Science Engagement Projects: Talent Development Programme Report on the 2020 Cohort

May 2021

Sylvia Hannan and Fabian Arends
Principal Investigator: Vijay Reddy
Human Sciences Research Council

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

HSRC
Human Sciences
Research Council

Table of Contents

ABBREVIATIONS AND ACRONYMS

DSI	-	Department of Science and Innovation
DST	-	Department of Science and Technology
HSRC	-	Human Sciences Research Council
LMS	-	Learning Management System
LoLT	-	Language of Learning and Teaching
STEM	-	Science, Technology, Engineering and Mathematics
SUNCEP	-	Stellenbosch University Centre for Pedagogy
TDP	-	Talent Development Programme

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The format of the 2020 Talent Development Programme (TDP), coordinated by Stellenbosch University Centre for Pedagogy (SUNCEP), was altered as part of an emergency response to the Covid-19 pandemic and the consequent lockdown. Due to social distancing protocols the 2020 TDP programme had to move from contact sessions to a digital platform, where learners worked from home. The result was the development of an integrated Learner Management System (LMS), and the provision of the necessary resources (laptops/tablets and data) to learners.

The Human Sciences Research Council's (HSRC) role is to track the TDP participants, and to report on the outcomes of the programme for the period of 2017 to 2022 (Phase 3). Baseline questionnaires were administered to the Grade 11 and 12 learners who participated in the 2020 TDP. This was done in coordination with SUNCEP via the LMS platform. Indicators presented in this report include learners' background information learners, their experiences of the TDP, and the impact of Covid-19 on their learning and well-being.

Talent Development Programme Participants

The TDP learners were selected from schools in all nine provinces, with two thirds of learners from no-fee schools and one third from fee-paying schools. Learners were selected based on their high performance in mathematics and science. Most learners were Black African (81%) and female (51%). They came predominantly from poor to medium socio-economic backgrounds and had limited access to educational resources at home. English, which is the language the TDP is presented in, was spoken often at home by just over a third of learners.

Attitudes towards Mathematics and Science, and educational aspirations

Overall, the participants had positive attitudes towards mathematics and science: they enjoyed both subjects, showed confidence in their ability to perform well in the subjects, and were considering pursuing a mathematics or science-based career. Ninety-nine percent had intentions to pursue an Honours degree or higher in their chosen field.

2020 TDP experience

Most learners had some experience using computers or tablets prior to the TDP, although some had limited experience. The SUNCEP orientation programme was rated highly, and most learners found the TDP smart classroom "very" or "quite" easy to use. Around 60% of the learners had completed at least half of the mathematics and science lessons for the year at the time of completing the survey, and four out of five rated the lessons as "very" useful.

Learners highlighted eight key aspects of the TDP that they felt would impact on their learning during the year: 1) improving their knowledge, skills and achievement; 2) highlighting different questions and ways of answering questions; 3) building on, and extending, their schoolwork; 4) identifying areas in which they require improvement and increasing their confidence; 5) providing interactive support; 6) preparing them for the future; 7) provision of resources, and 8) providing support during the pandemic.

The impact of Covid-19

As all South African learners, the TDP participants experienced a loss of learning time due to school closures. The majority were able to communicate with their teachers during school closures, and they were provided with live/pre-recorded lessons by their teachers. In addition, schools provided learners with other resources, either electronically or in hard copy - learners in fee-paying schools generally had access to more online resources. Learners said they engaged with their schoolwork, completed past exam papers, and

accessed lessons beyond those provided by their schools while they were at home. Most of the learners appear to have a good support system at home.

Learners were anxious about the school they had missed but had continued working during the closure. However, a fifth felt "somewhat left behind" or "completely left behind". Approximately half of the learners personally knew someone who had been infected by Covid-19, and a small percentage had been infected themselves. Just over 40% of their parents/guardians' employment was negatively affected by the lockdown. While most learners felt their families had enough information and resources to manage the impact of Covid-19, a small percentage felt that they did not. Seventeen percent felt that they needed counselling or psychological support regarding the impact of the pandemic.

Recommendations

Overall, the 2020 TDP was successful and SUNCEP responded effectively during this unprecedented period by developing an online TDP platform. Our recommendations to enhance the programme are to:

- Develop a hybrid model for the TDP, incorporating online and face-to-face interaction, in 2022 and beyond,
- Address the spread of TDP schools across provinces – ensuring a more even spread,
- Establish an online network for past and present TDP learners,
- Establish partnerships between the TDP and participants' schools and universities,
- Engage learners' families regarding their involvement in the TDP, and tertiary and career opportunities,
- Incorporate support for learner well-being into the TDP, and
- Continue to provide resources such as laptops/tablets and data.

THE TALENT DEVELOPMENT PROGRAMME

The Talent Development Programme (TDP) is part of the Department of Science and Innovations' Science Engagement suite of projects. The programme was established in 2005 with the aim of enhancing youth's access to science, through identifying and nurturing learners with talent and potential. The programme targets school-going youth with the intention of improving their grades, 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 studies and ultimately science-based careers. The TDP also aims to produce a cohort of school leavers who will be prepared for life in higher education, and provides guidance on Science, Technology, Engineering and Mathematics (STEM) related careers.

The TDP has completed two implementation phases (2005 to 2009, and 2011 to 2016). It is currently in its 3rd Phase, which began in 2017 and ends in 2022. The three phases are outlined in Figure 1. This report presents findings from Phase 3, focusing on the 2020 cohort of TDP learners. Figure 2 outlines the focus areas and selection criteria employed in Phase 3, and Figure 3 highlights the learners included in this phase and the shift in the TDP model in 2020.

Figure 1: Phases of the TDP

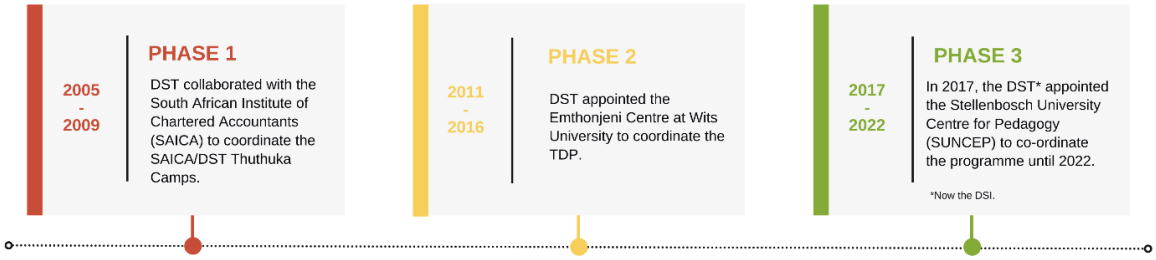


Figure 2: Phase 3 focus areas and selection criteria

Focus areas

For Phase 3, SUNCEP identified three focus areas for the TDP:

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

School selection

The selection of schools is done in collaboration with provincial education authorities The beneficiaries are selected from public ordinary schools which may meet 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.

