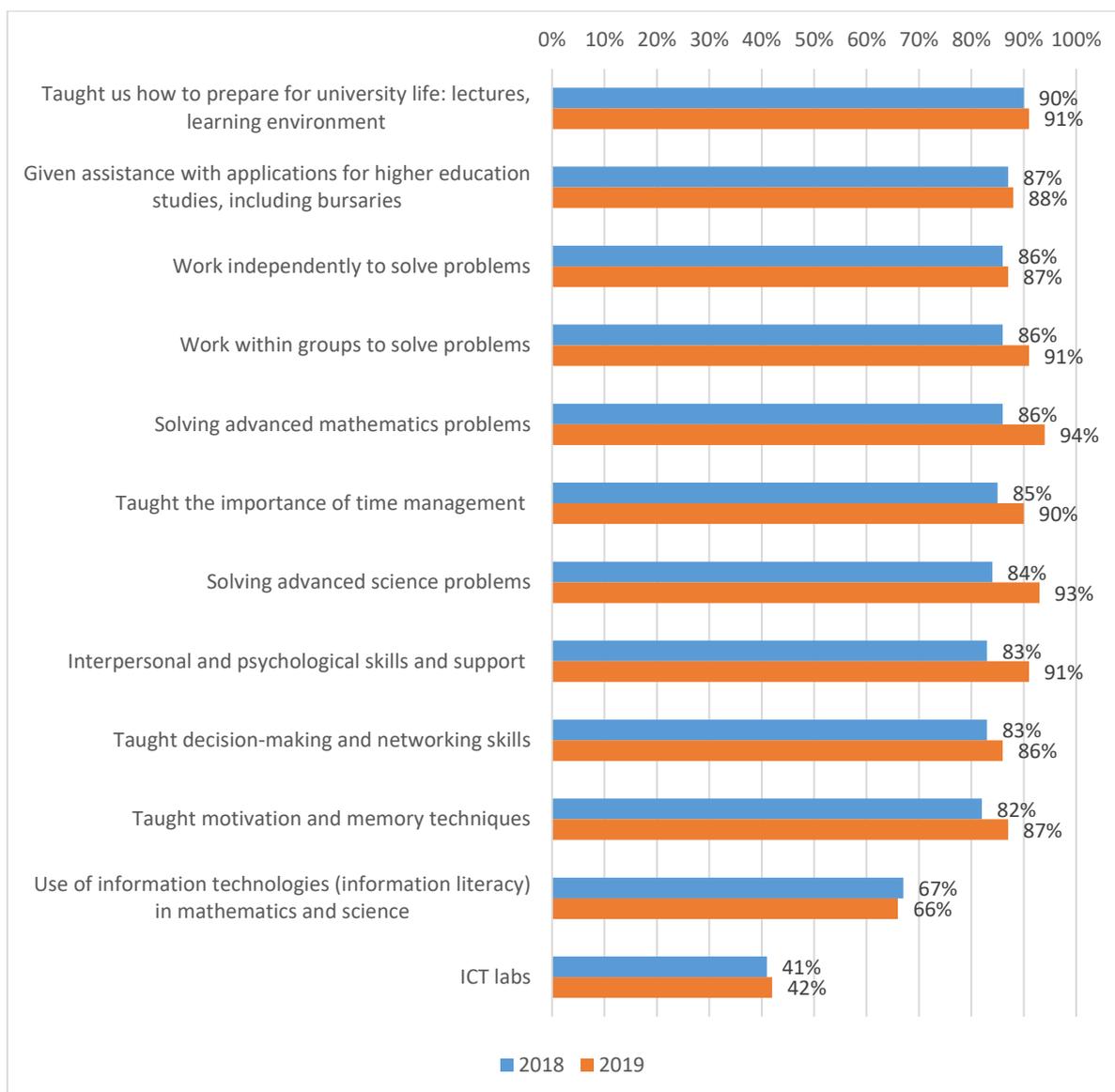
It is critical to make sure that learners, particularly those with STEM abilities and aspirations, are familiar with people who work in STEM fields that they may be interested in pursuing. These adults may inspire the learners and may form part of their support system while pursuing STEM studies and careers.

What were learners' experiences of the TDP?

Topic coverage in 2018 and 2019

The topics which are covered during the TDP are crucial, as these provide the foundation for the programme, and the knowledge and skills which learners gain. In the 2018 baseline survey, which was administered at the end of 2018, participants were asked about the topics that were covered in the TDP during the year. In the follow-up survey administered in 2019, the 2019 cohort were asked about how often a range of topics were covered during the year. Figure 19 provides the topic coverage (covered often/very often) for 2018 and 2019 as reported by the respondents.

Figure 19: Topic coverage 2018 and 2019



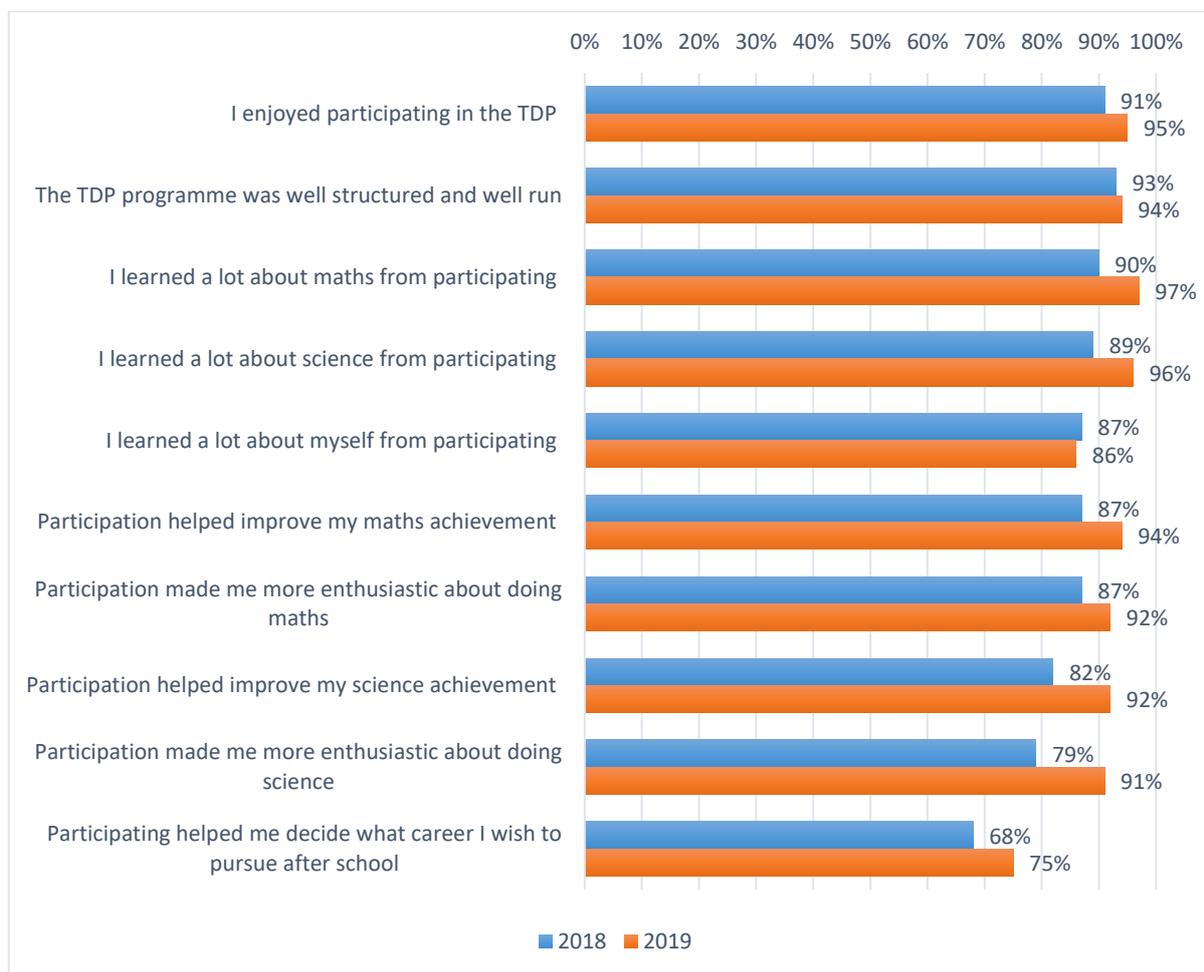
The majority of the topics were reported to have been covered “often” or “very often” by more than 80% of the respondents in reference to both years, including being taught how to prepare for university life, getting assistance with applications for higher education studies, working independently to solve problems, and working in groups. The topics that were reported as being covered often or very often in both years were the use of information technologies in mathematics and science, and ICT labs. For the majority of topics, a slightly higher percentage of respondents reported coverage often or very often compared to 2018.