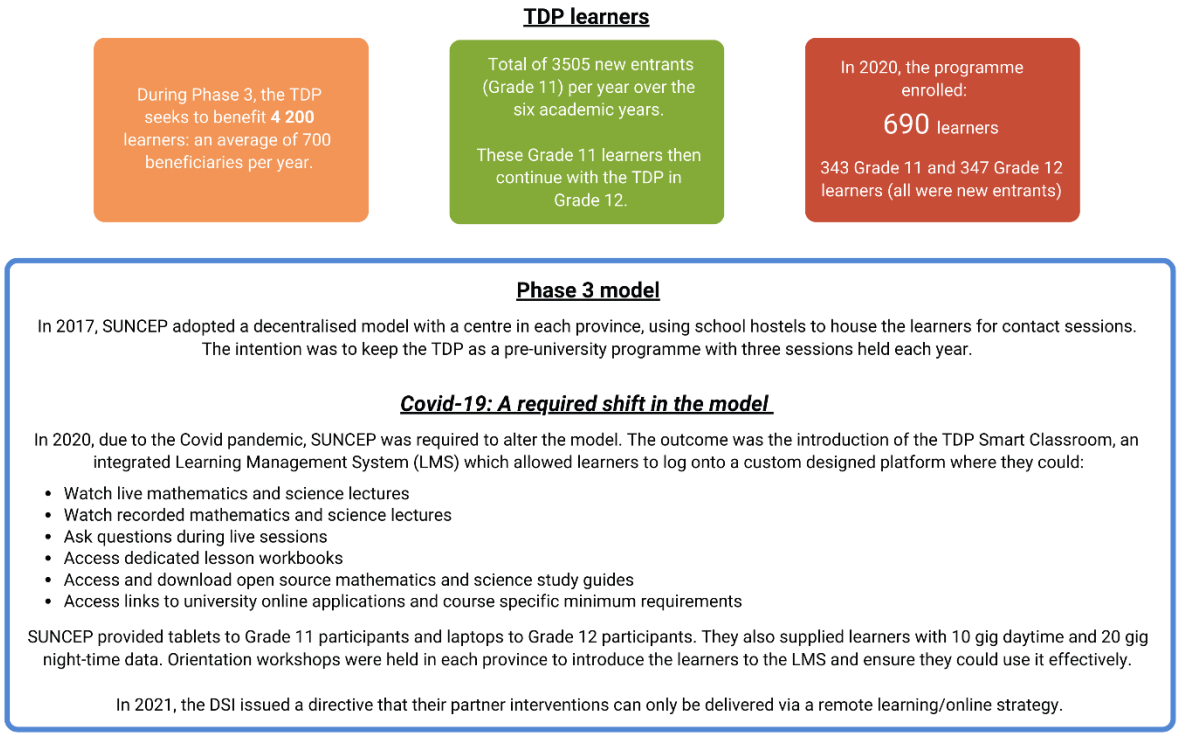
Learner selection criteria

SUNCEP aims to include high performing beneficiaries from working class backgrounds and families where tertiary education was not attainable in the past. The selection of learners is done in collaboration with provincial education authorities, and is based on academic performance. Learners must:

- Have taken Mathematics and Physical Sciences, and achieved at least 65% in each subject, in their previous grade (Grade 10 or 11).
- Preference is given to those learners involved in extra-curricular mathematics and science activities
- Provide their own written motivation
- Provide at least one letter of support from a school teacher or principal

In addition, TDP beneficiaries should be South African citizens or those who have permanent residence status.

Figure 3: Phase 3 learners and a shift in the model



Monitoring and tracking of TDP participants

The Human Science Research Council (HSRC) is responsible for monitoring the impact of the TDP on participants in terms of their experience, knowledge and skill gains, as well as their educational aspirations and career choices. This has been done through conducting tracking studies of the TDP participants in Phase 1, 2 and 3 (current phase).

The report

This report presents the baseline information that was collected from the 2020 cohort of learners. Part A includes a description of the cohort's demographics, attitudes to mathematics and science, and educational aspirations, as well as their 2020 TDP experiences. Part B focuses on the impact of the Covid-19 pandemic and resultant school closures on the participants' learning and well-being. Part C provides overall findings and recommendations regarding the way forward.

PART A: THE 2020 COHORT

Introduction

The HSRC administers surveys to the participants of the TDP for the two years that they attend the programme. These are used to collect predominantly baseline information, including information about 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, their educational aspirations, and their TDP experiences. Given the unusual circumstances of 2020, learners were also asked questions related to the impact of the Covid-19 pandemic on their learning and well-being.

Methodology

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 the educational attainment and aspirations of participants?
- What are the learners' experiences of the TDP?
- What are the learners' experiences of Covid-19?

The 2020 cohort consisted of Grade 11 and 12 learners, all of whom were new to the programme. Due to the introduction of the TDP Smart Classroom, SUNCEP was able to load the HSRC survey directly onto the platform and track its completion by the learners. SUNCEP registered 690 learners in 2020 (343 Grade 11 and 347 Grade 12). A total of 568 responses were received: meaning an 82% response rate.

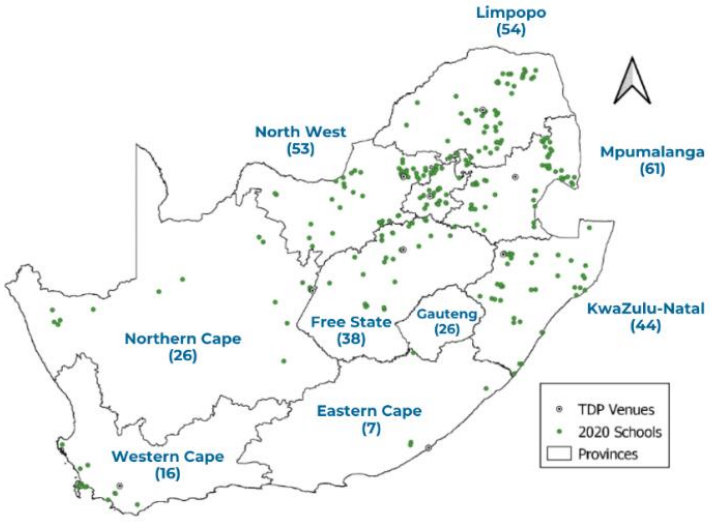
Who attended the Talent Development Programme?

The first part of this section provides an overview of all of the learners that attended the TDP during 2020.

Schools attended by the 2020 TDP cohort of learners

SUNCEP provided the HSRC with a list of the schools attended by the 2020 TDP cohort of learners in each province. Figure 4 provides a map of the locations of the schools and shows the number of schools in each province.

Figure 4: Location of schools attended by the 2020 TDP cohort[1]

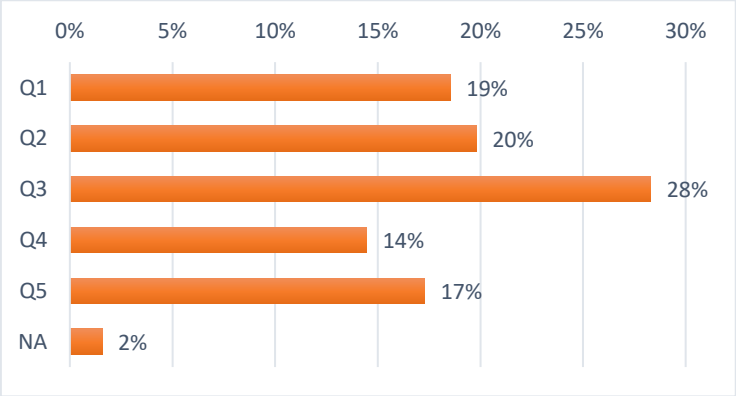


The number of schools that the TDP learners came from varied across provinces. Mpumalanga (61) Limpopo (53), North West (53) and KwaZulu-Natal (44) had representation from the highest number of schools, while in Free State (38), Gauteng (26) and Northern Cape (26) learners were selected from fewer schools. Western Cape (16) and Eastern Cape (7) were the two provinces with the least schools represented.

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. Schools that are ranked as quintiles 1, 2 and 3 are more resource constrained and are therefore allocated a higher state subsidy: these are categorised as no-fee schools. Quintile 4 and 5 schools are those that are more affluent, and therefore do not require the same level of subsidisation. Generally, learners from poorer backgrounds attend quintile 1, 2 and 3 schools, and learners from more affluent backgrounds attend quintile 4 and 5 schools. The quintile ranking of a school therefore provides an overview of the school's characteristics and learners' socio-economic background. Figure 5 shows the schools attended by the TDP participants by quintile.

Figure 5: Type of schools attended by the 2020 TDP cohort



[1] The HSRC researchers used the school name variable to establish a link between the 2020 cohort datasets and the Department of Basic Education Schools' Masterlist. 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.

Two thirds (67%) of the schools were quintile 1, 2 or 3 schools, while just less than a third (31%) were Quintile 4 or 5 schools. It is promising that a large portion of learners come from quintile 1 to 3 schools. These learners may not have access to the same level of resources and support as learners attending higher quintile schools; and therefore, the support provided by the TDP will provide them with better learning opportunities and assist them in reaching their academic and career goals.

Characteristics of TDP learners

The following sections present the findings from the 568 survey respondents only: they are referred to as learners or participants in the rest of the report.

Participants per province

In 2020 learners were selected from all nine provinces. There were between 71 and 83 learners registered in each province in the full 2020 cohort. Table 1 provides the percentage of learner responses per province in 2020. The survey was completed by a minimum of 53 learners in each province, with the least responses being from Mpumalanga and the most coming from the Northern Cape (73).

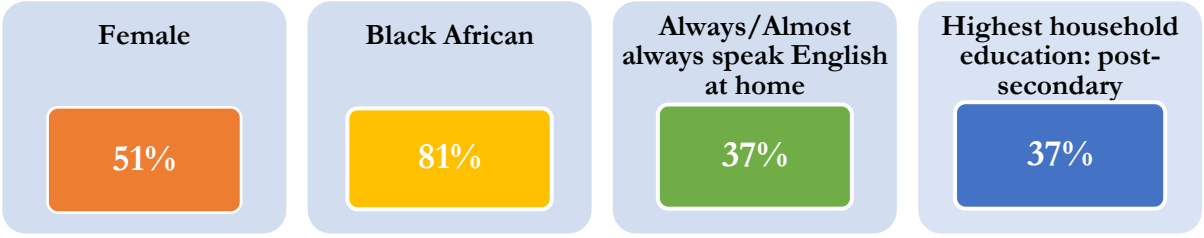
Table 1: Percentage of learners per province

Province	*% learners*
Eastern Cape	11%
Free State	11%
Gauteng	11%
KwaZulu-Natal	11%
Limpopo	12%
Mpumalanga	9%
Northern Cape	13%
North West	10%
Western Cape	12%

Profile of TDP learners

The split between Grade 11 and 12 learners was almost even, with slightly more Grade 11 (54%) learners responding. Figure 6 provides a summary of key demographic information. The profile of these learners shows that the programme is achieving its goal of selecting beneficiaries from working class backgrounds and families where tertiary education has not been attainable in the past. This is explored further in the following sections.

Figure 6: Profile of learners that responded



Home resources

To get a sense of learners' socio-economic backgrounds, participants were asked whether they had a range of resources in their homes (Figure 7): 1) home assets, which most learners would have access to in a house; 2) educational assets, that learners would be able to use for educational purposes; and 3) services provided externally by another party (water and electricity supply).

Figure 7: Home resources

Asset type	Household Resources	%
Home Assets	Own cell phone (not a smart phone)	21%
	Own smart phone	78%
	Own room	60%
	MNET or DSTV	73%
Educational Assets	Internet connection (besides the data provided by SUNCEP)	37%
	A computer or tablet (other than the one issued by SUNCEP for the TDP)	47%
	Study desk/table for own use	58%
	Dictionary	78%
Services	Hot running water from a geyser	42%
	Flush toilets	73%
	Running tap water	87%
	Electricity	96%

More than half of the learners had access to most resources. In relation to home assets, 99% of learners had either their own cell phone that was not a smart phone (21%), or their own smart phone (78%). Sixty percent had their own room - that would provide them with the required privacy to conduct their schoolwork and studies uninterrupted, and almost three quarters had access to MNET or DSTV, a paid TV channel, which would provide access to more educational programmes.

Due to the new TDP format adopted in 2020, SUNCEP provided learners with either laptops (Grade 12) or tablets (Grade 11), as well as data. The question therefore asked about access to an internet connection, and computer/tablet, besides that provided by SUNCEP. Just more than a third of learners had an internet connection at home, and just less than half had a computer or tablet. These are important assets which would allow learners to complete their schoolwork and access online educational resources.

Home language

Learners were asked how often they spoke English at home (Figure 8). Just over a third (37%) usually (always/almost always) spoke English at home, while just over half reported "sometimes" speaking English. Learners were also asked about the language spoken most often at home (Figure 9). The most common were IsiZulu, English and Setswana, followed by IsiXhosa and Sesotho. Although English was the second most common language, it was the home language of a small percentage of learners (17%). Many of these learners therefore have English as their second, or third, language.

Figure 8: Extent to which English is spoken at home

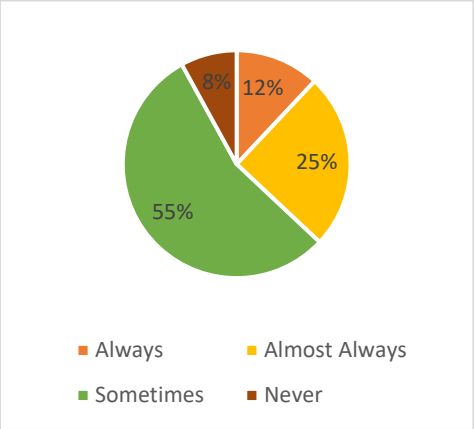
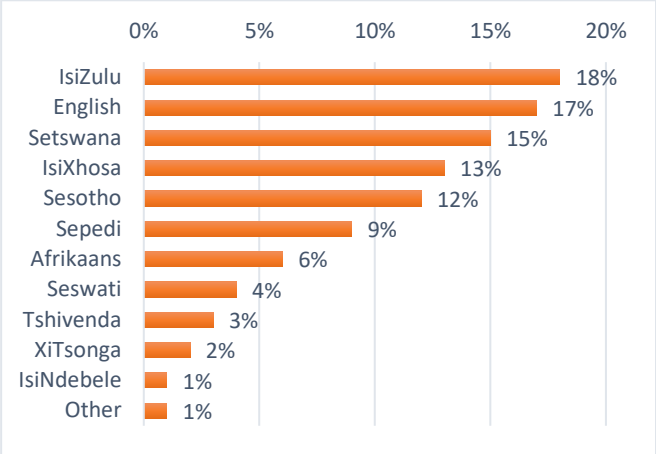


Figure 9: Home language

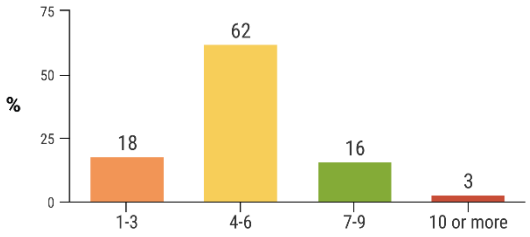


The home language of the learners, and the extent to which they speak English at home, has implications for the TDP, as English is the language in which classes and tutorials are delivered. It is therefore important to bear in mind that some learners may struggle with the material in English and may require extra assistance. This is particularly important due to the interruptions in schooling that learners experienced in 2020, which may have longer term effects on their learning. Difficulties with the Language of Learning and Teaching (English or Afrikaans) would have been compounded with the increase in digital instruction, where learners would not have had opportunities for code switching.

Home environments conducive to doing schoolwork

In the 2020 baseline questionnaire, we asked learners about their home working environment. This was particularly important as many of these learners spent a large portion of 2020 working at home due to school closures. The extent to which learners are in a home environment that is conducive to learning is an important consideration, as this will have an impact on their levels of completion and engagement with the TDP tasks.