All of the topics in Figure 19 provide valuable skills and knowledge for the participants of the TDP, both while at school and in relation to preparing them for their post-school studies. It is therefore encouraging that these topics are extensively covered in the TDP.

TDP Experience

The 2018 baseline survey included a question about the learners' experience in the TDP in 2018. At the last contact session of 2019, participants were asked about their TDP experience during the year. Figure 20 shows the percentage of respondents that agreed with each of the statements. Respondents were very positive about their TDP experience, both in 2018 and 2019. Around 80% or more agreed with the majority of the statements in both years, indicating that learners enjoyed participating, and felt the programme was well-structured and well run. Through the TDP, respondents learned a lot about maths and science, and were able to improve their achievement in these subjects. Participation also made them more enthusiastic about the subjects, and helped them to decide on their future career path. The TDP therefore seems to have enhanced learners' skills and knowledge, their enthusiasm and their confidence.

Figure 20: TDP experiences in 2018 and 2019



Favourite part of the TDP

One of the questions in the 2018 baseline survey was an open-ended question that asked respondents about their favourite aspects of the TDP in 2018. In the 2019 follow-up survey, respondents were asked about their favourite part of the TDP in 2019 using a close-ended question. A number of categories were identified within the responses regarding the 2018 experience (Figure 21) (Further quotes are provided in Appendix A).

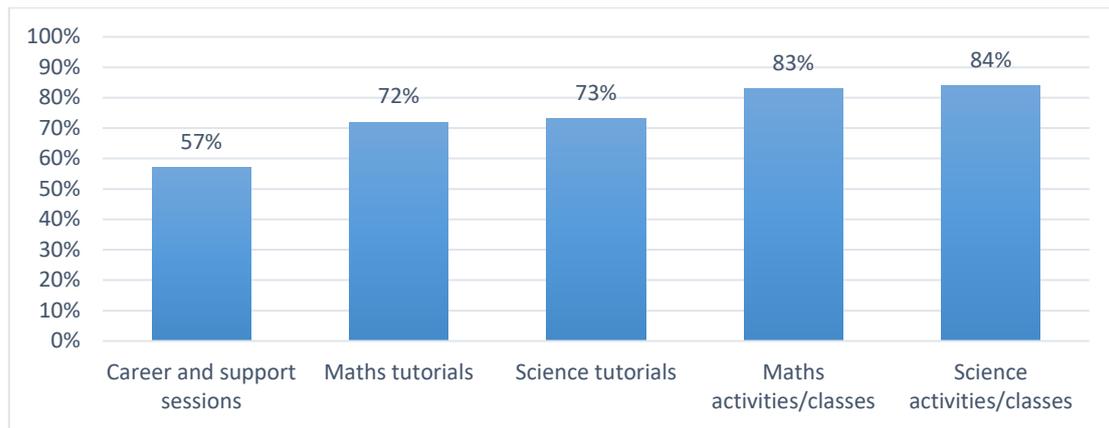
Figure 21: Learners' favourite aspects of the TDP 2018



Lab work was the favourite aspect noted by two of the respondents, as it was the first time either of them had been in a laboratory.

In 2019, learners were provided with a set of options to gauge which aspects of the TDP they considered their favourite (Figure 22). They could select more than one option. The following figure highlights the percentage of respondents that felt each activity was one of their favourite aspects.

Figure 22: Favourite aspects/activities 2019



Over 80% of respondents highlighted the science activities/classes (84%) and the maths activities/classes (83%) as some of their favourite aspects of the TDP. Around three quarters noted the science and maths tutorials as some of their favourite aspects. The aspect that was noted the least favourite by respondents was the career and support sessions (57%).

What would you tell a friend about the TDP?

Another open-ended question was included in the baseline survey in 2018, relating to what the respondents would tell a friend about their 2018 TDP experience. Some of the responses are highlighted in the following figure (Further selected quotes can be found in Appendix B).

Figure 23: Some responses to “What would you tell a friend about the TDP?”(2018)



A range of responses were received to this question, focusing on the value that the learners have gained from participating in the TDP, in relation to their own development, as well as their interactions with others. Through the programme, respondents indicated that they have improved their knowledge and skills in the core subjects of mathematics and science, as well as learned skills such as time management, critical thinking, problem solving and effective communication. They have also gained confidence in their own abilities and become more motivated to succeed, being more aware of the value of working hard to achieve your goals. They have also learned how to interact with people from different backgrounds, recognising the importance of team work, and respecting and valuing diverse opinions. Some responses also highlighted the assistance they received in terms of preparing for life at a higher education institution and the guidance related to the career opportunities that are available. The TDP is therefore providing opportunities for participants to learn and grow, both intellectually and personally.

Impact of participating in the TDP

In order to better understand the impact of the TDP in 2019, respondents were asked to what extent they agree or disagree with a number of statements related to impacts of the programme on their lives (Figure 24).

Figure 24: Impact of the TDP 2019 (% agreed)



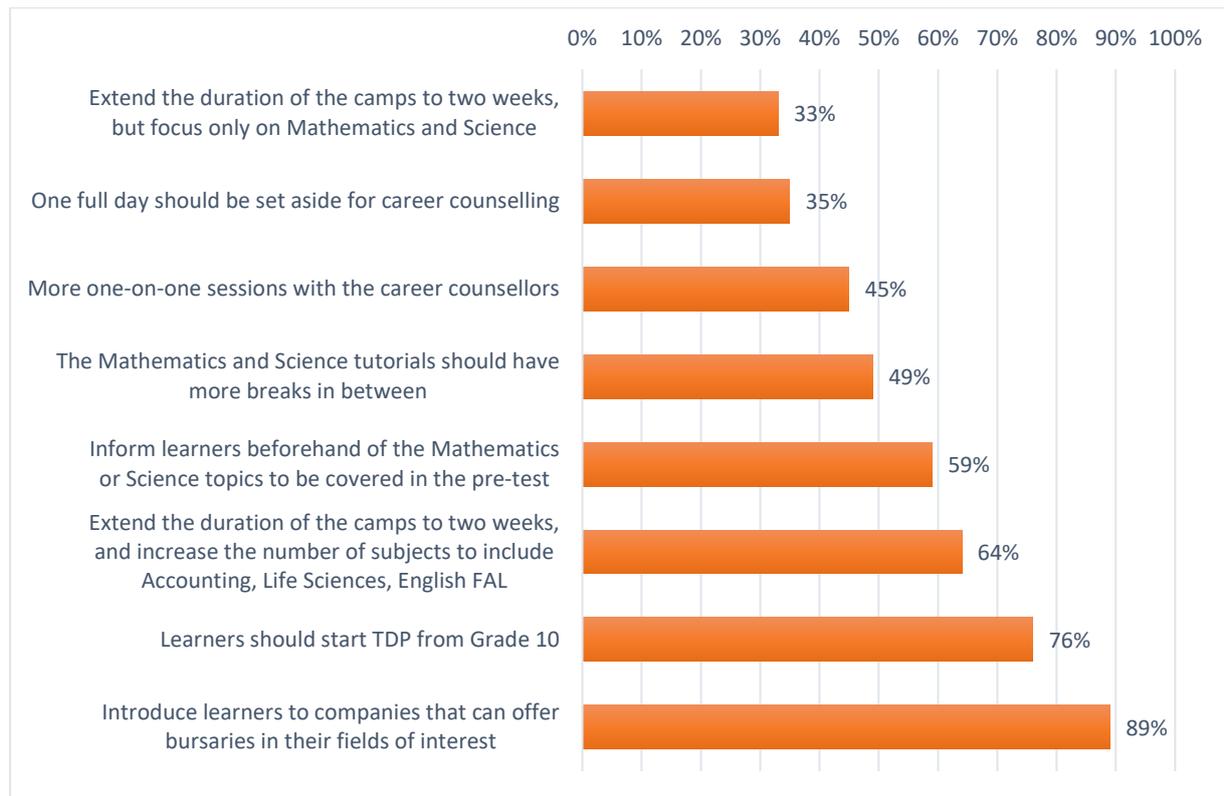
Overall, the programme appears to have had a positive impact on participants. More than 80% of the respondents agreed or strongly agreed with all of the statements. Respondents agreed that as a result of participation in the TDP in 2019, they are better able to produce high quality work (91%); set their own learning goals (90%); can make changes when things do not go as planned (90%); prioritise their assignments (85%); and manage their time wisely when working on their own (82%). In dealing with others, they noted they are better able to encourage others to do their best (87%); and to lead others to accomplish a goal (84%). They also agreed that they can respect the differences of their peers (93%); work well with learners from different backgrounds (90%); and are able to include others' perspectives when making decisions (90%).

The TDP is therefore having an important impact on participants' confidence in their abilities to produce high quality work, achieve their goals, to work independently, to make decisions, to motivate others, and to work well with others.

Suggested improvements to the TDP

In the 2019 follow-up survey, learners were asked about possible improvements to the TDP. They could select more than one option from the list provided. Figure 25 presents the results.

Figure 25: Suggested improvements 2019



The most commonly suggested improvement or change was that learners should be introduced to companies that can offer bursaries in their fields of interests (89%). Just over three quarters (76%) also noted that learners should start TDP from Grade 10. Around two thirds (64%) thought that the duration of the camps should be extended to two weeks and that the number of subjects should be increased to include Accounting, Life Science and English FAL; while a third felt that the camp should be extended to two weeks, but only focusing on Mathematics and Science. Fifty-nine percent highlighted that learners should be informed of the Mathematics and Science topics to be covered in the pre-test beforehand; and just less than half (49%) indicated that there should be more breaks in between the tutorials. More one on one sessions with the career counsellors was suggested by 45% of respondents, while 35% felt that a full day should be set aside for career counselling.

Summary

The respondents highlighted overall positive experiences during the TDP. The programme incorporates a range of activities and topics which are useful to participants, both while they are still at school and in their post-school endeavours. The TDP also provides participants with a range of skills and knowledge related to mathematics and science content, as well as to their future studies and own personal development. Furthermore, the TDP plays a role in helping learners to identify their future career paths, and encourages them to become more confident and motivated.

Part B of the report presents a more in depth evaluation of the 2019 TDP, which emerged from a qualitative component undertaken at the June contact session.

PART B: QUALITATIVE COMPONENT: GIVING LEARNERS AND STAFF A VOICE

Introduction

In 2019, a qualitative evaluation component was added to the study to provide further detail and allow more in depth analysis of the programme. The aim of this component of the study was to examine staff and learners' perceptions and experiences of the TDP, and to establish whether the programme has enhanced their trajectory towards SET careers in higher education. This allowed for a greater understanding of how the programme functions and its influence on the learners. Furthermore, it allowed for identification of ways in which the programme can be enhanced to ensure the best possible outcomes for the learners.

Aim

The aim of the qualitative component was to examine learner and staff perceptions and experiences of the TDP. The HSRC evaluated whether the TDP has achieved its objectives stipulated as:

- Enhance participants' chances of improving their grades and academic performance;
- Produce cohorts of school leavers who are prepared for higher education life and equipped with skills and tools to be lifelong learners; and
- Influence participants to pursue science, engineering and technology (SET) careers

Key Research Questions

The following key research questions guided the evaluation of the programme:

- How do TDP participants' perceive and experience the programme in supporting their interests in mathematics and science?
- How have participants' attitudes towards mathematics and science changed as a result of the programme?
- What are the key features of the TDP that promotes a positive and stronger interest in mathematics and science?
- How do participants perceive the TDP's influence on their educational aspirations and career choices in mathematics and science?
- What improvements could be made to the programme?

Methodology

Sampling

The participants were 2019 Grade 12 learners attending the June contact sessions. These are learners recruited during the 2018 academic year, and who first participated in the TDP in 2018 when in Grade 11. These learners have sufficient experience of the supplementary and additional activities offered during the TDP to be able to provide a narrative of the influence of the programme on their academic and personal views and aspirations.

In addition, interviews were held with the provincial coordinators, centre managers, career counsellors, and mathematics and science tutors.

Convenience sampling was used in selecting five of the nine TDP sites for inclusion in the qualitative study. Convenience sampling refers to a non-probability sampling technique where participants are selected because the targeted population meet certain criteria, is easily accessible, available at a given time and willing to participate in the study (Etikan, Musa and Alkassim 2015). In our case, the targeted Grade 12 learners were all attending contact sessions at a given time and location in Gauteng, North West, KwaZulu-Natal, Free State and Mpumalanga province, which were also easily accessible from the Durban and Pretoria HSRC offices (see Table 4).

Table 4: TDP Contact Session Venues 2019

Province	School Name	District/Town/Suburb	June 2019
WC	Emil Weder Secondary School	Genadendal	
FS	Die Hoërskool Kroonstad - Landbou Terrein	Kroonstad	Selected
MP	eMakhazeni Boarding School	Machadodorp	Selected
GT	St. Barnabas College	Randburg	Selected
NC	Kimberley Girls High School	Kimberley	
KN	Tugela High School	Amajuba - Newcastle	Selected
EC	Grens High School	East London	
NW	Hoër Tegnise Skool Rustenburg	Rustenburg	Selected
LP	Mastec Institute	Polokwane	

Data collection

The HSRC visited the five TDP provincial centres during the June 2019 contact sessions, from 18 to 21 June. Two focus group interviews of between eight and twelve Grade 12 learners were conducted at each site. In addition, individual interviews were conducted with mathematics and science tutors, career coordinators, centre managers, provincial coordinators from the North-West and Free State education departments, and a Mathematics critical friend from KwaZulu-Natal.

The focus group discussions addressed the participants' perceptions and experiences of the programme and how this might enhance their trajectory towards SET educational aspiration and careers. The interviews with TDP staff focused on the overall managing, planning and coordination of the TDP, the roles of the different stakeholders and their perceptions of the programme. All interviews were audio-recorded and later transcribed by professional transcriptionists.

Data analysis

The categorical-content approach, also known as content analysis, was used in analysing interview transcripts. This analysis entails identifying common features from the data and classifying this into categories (Lieblich, Tuval-Mashiach and Zilber, 1998). The analysis did not only serve to identify and describe categories, but also the relationship between categories (Polkinghorne 1988) emanating from learner focus group interviews and individual interviews with TDP staff.

Voices of the TDP learners and staff

The broad categories or themes identified were guided by the research questions, and the sub-themes emerged from the data. The following themes and sub-themes were identified: (i) learner perceptions and experiences of the programme, (ii) key features of the TDP that promote a positive and stronger interest in mathematics and science – this entailed the following sub-themes: highly qualified tutors and disciplinary and pedagogic knowledge competence, development of critical thinking skills, teaching and learning strategies, preparation for tertiary education, and sharing knowledge and skills with others, and (iii) the influence of the programme on career choice in mathematics and science- this includes a sub-theme on the importance of career guidance as an aspect of the TDP. Lastly, programme challenges and recommendations for improvement identified from the data are presented.

Learner's perceptions and experiences of the programme

This theme entails the learners' perceptions of, and experiences in, the programme. Learners indicated that they found the mathematics and science content beneficial in that the programme focuses on curriculum content that they had either not fully grasped; or that had not been properly taught, or not at all taught, at their respective schools. Furthermore, one of the learners described the programme as representing what schooling should be like in South Africa. Others commented about their tutors' disciplinary knowledge competence and caring attitude. As echoed by a learner *"TDP tutors are interested in us as human beings"*. Additionally, these learners appreciate the fact that they come from similar socio-economic backgrounds and feel motivated to work hard as they see others do the same. The programme has created the opportunity for collaboration and learning from each other.

In comparing the programme with their schooling context, the learners pointed out the weaknesses in teaching and learning happening at their respective schools. They mentioned the following:

"What we learn here are things that aren't really covered in school. They skip topics that are difficult for them. High school teachers don't really go deeper when they teach. Let's say they are teaching a certain topic, they don't really cover all the basics. They just touch here and there and pass on, yea".

"At school, teachers tend to like skip topics that are difficult for them. Yeah they will ask the basic stuff".

"I think for us personally from last year it was always sad that we only have seen the stuff after we wrote about it only because we didn't have an efficient teacher".

"We didn't do calculus at our school so there was certain calculus topics at the test which I didn't know how to approach with confidence".

"You struggle with this this this and my school teacher they still struggling they can't help me there".