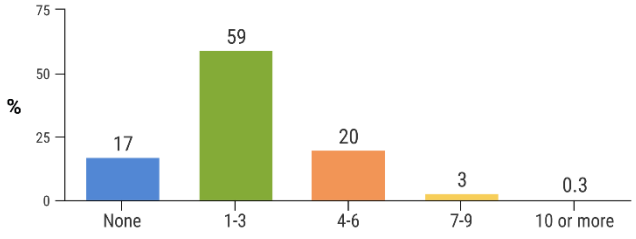
Number of people living in house (%)



Around two thirds of respondents lived in a house where there were four to six people, and 19% lived in homes where there were at least seven people.

A quarter reported that there were four or more people at home during the day.

Number of people home during the day (%)



59%

reported having a quiet space to work at home without being interrupted. This would allow for an environment more conducive to learning.

Parental education

Parental education is an indication of socio-economic status and provides important information about learners' home environments. 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). The highest levels of household education are presented in Table 2. A third of the learners indicated that the highest level of education completed was Grade 12 (matric), and a further third had parents/guardians that had attained a post-secondary qualification. Two thirds come from moderately well-educated families; while 17% are from homes where their parents/guardians only completed Grade 9 or did not go to school.

Table 2: Highest level of household education

	Highest level of household education (Mother or Father)[2]
Less than Grade 12 (Matric)	17%
Completed Grade 12 (Matric)	33%
Completed post-matric certificate/diploma	18%
Completed first degree or higher	19%

Summary

Learners were selected across the different school types, with the majority coming from less resourced environments. However, in some provinces learners were selected from very few schools, limiting the scope of the TDP in those provinces. The participants were largely Black African individuals, with just over half being female. This is important in relation to the goals of the TDP.

More than half had access to various home and educational assets, as well as externally provided services. Sixty percent had their own rooms, which would provide privacy for studying. Just less than half had access to a computer or tablet, and just more than a third reported having an internet connection, other than that provided by SUNCEP. These are essential assets that allow learners to access additional educational resources that will enhance their studies. Overall, the level of home resources they had access to is slightly higher than the majority of South Africans. This likely contributed to their higher achievement, facilitating access to the TDP.

Almost two thirds of learners reported only sometimes or never speaking English at home, and 17% reported English as their home language. It is important to consider that some learners may struggle with the TDP material in English to some extent and may need extra support to grasp the material. This is particularly relevant with interactions becoming increasingly digital.

Approximately a third of the learners had parents/guardians with a post-secondary qualification, while the majority had a matric qualification or less. The TDP achieved the goal of targeting high performing beneficiaries from lower/medium SES or working-class backgrounds, and families where high levels of tertiary education have not been attained. Some of these learners may have limited support at home in terms of educational capital. Out of school programmes like the TDP offer additional support to learners to improve their academic performance.

[2] Just over a third were not sure of the level of education achieved by their father, and 15% were not sure of their mother's level of education. Information provided by learners about parental education levels must be read with caution, as it may be inaccurate.

Learners' past (attainment performance), present (attitudes), and future (aspirations)

Educational attainment in mathematics and science

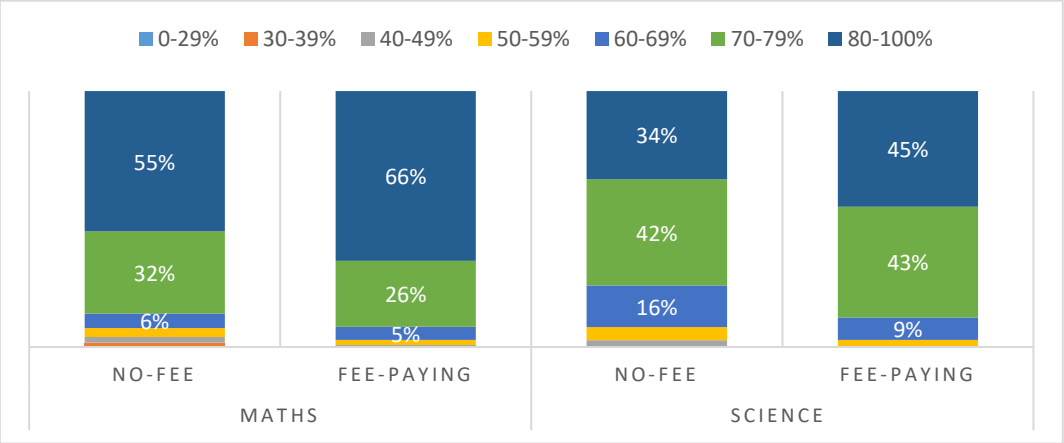
We asked learners to provide their mathematics and science examination results from the previous academic year (Grade 10 or 11). Most had achieved a B or higher for mathematics (91%) and science (81%) (Table 3). This highlights that the TDP participants are talented learners, and that they have the potential to pursue, and excel in, STEM tertiary studies and careers.

Table 3: Learners' mathematics and science achievement in the previous academic year

	Mathematics	Science
A (80-100%)	61%	39%
B (70-79%)	30%	42%
C (60-69%)	5%	13%
D (50-59%)	3%	4%

When looking at the previous year's results by school type, it is evident that more learners in fee-paying schools achieved between 70 and 100% in mathematics and science than learners in no-fee schools (Figure 10). It is however, encouraging that learners in no-fee schools are also performing well in these subjects.

Figure 10: Learners' achievement in the previous academic year by school type

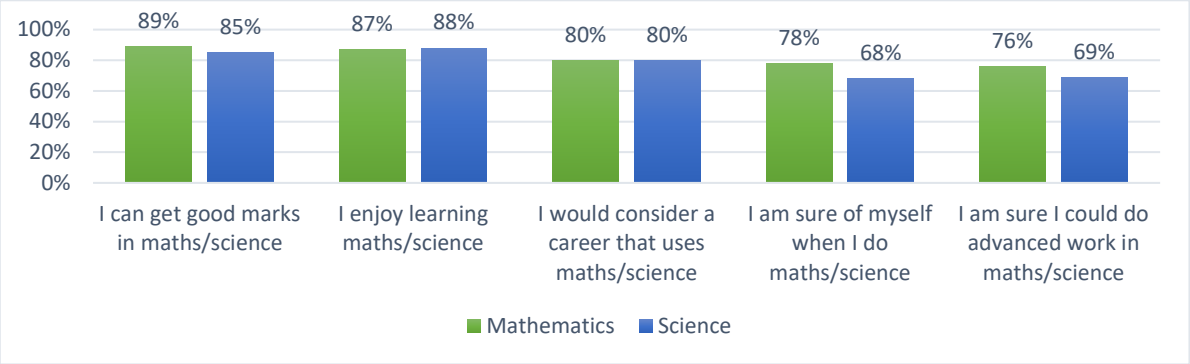


Attitudes to maths and science at school and as career pathways

Studies have shown that learners with positive attitudes towards mathematics and science achieve higher average test scores (Juan, Reddy, Zuze, Namome and Hannan, 2016; Zuze, Reddy, Visser, Winnaar and Govender, 2017[3]). In general, the TDP participants exhibited very positive attitudes towards mathematics and science: being confident when doing these subjects, and in their ability to perform well in them. They enjoyed learning these subjects at school and would consider pursuing a career in mathematics or science. Around 70% felt that they could do advanced work in mathematics and science. Figure 11 shows the percentage that agreed or strongly agreed with each of the statements regarding mathematics and science. These findings highlight their confidence in, and enjoyment of these subjects.

[3] 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).
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.