This highlights a major weakness in the education system: that many learners in South African schools are taught by teachers who have limited subject content knowledge and weak pedagogical content knowledge. This lack of competence in teaching and learning would explain why some of the learners found the pre-tests difficult. They attributed their poor performance in the test to not having a Maths teacher during the preceding term, content not having been covered at school, and inadequate teacher content knowledge. A Science tutor corroborated this by indicating that the learners were expecting the usual low-order type of questions that they are accustomed to.

The TDP attempts to address, among others, challenges related to poor teacher disciplinary knowledge and pedagogic knowledge in maths and science by focusing on clearing misconceptions in content, closing learning gaps and developing the learners' critical thinking abilities.

Key features that promote a positive and stronger interest in mathematics and science

The sub-themes identified in this category include tutor qualifications and subject content competence, the use of teaching and learning strategies that enhance learning, the development of critical thinking skills and other skills, preparation for tertiary education, and the sharing of knowledge and skills with others.

Highly qualified tutors, and disciplinary and pedagogic knowledge competence

The findings revealed that the programme has highly qualified tutors who are competent in their knowledge of mathematics and science, and know how to facilitate knowledge in order to enhance learning. For example, some of the tutors have the following qualifications: Honours degree in Mathematics, BSc in mathematics, physics and chemistry and a post-graduate diploma in education, and an Honours degree in mathematics education and enrolled for a Masters degree in science education. Some have extensive experience as high school teachers and university lecturers in their respective subjects, and have been involved in other maths and science intervention programmes, and others have been involved in marking and moderating matric examination papers.

Given their subject knowledge and pedagogic competence, TDP tutors are able to improve the achievement levels of their learners. This was confirmed by learners themselves and three former TDP learners who visited the Gauteng site during the contact session. They made the following statements:

"Yes, my marks improved very much. I in fact got a 90% in maths" [Grade 12 learner].

"I got eight distinctions. I got 90% for maths and over 90% for physics"; "English home language, picked me up so I ended up getting six distinctions"; "I got 88% for Maths, 84% for Physics" [Former TDP learner].

This point was further supported by the North-West Provincial Coordinator who mentioned that although the programme targets learners with outstanding academic achievement (i.e. Level 7 learners: 80 - 100%), it is able to improve the marks of learners who were recruited with scores ranging between 65-70 percent. She pointed out that, in the North-West, it is important to have

representation of learners from all districts in the programme. Therefore, at some stage the province had to lower the recruitment bar to accommodate learners from one other district. The programme proved to be a success in that there was improvement in the performance of learners who entered the programme with a score of 60%. The Provincial Coordinator said: *“I have evidence that they were able to improve performance from 60% to 80%.* Similarly, a critical friend from one of the sites confirmed the success of the programme in this manner: *“Well, one can see the successes in the statistics. 40 learners got an average mark of above 80% for maths. So, they’ve really performed well”.*

The Free-State Provincial Coordinator who also serves as the Centre Manager said: *“So far, it’s the performance of our learners. I would say it with confidence their performance is improving by each and every camp you know”.*

As indicated by the learners and other TDP staff, tutors display key behavioural attributes identified by Pretorius (2013) as being positively related to learner achievement. These include having an in-depth knowledge of the curriculum, being intelligent, confident, committed, enthusiastic, and genuinely concerned about learners, as well as creating an inviting atmosphere in their classrooms.

Teaching and learning strategies that enhance learning

The Grade 12 learners mentioned that the programme exposes them to teaching and learning strategies that enable them to better understand content. The findings from all five provinces revealed that the learners found working in small groups to be the preferred, and most beneficial, mode of learning. They found peer-to-peer interaction during tutorials useful because they were able to share ideas and formulate their own solutions to maths or science problems. One of the learners said the following: *“And sometimes peer to peer teaching is much easier than when the teacher explains to you it may happen that your peer will explain much better than your teacher. We are given that freedom to ask one another unlike at school where you have to raise your hand and the teacher is attending to other learners”.*

The learners pointed out differences in modes of teaching at the TDP contact sessions and at their respective schools. As echoed by one of the learners, it seems that at school, working in groups is discouraged: *“In our school they don’t let us work in groups you get your stuff you work by yourself and if you need help you have to ask the teacher, but like yesterday they allowed us to spilt up into groups and we allowed to listen to music and it’s a more relaxed environment. It’s more pleasant you don’t feel so stressed while you do your work as well. It’s more relaxed and you can ask each other for help”.* Tutors confirmed that they use a combination of whole class teaching and group activities. They give learners activities that allow them to interact with each other – a practice which is uncommon in their schools.

The findings suggest that TDP tutors are competent to use learner-centred approaches to facilitate learning, whereas in most South African classrooms group discussions is discouraged.

Development of critical thinking skills and other skills

One of the positive attributes of the programme is the development of learners’ critical thinking skills. This is achieved through addressing level four questions as stipulated in the Curriculum and Assessment Policy Statement (CAPS), that is, questions that require critical analysis and evaluation. A

mathematics tutor noted that the learners encounter these type of questions for the first time in the programme.

Additionally, the programme develops their leadership skills, communication skills and presentation skills. For example, during tutorials they get the opportunity to do presentations. One of the learners said: *“Especially during physics lessons, we have to go to the front to present on behalf of our groups”*.

Preparation for tertiary education

Learners mentioned that the knowledge and skills provided by the programme prepares them for life at university, and enhances their chances to access and be successful in higher education. They are exposed to different study methods, time management, stress management and managing funds, i.e. how to live on a limited budget. For example, they learn how to manage the limited funds received from bursaries or from the National Student Financial Aid Scheme (NSFAS). They acquire skills that would help them adjust at university to prevent them from dropping out. One of the learners said: *“We watch those videos whereby they tell us how to manage stress and the transition between high school and University, and we should deal with everything, and how to cope with your exams. It’s like we’re exposed to the University kind of lifestyle”*.

A Centre Manager from Gauteng who is in contact with former TDP learners mentioned that he is aware of six former learners who are studying medicine and actuarial sciences, and who are doing well at their respective universities. Some of these students visited the camp to motivate the current cohort of learners. A Career Counsellor mentioned her encounter with a former TDP learner, studying Engineering at Wits who mentioned that it is much easier to adapt at University. This suggests that the TDP is successful in meeting its objective of preparing learners for university life.

Sharing knowledge and skills with others

This sub-theme emerged during focus group interviews with the learners, in the address by former TDP participants and in the interview with a TDP critical friend. The participants pointed out the importance of sharing the knowledge and skills acquired in the programme with other learners. They highlighted this in the following manner:

“Whenever I go back to my school, I know that whatever I’ve learnt at this camp I have to help others, and, we all know that as you help others there are certain things that you pick up. Because the province is depending on everyone’s results. So, even though the programme is developing us, we also have to develop in our communities”

[Current TDP learner]

“Make sure that when you succeed, help others to also be successful. You must make sure that you succeed together, because at the end of the day you not going to be a doctor or an engineer alone, but you going to need others”

[Former TDP learner studying medicine at UCT].

“Realise that you don’t only do it for yourself, but do it for your community. I think that’s a problem that as a country we have that we can be selfish guys at times, you

think that we can do it for yourselves and we do it for our own families, but then what about the environment we live in, what the person next door, what about the person we meet you going to meet. Make sure you don't forget about them. It's important that we give back to our communities and that's the only way we are going to rise higher" [Former TDP learner studying Engineering at UCT].

The utterances made by the current and former TDP participants show that they have developed confidence in the knowledge and skills acquired in the programme to the extent that they are committed to sharing the knowledge, skills and resources with peers at their respective schools and giving back to their communities. This highlights an important aspect of the TDP's impact.

TDP influence on career choice in mathematics and science

Learners indicated that the programme influenced their career choices by exposing them to careers in Science, Technology, Engineering and Mathematics (STEM). They are provided with resources such as career booklets and the national career portal for STEM-related career information. The interviews revealed that there are learners who are interested in pursuing careers in STEM, and those that are not. The former found career activities useful and supportive of their career choices. They made the following comments:

"It changed our minds about careers we want because of information we got at the camp Maybe we all thought of something at first and then, as we researched more about it, our ideas changed".

"I haven't decided but it has strengthened my chances and my decisions...I haven't really decided but it narrowed it down".

"I will also be doing Civil Engineering but specialising more in Structural Engineering because when I was doing research it is the one that has the most Maths and I love doing Maths".

"And also, we were given books about careers in Science and Engineering which explained like briefly what each career is all about and what you need to do to enter that field".

" Could not decide on career I want to follow but career coordinator helped me decide on at least two options".

"I wasn't sure what I was going to apply for until she forced me to think about it and to make a decision".

Although most learners appreciated being exposed to STEM careers, some felt that they were being forced to pursue careers in this area. The learners expressed their disapproval in the following manner:

"Even though I am good at maths and science but I grew up having a certain dream and I wanted to pursue my dream and it's not based on science so, it's a bit discouraging because that's my dream".

“Not dream careers but forced to choose. She is dictating... She tells you what you supposed to do” [This learner had chosen to study environmental law].

“TDP channels us to certain careers and studies at universities. What about entrepreneurship or doing something else?”

“Career counsellor wants to choose careers for us and she is persistent”.

During an interview with one of the career counsellors, she confirmed that she discourages learners from choosing careers other than those in STEM fields. She said this: *“Learners had no idea that they must have three options when they choose university courses. They did not know that the three options must be in the STEM cause some chose Law”.*

The TDP’s influence on career choice in mathematics and science is evident in the following careers chosen by the learners: Metallurgical engineering, Electrical Engineering, Sports Science, Bachelor of Science, Astrophysics, Medicine, Actuarial Sciences, Geographic Information Systems (GIS), and Environmental Science.

Importance of career guidance as an aspect of the TDP

The TDP introduced career guidance and career choices, a critical aspect of the Life Orientation curriculum. The importance related to this component of the programme was highlighted by both the learners and the TDP staff. Highlighting the importance of this component, the Free-State Provincial Coordinator indicated that this aspect of Life Orientation is not taught in schools. She said: *“Career guidance is not done, not even at the best schools. Learners had no idea about career paths. Even children from the best performing schools in the province are uninformed about career paths”.* Furthermore, a career coordinator pointed out that schools focus on assessing learners to determine their content knowledge in Life Orientation, instead of preparing them for life after schooling and for their future career paths. These statements support Diale, Pillay and Fritz (2014), and Maila and Ross’ (2018) findings about the teaching of Life Orientation (LO) in South African schools. Diale, Pillay & Fritz (2014) study revealed that teachers felt incompetent to teach Life Orientation because they do not have the qualifications to teach this subject. Furthermore, although they received training in the subject, this was not adequate enough to give them the required tools and techniques as well as the practical guidance for effective delivery of this subject at their schools. In a similar study, Maila and Ross (2018) point out that, many of the matric learners were unaware and uninformed about admission requirements in certain fields of study at the various higher education institutions.

Introducing career guidance as part of the TDP, serves to address a critical weakness in the education system, with regards to the teaching of this component in the Life Orientation curriculum. The TDP Career Coordinators have the relevant qualifications and expertise to deliver this aspect of the curriculum. For example, some of the Coordinators have Honours or Masters degrees in Life Orientation. One indicated that she is an Industrial Psychologist. In addition, as part of curriculum guidance, TDP learners are provided with knowledge about STEM careers, and learn how to access the relevant career platforms such as career-wise and companies offering bursaries. They are assisted in choosing careers according to their personalities, interests and abilities. Furthermore, they are given support in creating their own e-mails, applying for bursaries, and designing their Curriculum Vitae with

letters of motivation for job applications. They are also supported in doing job shadowing as part of their assignment. A career coordinator mentioned that 90% of the learners did not have e-mail, and some had never worked on a computer before. In addition, learners are provided with resources such as a WhatsApp group consisting of learners and their Career Coordinator, intended to enable communication and support to continue beyond the TDP contact sessions.

Challenges encountered in the TDP

The TDP is not exempt from challenges, and the main challenges identified by staff were related to the recruitment of level 7 learners, competing intervention programmes, and the poor quality of teaching in schools.

The North-West provincial coordinator mentioned that she could not get all 40 learners to attend the camp because of other programmes in the province that offer interventions in more than two subjects. Parents also support these programmes, which makes it difficult to attract these learners to the TDP. In the same way, the Gauteng Centre Manager mentioned that there are a number of service providers targeting the same learners in the province. Furthermore, the TDP staff mentioned that it is difficult to find high performing learners from quintile 1, 2 and 3 schools.

One tutor was of the opinion that there is a problem with the selection process. In his opinion, many of the current participants should not have been included in the programme. According to the tutor, many of the participants from quintile 1, 2 and 3 schools did not comply with the criteria for inclusion in the TDP. He suggested that the recruiters cast their net wider, as he was adamant that he had taught high performing learners in some of the poorer areas, but that they seem to have been overlooked in the case of the TDP. Like him, the other TDP tutors were very confident in their abilities to improve the learners' content knowledge.

Tutors and learners alluded to the challenges pertaining to the poor teaching and learning happening in schools that some learners were recruited from. A tutor mentioned that the TDP focuses on critical thinking abilities, yet a learner cannot be expected to think critically about content when they have not mastered the content, or the content has not been properly taught. He said: *“So if you check, they expect me to teach all the content that is covered in term 2 in one week. So that means everything that I do, even if I am going to do it in a way that a child understands, I will be doing it in supersonic speed”*.

What improvements could be made to the programme?

TDP staff and learners made the following proposals:

Figure 26: Suggested improvements from the staff and learners



Summary

This qualitative analysis demonstrated that the Talent Development Programme is succeeding in meeting its objectives of (i) enhancing learners' opportunities to improve their grades and academic performance in Maths and Science; (ii) produce matriculants who are prepared for higher education life, and equipped with skills and tools to succeed in tertiary education and beyond, as well as (iii) influence learners to pursue careers in Science, Technology, Engineering and Mathematics. As articulated by one of the learners, the programme mirrors what schooling in South Africa should be like - where teachers have expertise in disciplinary and pedagogic knowledge as well as in questioning skills to promote higher order thinking among their learners - failing which, all other efforts aimed at improving the quality of South African schooling are likely to come up against low ceiling effects (Taylor 2019).

In addition, the programme has revealed the importance of equipping learners with the knowledge and skills to make informed career choices and to prepare them with skills to not only access but be successful in higher education. The South African education system needs to place high value on

career guidance and counselling as an aspect of Life Orientation curriculum. They should employ qualified teachers who have the necessary competence to teach this subject and provide the necessary resources such as computers with internet connection to enable learners to access the career portals, to create their own email addresses and search and apply for bursaries offered in their respective fields.

The final section of the report presents the overall findings and recommendations from the evaluation of the TDP between 2017 and 2019.

PART C: FINDINGS AND RECOMMENDATIONS

The Talent Development Programme (TDP) provides opportunities for Grade 11 and 12 learners to improve their mathematics and science knowledge and skills, prepare for higher education, and provides guidance to help learners decide on their future career paths. In order to enhance the impact of the TDP, it is important to identify ways in which the programme can be enhanced. Based on the findings from the 2017, 2018 and 2019 cohorts set out below, a number of recommendations are made.

Findings

Learner backgrounds

The TDP learners come from predominantly medium and low SES households. This is important as the TDP aims to target such learners, who traditionally would not be able to access additional resources, to provide them with additional support. The parents/guardians of many of the learners have not achieved high educational attainment, which has implications for these learners in terms of the educational capital available to provide them with support in their homes. The majority of learners indicated that they only sometimes speak English at home. As the TDP is presented in English, and these learners will be predominantly taught in English at school, it is important to consider that for many of them English is their second language.

Learner attitudes to mathematics and science

The majority of the TDP learners exhibited positive attitudes towards mathematics and science as school subjects. They value these subjects, enjoy doing them, and are relatively confident in their ability to perform well in these subjects. Respondents also indicated that participation in the TDP has made them more enthusiastic about mathematics and science. Some of the learners have attended extra lessons in one, or both subjects, indicating the desire to perform well in these subjects.

Learners' future aspirations

The majority of learners stated that they planned to attend a University or University of Technology. A large percentage further noted that they were aiming to complete a post-graduate degree, predominantly a Masters or Doctoral degree. This highlights the high aspirations that these learners have in terms of their futures.

Furthermore, many of the learners were interested in pursuing careers in a range of STEM fields. Both of these factors have important implications for the extent and quality of the future STEM workforce in the country.