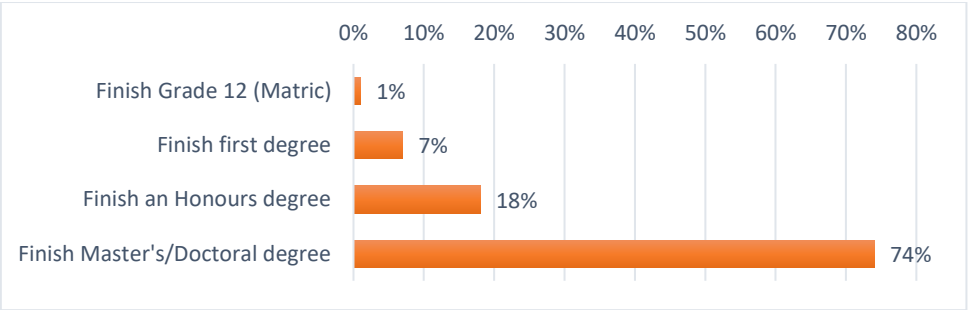
Figure 11: Attitudes to mathematics and science



Educational aspirations

Learners were asked about their post-secondary educational aspirations (Figure 12). Almost all intended to finish at least a first degree, with 18% planning on obtaining an Honours degree and almost three quarters (74%) setting themselves the goal of finishing a Master's or Doctoral degree. This emphasises the high educational aspirations of the TDP learners (although some may be overambitious); which is positive in terms of attaining the TDP aim of encouraging access to tertiary education.

Figure 12: Educational aspirations of learners



Summary

The learners that are selected for the TDP are those that have performed well in mathematics and science. Overall, learners had positive attitudes towards mathematics and science: being confident in their ability in the subjects, enjoying the subjects, and considering mathematics or science-based careers. In addition, 99% intended to pursue a tertiary education, with the majority aiming for an Honours degree or higher.

Learners' experiences of the TDP

Pre-existing computer skills

Learners were asked whether they had used a computer or tablet prior to the TDP to gauge their existing technological skills which would impact their ability to effectively engage with the integrated LMS. The majority had used a computer or tablet before, although 43% noted they had only worked on these devices a few times before[4]. Around 40% had used these devices to access the internet and to complete their schoolwork: both of which would be key for their participation in the TDP. Seventeen percent had used

[4] Forty-seven percent had computers/tablets at home, besides those supplied by SUNCEP.

them to play games. However, the 60% of learners who had only used these devices a few times or had not worked on computers before may have experienced some challenges in working with the LMS, thus highlighting the importance of the orientation provided by SUNCEP.

Often worked on a computer/tablet	40%
Worked on a computer or tablet a few times before	43%
Had not worked on a computer/tablet before	17%

TDP orientation

As noted earlier in this report, SUNCEP presented orientation sessions to assist learners in using the smart classroom. Learners were asked to rate the orientation that they received from 1 (poor) to 5 (excellent). Ninety-four percent of the learners rated the orientation as a 4 or 5, with just over two thirds rating it as excellent. This highlights a largely successful orientation provided by SUNCEP, which would enable participants to effectively engage with the LMS and thus have a successful TDP experience.

Mathematics and science lessons

Learners were asked how many mathematics and science lessons they had completed when they answered the survey to gauge how much time they had spent on the integrated LMS platform. The total number of lessons available in 2020 were 14 for Mathematics and 12 for Science. The majority of learners had completed at least five mathematics (90%) or science (88%) lessons, with around 60% having completed seven or more lessons for each subject. They were then asked to rate these lessons in terms of their learning – 83% rated them as being "very useful", while a further 17% rated them as being "somewhat useful".

In order to delve deeper into the impact of the lessons on learning, the following open ended question was asked: *"In what ways do you think the TDP smart classroom lessons will assist in your mathematics and science learning this year?"*. An overview of the key aspects highlighted by learners, as well as a selection of quotes, are presented in Figure 13 under the following headings:

1) Improving their knowledge, skills and achievement;
2) Highlighting different questions and ways of answering questions;
3) Building on, and extending, their schoolwork;
4) Identifying areas in which they require improvement and increasing their confidence;
5) Providing interactive support;
6) Preparing them for the future (university and careers);
7) Provision of resources, and
8) Providing support during the pandemic (school closures).

Examples of further learner responses can be found in Appendix 1

Figure 13: Ways in which the lessons will assist in learning

1. Improve knowledge, skills, & achievement

Learners felt that the TDP would help them to improve their knowledge and skills related to mathematics and science, allowing them to tackle more complex problems and improving their cognitive function. This would ultimately play a role in improving their achievement in these subjects, helping them achieve the high marks that they strive for.

"I'm now able to tackle everything regarding mathematics and science my marks will improve a lot".

"It will assist me by giving me lessons on math and physical science, improving my problem solving and critical thinking skills".

2. Different questions & ways of answering

Learners felt the TDP would encourage out of the box thinking, highlight different problem solving methods, and ways in which questions may be asked, as well as expose them to more higher order questions. This in turn would help them prepare for exams.

"It gave me a better understanding of my work, and gave me a different view on how to approach certain questions and answer them, as well as showed different ways a question could have been asked".

"they use typical exam questions which will help me learn ways to attempt some questions and they give us useful tips on how to do these questions and how practise them".

3. Build on/ extend schoolwork

Learners highlighted that the TDP would play a role in reinforcing work that was covered during school, as well as focusing on some aspects that were not covered in school; therefore both building on, and extending, the school coverage of mathematics and science.

"The TDP Smart classroom reinforces the topics that I have been taught during class and I am able to refer back to these lessons as I please".

"But the TDP lessons reinforce and sometimes teach us what we learnt or should have learnt at school".

4.Improvement, increasing confidence

Learners noted that the TDP would assist them in identifying their own shortcomings, common mistakes they make, and areas where they required further work and improvement. This would assist them to overcome some of their anxieties in mathematics and science, and increase their confidence in these subjects.

"In my opinion, the TDP smart classroom helped me a lot in overcoming the anxiety when approaching complex MATHEMATICS and PHYSICAL SCIENCES problems".

"The lessons will help me progress in these subjects, as I can focus more on my shortcomings in certain areas and better my school results".

5. Interactive support

The opportunity for interaction with lecturers and tutors was also highlighted. Learners felt they would be able to explain concepts clearly, provide support, highlight different strategies, and inspire confidence in the learners.

"The lectures are the best and they are far better than my teachers because they are always organized and even though they always try to summarize some of the topics they give a lot of important information and give me smart strategies".

"...taught it's really amazing knowing that I have a tutors from TDP that is able to explain things clearly. I am just able to understand and it been really helpful as the pressure is not too much anymore".

6. Support for the future

Learners were confident that the TDP would help them to achieve the necessary requirements to enter university and study their chosen field. Some also noted that they hoped to receive a bursary for their tertiary studies as a result. They also appreciated the career support materials provided.

"Career Support materials are also provided which have helped me in planning and decided on the career path that I want to follow".

"TDP Smart classroom definitely enhances my knowledge when it comes to maths and science, and which result in better marks and not only for going to grade 12 but also for as part of the admission requirements at a university".

7. Resource provision

Learners noted that the many easily accessible resources provided through the smart classroom would assist them in their learning, particularly as they would be available for revision. They also noted that the resources were well categorised by topic which would assist in revision.

"TDP has provided me with a tablet including monthly data for the internet connection of which I didn't have all along and it is truly helping a lot because i can now do school researchers and watch other tuition videos or visit online sites that specialise with the subjects that I am doing".

"...I can resume or rewind to clear a confusion unlike in class where some of my classmates would laugh at my question".

8. Pandemic support

Some learners emphasised that the TDP was extremely helpful during school closures amid the Covid-19 pandemic. It helped them keep up to date with their school work, as well as provided them with additional support in mathematics and science, allowing them to aim to either maintain consistent marks or even improve their performance in the absence of normal schooling.