Developing knowledge and skills: intellectually and personally

The TDP provides a unique opportunity for participants to build on their mathematics and science content knowledge, and their existing skills in these subjects. This is achieved through focusing on a variety of topics, presenting advanced content, and offering a multi-dimensional programme that incorporates an array of activities. The TDP also teaches learners critical thinking, problem solving, and different learning strategies, as well as time management and effective communication. A high

percentage of learners indicated that participating in the TDP had helped them to improve their mathematics and science marks at school.

Beyond this, the TDP provides participants with the chance to enhance a range of interpersonal/social skills, which contribute to both their own development and their interactions with others. Through group work, learners are encouraged to interact with others, recognise the importance of team work, and respect and value diverse opinions.

Participants are also encouraged to share the knowledge and skills they gain through the TDP with others, including their fellow learners once they return to school. In this way, the TDP cultivates a sense of responsibility for participants to give back to their communities.

The programme provides an opportunity for reciprocal learning and collaboration with high performing learners from different schools, but similar socio-economic backgrounds. Learners also highlighted that they became more confident and motivated to succeed as a result of participating in the TDP.

Comprehensive nature of the TDP

The TDP builds on the mathematics and science curriculum taught at schools, and helps learners to better understand concepts they may have struggled with in class, or that may not have been covered in class. Learners found the programme to be beneficial because of the intense focus on such content, and found this to be intellectually stimulating and motivating. It therefore provides a platform for advancing learning, and strengthening mathematics and science skills and knowledge.

The incorporation of classes and tutorials, where learners engage with experienced teachers and tutors provides a further advantage that may not be available in schools. This allows participants the opportunity to get more one on one assistance. Their motivation is also enhanced by their perceptions of tutors as highly qualified, competent and knowledgeable, with a caring attitude.

One of the positive attributes of the programme is the development of learners' critical thinking skills through addressing level four questions, which require critical analysis and evaluation, as stipulated in the Curriculum and Assessment Policy Statement (CAPS). Even though some learners encounter these type of questions for the first time in the programme, the experience of the tutors, coupled with learners' academic abilities, ensures that they master the content.

Higher education preparation

The TDP plays an important role in preparing learners for higher education. Through assisting learners in improving their mathematics and science marks, the programme enables them to gain access to a variety of tertiary institutions and programmes. The TDP also assists learners in applying for bursaries as a means of increasing their access opportunities.

The skills that learners are taught at the TDP, such as time management, working with others and enhancing their learning, are also key aspects which will contribute to their success in higher education.

Career guidance

Career guidance forms a core component of the TDP. Learners are introduced to a variety of careers that are available to them in STEM fields. This guidance is essential in the formation of career goals and pathways for these learners, particularly as they are poised to play a critical role in STEM in the country. A high percentage of learners felt that the TDP helped them to decide on the careers they wish to pursue.

Many learners do not have the means at home or at school to continue their own research or investigations into future educational and career opportunities.

TDP format

The format of the TDP, which consists of three contact sessions per year, and includes Grade 11 and 12 learners, provides an opportunity for consistency, in terms of the interactions that learners are able to have with each other, and with the teachers and tutors. This consistency is important in allowing them time to get to know each other, grasp the content and feel comfortable in their environment. The majority of learners enjoyed participating in the TDP, and felt that it was well structured and well run.

Challenges

One of the major challenges facing the TDP is the recruitment of level 7 learners (those achieving between 80 and 100%), and keeping learners in the programme due to competing intervention programmes. Due to the poor quality of teaching in schools, some learners are lagging behind academically when they enter the programme.

Recommendations

The recommendations presented below are based on the researchers' findings, as well as the opinions of the TDP stakeholders.

- Remain cognisant of the backgrounds that learners come from, in terms of parental education, availability of home resources, and home language. This may require the development of targeted interventions or support strategies for some learners.
- Improve the recruitment and selection process. This will eliminate weaker learners from entering the programme and tutors engaging in differentiated teaching; or consider extending contact sessions, if possible, to allow more time for learners to grasp the content, and for the closure of learning gaps.
- The TDP needs to expand its reach, in terms of geographical spread, due to the large numbers of learners looking for such interventions.
- The allocation of a full day for career guidance activities may be beneficial, rather than allocating time only in the evenings for this. This may incorporate presenting an array of career options to learners, more one-on-one time for learners with the career counsellors, motivational talks from professionals in STEM careers.
- Inviting previous TDP participants to talk about their experiences in their current STEM studies or occupations. This would also allow them to provide current TDP participants with an idea of life in higher education.

- The DSI or organisers should consider donating tablets to the TDP learners preloaded with relevant software, study materials and links to funders. These devices could be used at camp during the tutorials or career guidance activities, or for learners to engage with the content at home. This will also address the lack of computers at centres. Such an incentive may serve to keep learners in the programme.
- The establishment of partnerships between the TDP and the participants' schools may facilitate further learning opportunities for these learners, as well as for other learners in these grades. TDP should also communicate to schools the possible funding opportunities available to selected learners.
- Where possible, organisers, through the provincial coordinators or centre managers, should also engage parents of TDP participants regarding the benefits of the programme, travel arrangements to and from the camps, and security arrangements at the camps.
- The establishment of partnerships between the TDP and local universities to allow local universities to interact with TDP participants in terms of the STEM programmes offered and bursary opportunities.
- Bursaries are often a crucial component of ensuring that learners are able to pursue their chosen career paths. Establishing links through the TDP with organisations and companies that offer bursaries for STEM studies is therefore important. This may provide further incentives for learners to participate.
- The creation of a platform that allows for continued interaction with TDP participants, and among the participants themselves once they have left school, may add value to the continued impact of the programme.

This report has provided an examination of the Talent Development Programme, through exploring the data collected through surveys administered to the 2017, 2018 and 2019 TDP cohorts, as well as interactions with learners and stakeholders. The last section of the report has presented a number of key findings, and related recommendations which may contribute to enhancing the impact of the programme. A second report, focusing on post-school evaluations of the TDP cohorts, will be produced.

References

- Branson, N. and Zuze, T. L. (2012). Education, the great equaliser: Improving access to quality education. In K. Hall, I. Woolard & L. S. Lake, C. (Eds.), *South African Child Gauge 2012*. Cape Town: Children's Institute.
- Caro, D.H., McDonald, J.T. and Willms, J.D. (2009) Socio-economic Status and Academic Achievement Trajectories from Childhood to Adolescence. *Canadian Journal of Education* 32(3): 558-590.
- Case, A. and Deaton, A. (1999). School Inputs and Educational Outcomes in South Africa. *Quarterly Journal of Economics*, 114(3), 1047-1084.
- Diale, B., Pillay, J. and Fritz, E. (2014). Dynamics in the personal and professional development of Life-orientation teachers in South Africa, Gauteng province. *Journal of Social Sciences*, 38(1): 83-93.
- Etikan, I. Musa, S.A. and Alkassim, R.S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1): 1-4.
- Harris, A.L. and Robinson, K. (2016). A New Framework for Understanding Parental Involvement: Setting the Stage for Academic Success. *Russell Sage Foundation Journal of the Social Sciences*. 2(5): 186-201. doi:10.7758/rsf.2016.2.5.09.
- Juan, A., Reddy, V., Zuze, T.L., Namome, C. and Hannan, S. (2016) Does it matter whether students enjoy learning science?: exploring student attitudes towards science in South Africa. (HSRC Policy Brief, March).
- Lieblich, A., Tuval-Mashiach, R. and Zilber, T. (1998). *Narrative research: reading, analysis and interpretation*. Thousand Oaks, California: Sage.
- Maila, P. and Ross, E. 2018. Perceptions of disadvantaged rural matriculants regarding factors facilitating and constraining their transition to tertiary education. *South African Journal of Education*, 38(1): 1-12.
- Polkinghorne, D.E. (1988). *Narrative knowing and the human sciences*. Albany: State University of New York Press.
- Pretorius, S.G. (2013). Teacher effectiveness in the South African context: First steps towards a comprehensive definition. *Journal of Social Sciences*, 36(3): 235-246.
- Roksa, J. and Potter, D. (2011). Parenting and Academic Achievement: Intergenerational Transmission of Educational Advantage. *Sociology of Education* 84(4): 299-321.
- Watt, L. (2016). Engaging hard to reach families: learning from five 'outstanding' schools. *Education 3-13* 44(1): 32-43.

Zuze, L., Reddy, V., Visser, M., Winnaar, L. and Govender, A. (2017). *TIMSS 2015 GRADE 9 National Report: Understanding mathematics and science achievement amongst Grade 9 learners in South Africa*. Cape Town: HSRC Press.