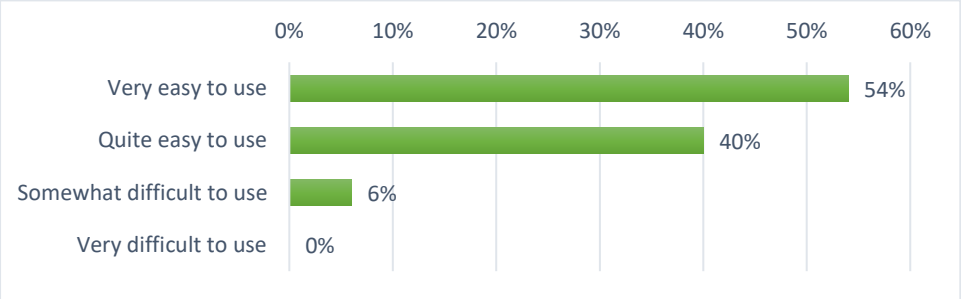
"I think it will greatly improved my Mathematics and science marks and assist me with keeping up to date in my school work especially during this covid 19 pandemic".

"This year was quite rough during the lockdown our teachers couldn't reach us because of the lack of resources in our school, I had to self-teach myself a lot of schoolwork and I didn't have someone to ask for help but TDP gave me the platform...".

Smart Classroom use

Learners were asked to rate the smart classroom in terms of ease of use (Figure 14). Ninety four percent found the platform "very/quite easy to use". An accessible and easy to use platform was crucial in assisting learners in gaining the full benefits of the TDP, as the usual face-to-face interactions were not able to occur.

Figure 14: Rating of smart classroom use



Summary

Most learners had some experience using digital devices such as computers or tablets before. The orientation programme provided by SUNCEP was rated highly by the learners, emphasising its importance in preparing learners for the new 2020 TDP format. The majority also found the TDP smart classroom "very" or "quite" easy to use.

Most of the learners had completed at least five mathematics and science lessons, and around 60% had completed at least half of the available lessons at the time of completing the survey. The responses thus relied on information from learners who had experience with the LMS. Learners rated the completed lessons, with four out of five finding the lessons to have been "very" useful. This shows that learners benefitted from engaging with the lessons on the LMS. Learners highlighted eight key aspects of the TDP that they felt would impact on their learning during the year.

PART B: The impact of Covid-19

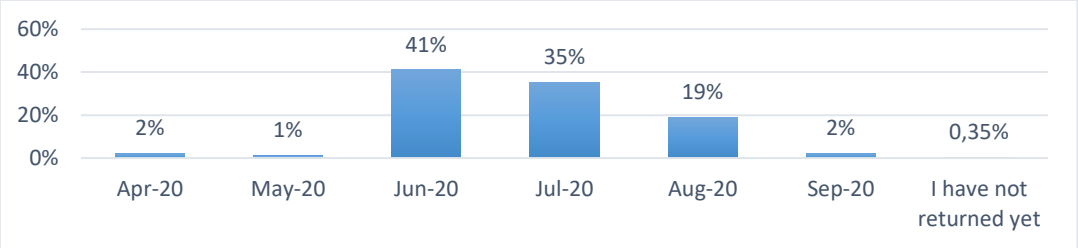
The Covid-19 pandemic had a significant impact on learners as school closures affected the amount of time they were able to spend in school in 2020, and thus determined the types of interactions they had with their teachers and peers. Additionally, many learners were impacted financially and emotionally by the effects of the pandemic. We thus included a set of questions on the impact of Covid-19 and school closures on participants' learning and well-being.

Educational impact

School closures

Learners were asked when they returned to school following the initial school closures (Figure 15). The learners' return to school was staggered, with 41% returning to school in June, and 35% in July[5]. One quarter returned later than the official opening dates. This highlights the impact on learning experienced by the TDP participants during this time. The role of the TDP, particularly in assisting learners in mathematics and science, and providing digital resources, thus became even more important.

Figure 15: Learners' return to school



School-learner interaction during closures

Continued and frequent communication between teachers and learners would have been crucial to ensure continued progress. Most learners (87%) were able to communicate with their teachers via WhatsApp, 16% contacted their teachers via telephone and 14% communicated with their teachers via e-mail[6]. Twelve percent reported having no communication with their teachers.

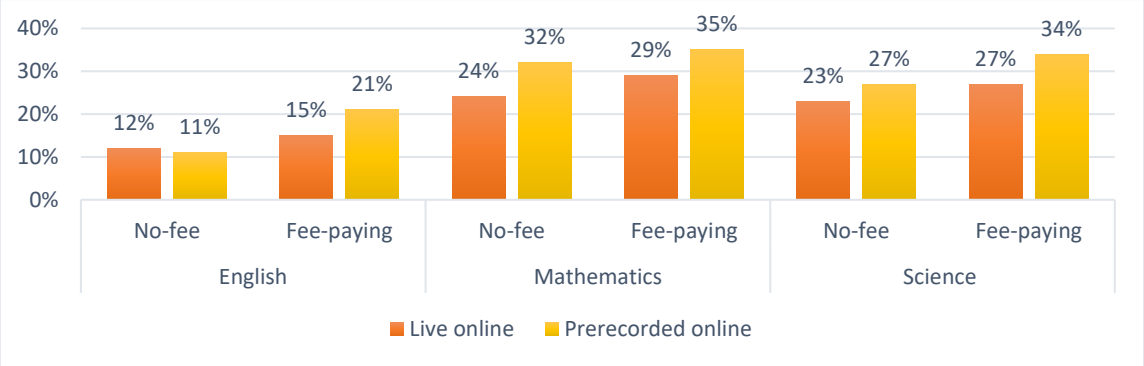
Learners were also asked whether they were provided with live, and/or pre-recorded, online lessons, by their teachers in English, mathematics and science, during school closures (Figure 16). Around a third of learners had access to live online lessons in mathematics and science, with only 16% reporting access to such lessons for English. A higher percentage were able to access pre-recorded lessons online: 51% for mathematics, 43% for science, and an only slightly higher 18% for English. The period during which learners had the highest level of access to online lessons was from April (48% had access to online lessons, whether live or pre-recorded) to May (48%). As learners began to return to school, the provision of these

[5] The official return date for Grade 12s was the 8th June 2020 and Grade 11s returned on the 6th July 2020.

[6] Learners were able to select more than one option.

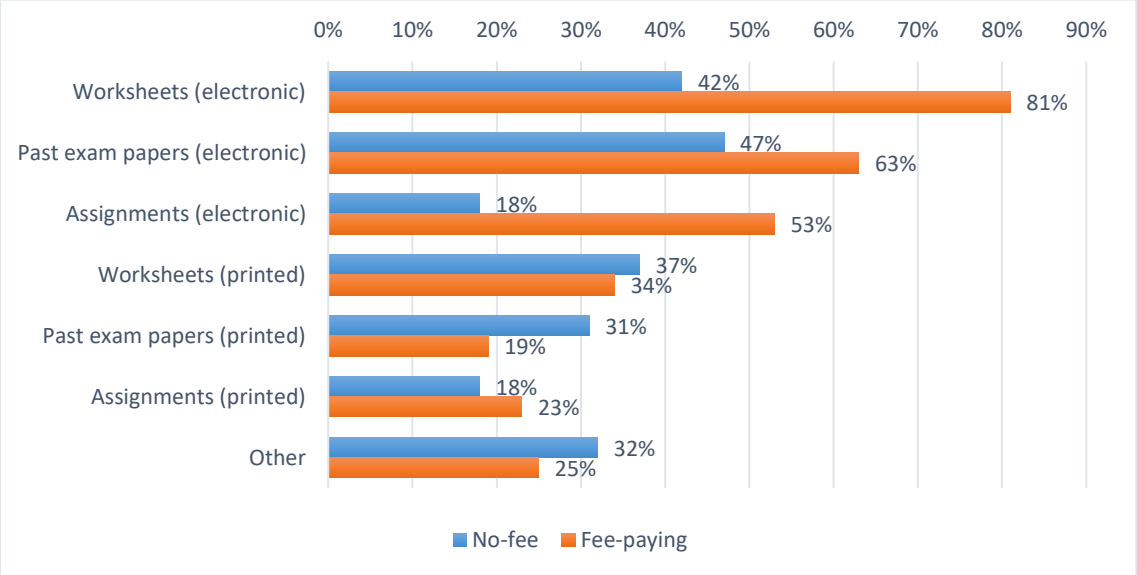
lessons decreased between June (37%) and September (19%). Learners from fee-paying schools had greater access to both live and pre-recorded online lessons, although the learners from no-fee schools were not far behind in terms of their access to online lessons (Figure 16). This is positive for those learners in no-fee schools as they would have had less access to resources at home.