Appendix A: Respondents' favourite aspects of the TDP (2018)

Motivational speakers

"The motivational speakers. They showed us that we can be better people than we already are."

"The motivational speakers because their stories really inspired me and when ever a motivational speaker can to speak to us, I felt a certain drive to achieve."

"When motivational speakers came to visit, because they taught me nothing is impossible in fact the word means I'm possible to achieve anything whatever obstacles thrown in my way."

Classes and tutorials

"The lessons because they helped me to understand better of what I am learning and for me to help the learners from my school to also understand better."

"Classes. The content was more informative and the equipment used triggered a lot of interest."

"The classes were very useful and educational. My understanding of work was greatly improved."

"The classes its different from what we have at school and you learn so much more."

"Tutorials, during tutorials I was able to learn diverse ways of solving problems as enough interaction time between learners was given."

"Tutorials, I enjoyed cooperation in the class, I was able to get help where I struggle and raise my point of view in different problems."

"The 3 hour long tutoring sessions. During those few hours not only did we learn effectively but we looked at different ways of approaching problems. We also discussed more complex problems with respect to certain topics."

"Tutorials. They gave us time to ask Questions and the tutors gave us individual attention. They were able to pay attention to our individual challenges and help us solve them."

"...For me it was a time where i could be somewhat free. During class, you are to take in the one method that is presented to you by whomever is teaching. But during tutorials, it was okay to hear more than one. Above all, our tutorials were pretty informal which meant that it was more than okay to share a few laughs here and then. They were fun."

"Maths classes because they always kept our minds awake and alert"

"Science tutorial because we always worked in groups and everyone participated and we all asked questions and got the help we needed."

"The physical science lessons were my favourite part as they helped me understand the subject better and provided challenges."

“Class presentations. We had a great opportunity to get different information in the most interesting ways. Everyone in the classes had a unique way of relaying what they had absorbed from tutorials and independent studying to the rest of us. It was also a great way for us to get to know each other and it brought life when were a bit drained.”

Interaction with other learners

“Meeting new people with different backgrounds. I was able to interact and become friends with people I wouldn't have met had it not been for TDP.”

“Interacting with other students. Motivates you when you have common understanding and goals.”

“My favourite part was getting to know other people who, similar to myself, who are focused and dedicated to their work, yet do not let it influence their character. Everybody is freely themselves and accept everyone else for who they are. There is almost no judgement and everyone is always eager to help each other.”

“Meeting new people. TDP gave me a platform to build new relationships and taught me how to effectively communicate with others who had different perspectives/ point of views.”
“The way most students were able express their intellectual interests without having to feel isolated, and the way they were genuinely interested in what others had to say without any sense of pride.”

“Being in a classroom of individuals from different backgrounds who have the same drive and dedication to education was refreshing and allowed me to adopt a new and better attitude towards my studies.”

“My favourite part of the TDP was meeting individuals who were just as intelligent and diligent as I was. Each person would come up with their own method to solve a problem. I learnt to appreciate other people's perspectives. Just because they might think differently doesn't mean their wrong, this is why it was my favourite part.”

“Sitting with other kids and listening them tell their stories. It really served as a motivation to me that I can do everything. No goal is too high, with the right attitude and energy it can be done.”

“The group activities. In some areas of the work I was behind, or felt unclear. I felt comfortable enough to ask my peers for help and clarity.”

“When we were doing group work during tutorials because I got to understand things from a different perspective as I did while we were discussing questions whereby everyone get to say their way of understanding. This helped me to be able to approach questions differently so which is a great thing.”

Learning

“Given the opportunity to improve my maths and science because my parents did not receive opportunities like this in their time.”

“During tutorials I learnt and enjoyed mathematics and physical sciences, because we were given enough time to learn, ask questions and understand the real motives behind the

program and what was being required of us to do. We were being built-in mentally and how to do our work effectively."

"Focussing on the topics already covered at TDP and revising it with better depth of understanding. Then after those topics, to then go through new topics to get a boost and better understanding before we learn it at school."

"I like the fact that they were also challenging us with questions from grade 12 which prepares us for grade 12 and also challenged us with questions from different sources which are more challenging from the ones we usually do which also sharpens our minds and makes us to be able to answer different questions we are not used to in the exam"

"Foundation skills. It helped me to identify things that derailed me to achieving my desirable marks in my academics."

"The learning, because at my school, we do not follow the syllabus chronologically the way other schools do and it was a challenge to learn new things, things that other people had already been tested on. I liked how we learned more than what we were taught at school."

"The fundamental skills; it helped to prepare me for exams and life as a whole."

"The fact that we are taught work and then immediately practice it which really helps to ensure understanding."

"... because I had learned new methods of solving problems and covered all the topics that I didn't do at my school."

"It helped me gain confidence in myself. It showed me that I can survive the life of an university student."

"Learning for the whole dayThis was preparing me for varsity life and assisted me to be self-driven ,because of wanting to achieve my goals and objectivesTo be committed and determined ."

Teachers/tutors:

"Being taught by different teachers than my school teachers."

"... and the professor really inspired me."

"...because the teacher made the work amusing and easier for understanding."

Tests/quiz

"The pre- and post-tests. It was great to see how hard work can bring a big improvement in my marks."

Study sessions

"Study time. That was when I received the most help from my peers."

"Study session, you get time to revise your work and better improve your knowledge on it."

Appendix B: What would you tell a friend? (2018)

"I would tell them that what I've learnt from the programme is to be the best that I can be, hence it is mostly involved in Talent Development. I've learnt the importance of partnership, leadership, team work and communication as one of the basic requirements for better progress in doing business (the work given). Another thing is motivation, courage and strength. I've learnt that motivation starts with oneself. You cannot do something just because you see someone else doing it its a matter of doing what's best for you and having courage that you'll succeed in it. Being strong and not losing hope. Success comes from moving from failure to failure without loss of strength. Hence even though I was failing to get some of the answers right I had to stay on my lane and keep on going until I get it right."

"To never give up and it taught me to be persistent and understand the question."

"I have learnt how to keep working hard and stay motivated and even if there are times in your life where you fail at certain things, keep trying because you will eventually get there."

"I have learnt how much investing in your studies can pay off. My marks have improved drastically and k don't think it would've been possible without TDP. I have learnt a lot about how many careers there are out there and how many choices I have, and how hard I have to work to vet there. I have learnt how to manage my time better, how to solve problems faster in math and physics. I have also gotten to know others learners who are like minded and just as curious as I am

"The importance of knowing what you want in life and plenty level 4 questions we don't cover at school."

"I have learned to be consistent in my studies and to seek for help where required."

"That there are many different ways to do one particular thing and that doing well takes a lot of work."

"I have learned how to study and also learned how to be independent not depend on my teachers."

"I was assisted in math and science to improve my overall performance and allow me to get access into a university of my choice."

"I was exposed to a more interactive environment. We worked through difficult content and we revised it, in order to ensure we understand the work."

"I learned that everyone has potential and can achieve his or her goals not based on their background. In the programme I learned many chapters both in maths and science that were not covered at our school, and understood better. I learned that one should work even more harder to achieve 100% in maths and science."

"I have learned how to work to my best abilities and learned how to help others and to encourage them in their schoolwork."

"I have learnt to do my outermost best, I have learnt to manage time properly I have learnt goal setting skills and got a broader understanding of concepts covered in maths and physical sciences .I have gotten myself prepared for varsity life and all the duties expected from me, everything that was an obstacles in my studies before TDP I have managed to look through with a better perspective and

conquere . Ive found my full potential, and learnt to work hard to solve mathematical problems .The tutors have taught me that every problem has a solution”.

“I would say that I learned valuable skills for studying and mastering Maths and Science. I would also say that I got the chance to learn from my peers, important study skills for other subjects as well.”

“I HAVE LEARNED HOW VARSITY LIFE FEELS. I HAVE LEARNED HOW TO COPE UNDER PRESSURE IN CONSIDERABLE SMALL AMOUNTS OF TIME.”

“I learnt how important it is to take your school work seriously and love your school work .I learnt that team work is important for us as youth to succeed, I also learnt that people should work out of their comfort zone so that they achieve more .I have learnt that respect goes a long way when living with people from different backgrounds.”

“I would say it taught me to be a better person and always help those who need help and that the university life will expect much but we should relax and focus.”