Figure 16: Provision of online lessons, by school type



Learners were also asked about a range of other resources provided by their teachers - the most common resource was electronic worksheets, followed by past exam papers sent electronically, printed worksheets and assignments sent electronically. Printed assignments were provided to 19% of learners. The electronic resources were provided to higher percentages of learners in fee-paying schools, while generally learners in no-fee schools received more printed resources (Figure 17).

Figure 17: Resource provision by teachers during school closures, by school type

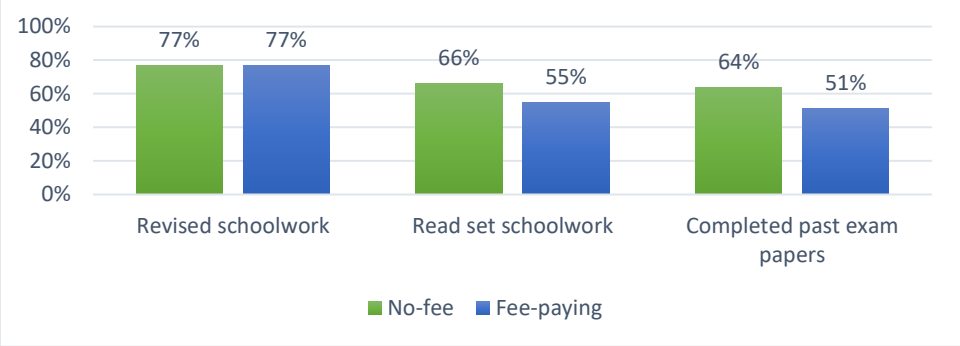


The learners may have had access to more than one of these resources, and it is reassuring that teachers continued to find ways to support learners during school closures. This support would have been enhanced through the resources provided on the TDP LMS, providing an advantage for the TDP learners.

Self-motivated learning

For learners to make progress during school closures, it would have been important for them to undertake learning activities on their own. Therefore, we asked, besides the work provided by their teachers, what activities learners did at home. Just more than three quarters reported revising their schoolwork in both no-fee and fee-paying schools, while higher percentages of learners in no-fee schools reported reading their set schoolwork and completing past exam papers (Figure 18).

Figure 18: Self-motivated learning, by school type



Learners were also asked how they accessed content in English, Mathematics and Science, besides the material that was provided by their teachers (Figure 19)[7]. Accessing lessons online and watching lessons on TV (DSTV) were the most common methods used to access content, particularly in Mathematics and Science. A small percentage of learners also accessed lessons via the SABC channels and listened to lessons on the radio. English was the subject that learners accessed the least extra content for.

Figure 19: Other means of accessing subject content during school closures

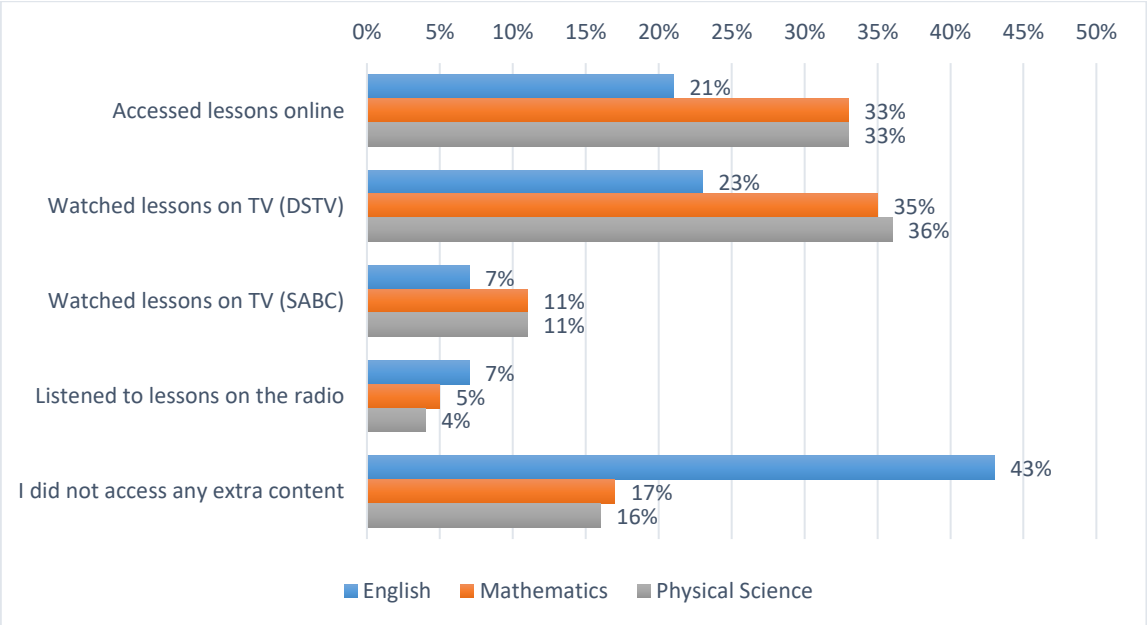
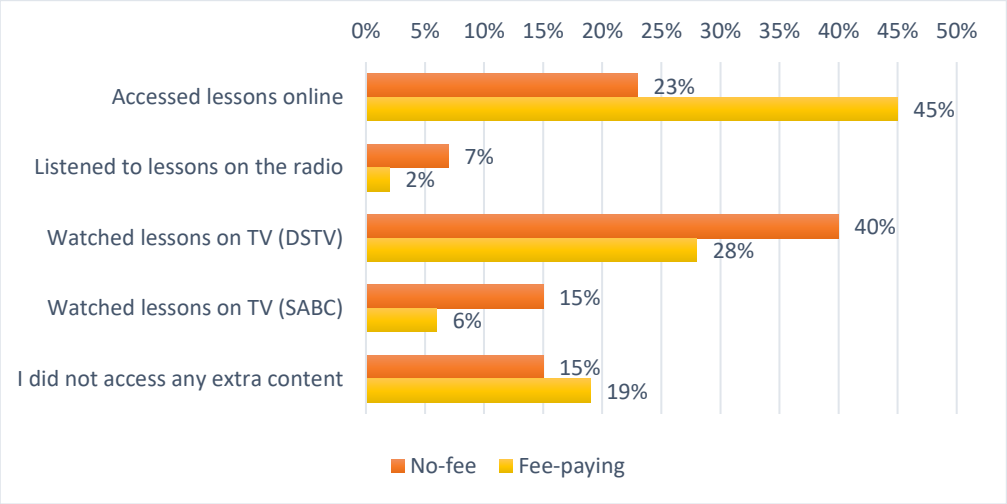


Figure 20 shows that learners from fee-paying schools were more likely to access mathematics lessons online, while those from no-fee schools more often listened to lessons on the radio and TV (SABC and

[7] They could select one option, as the most common form of access.

DSTV). A slightly higher percentage of learners from fee-paying schools did not access any extra content in mathematics. Similar patterns were found for accessing science and English lessons.