“I have learned to use my surroundings to my advantage. I became more motivated than ever to achieve my best and to reach my greatest potential. I have learned to set and achieve goals and manage my time well enough to do so. I have learned that math and science are subjects you need to get the concept of first, and then you can tackle any question there is! I have learned to interact and become an active team member.”

“I have learned that I have the potential to be among the best. I have learned techniques on how to solve level 4 questions in math and science. I have learned to self-motivate and unlock my potential in learning.”

“I have learnt discipline, time management when writing tests, group work, problem approaching skills when solving Science and Maths problems.”

“They taught me everything I need to know to make the right decisions pertaining to my lifelong career.”

“I learned a lot. Not only maths and science but I also got to experience working constantly like it would be expected at university. I got to learn easier ways to deal with problems I struggled with too.”

“I would tell him/her that I've learned a lot when it comes to maths and sciences, not only that. I learned about how our brain work when we study, I've learned about perseverance and persistence. I've learned how to socialize with different people from different schools, different mindset. Also I would tell him/her that I've learned how to collaborate with others.”

“I have learned to be a hard worker, it helped me realise that working hard helps to unlock one's potential and be greater. That the mind is the strongest too and whatever you tell it, it will be stuck in that, so change your mindset, shift your focus and be successful in life.”

“I learned about how to sharpen my skills, the value that lies within helping others. I was taught to always hold on to the basics and that whenever I am stuck I should go back to grade9 work especially in Mathematics. I learned how to be courageous and became a leader. The programme taught how to make friends and get used to working in groups and yeah it fed us alot I even gained weight.”

“Firstly I learnt a lot in Math and science topics that I struggled with. I learnt to let go of my pride and ask for help from people who know. I was the worst in time management skills but now I try to manage my time very well. I learnt to socialize with other kids and lastly ,it may sound cliché but I learnt to NEVER JUDGE A BOOK BY ITS COVER.”

“Firstly ,I learnt that communication is important. Secondly, the programme made me realise that there is no right or wrong answer and we all make mistakes afterwards we learn from them a lot. Lastly I learnt that time management and planning is very important in order for me to achieve what I aim to.”

“I have learned that hard work pays off and if in life you relax someone else is working hard to make their dreams a reality. That as a person who need to always be in your toes and overcome every challenge coming your way.”

“Firstly, I have learnt how to understand the theory behind a certain concept before applying it, so that I am able to use it in higher institutions. Secondly I have learnt how important is it to know how to manage my time without wasting it further more. Thirdly, I now know how important is it for me to study on my own before the teacher could teach the topic ,where it will be a revision for me when he/she start to teach that topic. I have learnt beyond what I have never imagined and expected, and all thanks to the people who have worked as a team so hard to organise the TDP PROGRAMME for us. May the LORD BLESS them.”

“I have learned problem solving skills in advanced Mathematics and science. I have also learned effective studying skills from my fellow TDP participants and tutors. I have learned studying skills and strategies and how to network my brain for changes in my environment. I have also learned how to get along with people from different backgrounds.”

“I received a lot of study material that I was able to apply in preparation for my examinations during the course of the year. It also taught me that even when I think I’m working hard, a lot of people are still working much harder than I am and that helped motivate myself to work harder as well.”

“I learned that when you get together with mass group of people, you'll find that most of you are from different backgrounds and different opinions on a lot of things. Don't let that influence you negatively towards them. You might also find that people will make quick judgement on you. Even though they might dislike, disregard or belittle, stay true to yourself. Individuality is not a bad thing, niether is being different.”

“I had learned how to work as an individual and as a group, I had also learned how the university life is, I had also learned that there is more to understand about physical science and mathematics, and never tell yourself that I know a certain chapter well before you practice more questions about it, I learned that I must work hard to get the best result.”

“I learnt a lot about respecting people's ideas and thoughts.”

“I would tell my peers that TDP programme taught me how to answer and get rid of high level questions both in pure mathematics and physical sciences and also emphasize that I've learned the importance of time management, persistence and perseverance towards my studies.”

“I have received a lot of motivation. I have not just learned how to solve maths and science problems but I have also learned how to build great friendships. I learned how to work well under pressure and the tutorial sessions definitely helped me to do better during the November exams. The TDP team did a great job preparing me for the exams and further studies.”

"I learned some deep mathematics and physical sciences which helped me during my exams .The tutors gave us some very difficult question, which made me realize that maths and physics need hard work .Also I learned to think out of the box and to use my imagination .Time management also, because during exams time is crucial .Most importantly it increased my love for math and physical sciences in an unimaginable way, I enjoy the TDP."

"First and foremost that 100% is attainable with hard work, focus and perseverance. I've learned to work in groups. I've learned to manage my time. I've learned to be courageous and have confidence."

"I learned how to manage time responsibly, speak and present answers with confidence and to work independently and with peers."

"I learned to use my time wisely and study hard. Also I met different people who didnt speak my language so english was the way to communicate and thus during that time I improved my english and I'm even now reading books to improve it."

"I would tell him/her that I learnt to think out of the box. If maybe you come across a question you are not familiar with in the exam or test, try it, dont just give up and say to yourself that its difficult and you cannot do it. Because you will find that the question is easy, it just needs you to apply what you have learnt in the classroom that will make you answer the question. I also learnt to challenge myself with challenging questions from different sources in order to improve my knowledge about something. I have learnt that and it is really working for me and that makes Maths and Science more fun!!"

"I have learned to start taking my work more seriously than before and to ensure that I strive for each and every goal that I have set for myself."

"I have learned that self-motivation goes a long way. It's all about perspective too, if you think something is difficult it surely will be but never stop trying until you get it right."

"I have learnt to stay positive and be able to trust in my own abilities. I've also learnt that there are many opportunities for us as young people. I've learnt how to manage my time and to never stop learning."

"I would say I have learned how to become a confident person in everything I do and not care about those who criticise me. And I have learned the importance of respecting others and have a good relationship with others so that we can work in groups."

"Aside from the obvious - maths and Science- TDP has taught me how to recognise my potentials and achieve my goals. TDP has also given me a sense of community. Most of TDP pushed me past the horizon and taught me how to achieve goals that I once deemed impossible. I am forever grateful."

"I would tell that friend that in TDP, I learned how to think for myself and to not always expect what I studied to be asked directly. I learnt how to set goals and the competition has motivated me to work harder. I would tell that friend that TDP changed my life for the better. As much as my marks don't reflect a major major change, I have seen a change in my marks and the way of understanding things. TDP has taught me how teachers can spoon feed me and that at some point I have to use my brain... on my own. I would not only tell them what I had learned but I would use the knowledge I had gained from the programme and help them improve their knowledge."

"I learned how to grab the bull by its horns."

"There is more strength in a team than an individual."

"I learnt how to be truly independent and to take responsibility for my actions in terms of my education. It also taught me team-work skills and to be confident in asking for assistance as well as giving assistance."

"The programme has taught me the importance of Mathematics and Physical Science in different careers. My marks have improved since I have been part of the programme. I have gained more knowledge of Physical Science and Mathematics in the TDP classes and I am more confident in doing my work now. The programme has also taught me the importance of setting goals and has given me guidance on how I can achieve my goals."

"I have learned that nothing is impossible in math and science, to work hard and always respect time. I have gained confidence in problem solving and that in life you set goals to succeed. I have learned the importance of interacting with others and sharing ideas."

"TDP taught me to always work hard. It showed me how nothing is impossible and everything is doable. They showed me a glimpse of how varsity would be like. It helped me improve my studies and it improved my communication skills with peers. I learnt how to make friends with all different types of people. It mostly motivated me to do the best I can to reach my goals."

"I have learned to think outside the box and to be able to use skills that we are taught and apply them to solve even harder sums when they appear in an examination. which is something I was not able to do at first. At TDP you don't have to be the best and know the answers to everything but you do have to learn and study to the best of your ability. Yes I might get low marks in a pre test or post test that we usually write at TDP but when we do correction in class and when I go back home and start looking at the papers and realising my mistakes and also learning on how to approach that particular question next time, it really helps a lot. and the fact that when I got to class I was way better at solving problems than before and I also got higher marks than before and was able to help other pupils who were struggling like me."

"I learnt various methods to get to answers and solve problems. Additionally I learnt how to reason and check my answers and avoid careless mistakes. I also touched on topics beyond the syllabus at school which motivated me to not limit my learning just to what is taught in classroom, but to do extra research independently."