Figure 20: Other means of accessing mathematics content, by school type

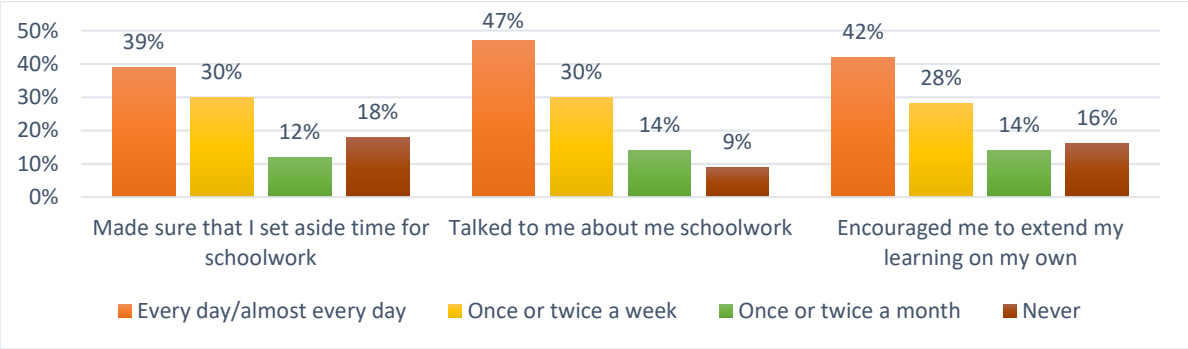


The learners found different ways of accessing content, particularly for the key subjects of mathematics and science. This highlights that the TDP learners are highly motivated to continue learning on their own.

Home support

Support at home played an important role in keeping children on track with their learning during school closures. We therefore asked learners how often someone at home; whether their parents, guardians, or siblings; had 1) made sure they set aside time for homework, 2) talked to them about their schoolwork, and 3) encouraged them to extend their learning on their own, during school closures (Figure 21).

Figure 21: Parental involvement in schoolwork and learning

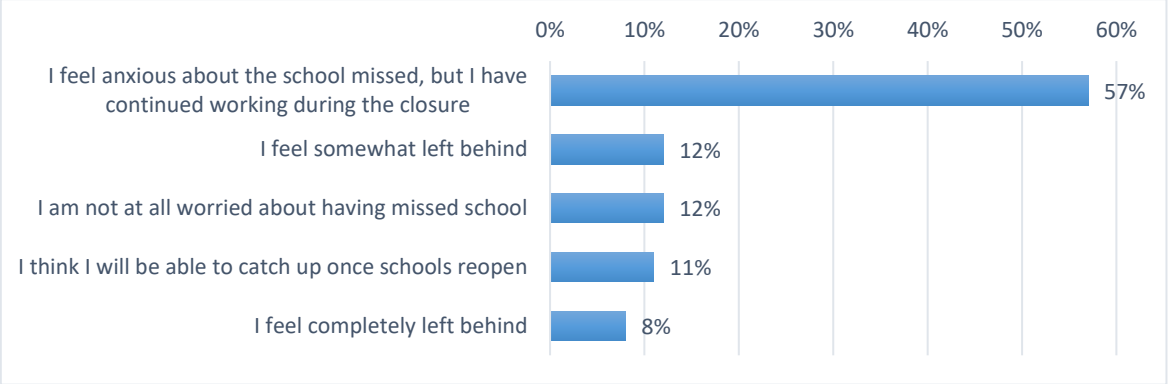


Three quarters of learners appear to have a good support system at home, that would have assisted them in continuing their learning during school closures. Just more than two thirds reported that someone at home made sure they set aside time for their homework at least once or twice a week. Just over three quarters had someone talk to them about their homework often; and 70% were often encouraged to extend their learning on their own. This type of support is crucial for learners during difficult times such as school closures, which are unprecedented for the current school population. The role that parents/guardians/siblings play in a child's learning must be emphasised and their support must be encouraged.

The impact on learner well-being

Learners were also asked a set of questions related to the impact of Covid-19 on their well-being. In relation to the impact of school closures on their learning (Figure 22), more than half of the learners chose the option "I feel anxious about the school missed, but I have continued working during the closure". This is positive, as although learners experienced anxiety, they stayed motivated and did what they could to continue their progress. A quarter reported not being worried at all or felt they would be able to catch up when schools reopened. However, a fifth felt "somewhat" (12%) or "completely" (8%). left behind. This is concerning as it may have had an impact on their results or may even have longer term learning impacts.

Figure 22: Learner views on the effect of school closures on learning



Learners were asked whether they knew of anyone who had been infected by Covid-19[8] (Figure 23). Two percent of learners had themselves been infected, with half knowing someone who had been infected and the other half not knowing anyone who was infected.

A further question asked whether the employment status of one or both learners' parents/guardians had been affected by the lockdown (Figure 24). A fifth reported that one or both had their hours cut at work, 12% reported a pay cut for one or both, and 10% indicated that one or both had lost their jobs. Forty-two percent of the learners' parents or guardians' employment was therefore negatively affected by the lockdown. This would have had an impact on the support that these learners received at home.

Figure 23: Knowledge of someone infected by Covid-19

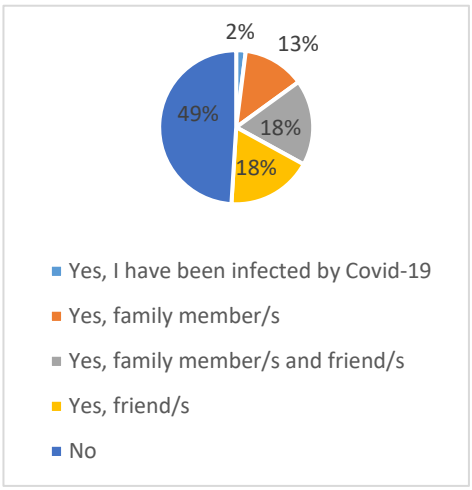
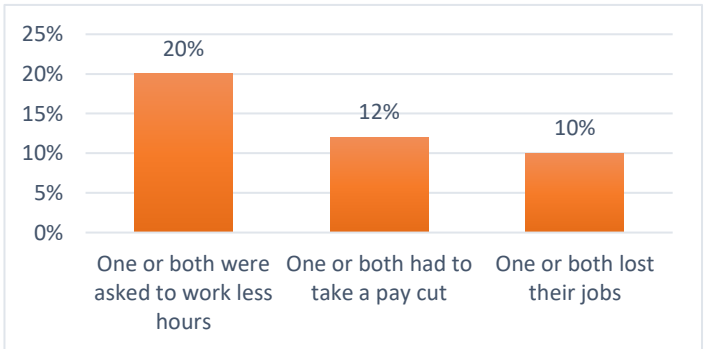


Figure 24: Employment impact on TDP learners' families



[8] Responses were collected before the second wave of the pandemic.

Managing the impact of Covid-19

Questions were also asked which focused on whether learners and their families were equipped to cope with the impacts of the pandemic, in terms of having sufficient information and resources. The majority agreed that their families had enough information (79%) and resources (61%). However, a small percentage indicated that their families did not have sufficient information (4%) or resources (12%) to cope with the impacts. Seventeen percent felt that they required counselling or psychological support regarding the impact of Covid-19 (ranging from "low" to "high").

Summary

The majority of the TDP learners returned to school in June or July after the initial closures. This highlights the loss of learning experienced during this time, and the differentiated strategies employed by schools in relation to their reopening. It is positive that the majority were able to communicate with their teachers during school closures, and that they had access to live/pre-recorded lessons during this time. In addition, many of the learners were provided with other resources, either electronically or in hard copy. Learners in fee-paying schools generally had better access to resources than those in no-fee schools. Learner participation in the TDP would have further enhanced their learning in mathematics and science during this time: an opportunity that most learners in the country did not have.

Many of the learners continued to engage with their schoolwork and completed past exam papers while they were unable to attend school. A high percentage also accessed lessons via various methods, beyond those provided by their schools. The majority appear to have a good support system at home. This support must be encouraged, as these talented learners that aim for high academic success require support at home and at school.

When asked about the impact of the pandemic, and associated school closures, more than half of the learners felt anxious about the school they had missed but had continued working during the closure. This is positive, as although learners experienced anxiety, they stayed motivated. However, a fifth indicated that they felt "somewhat left behind" or "completely left behind".

Approximately half of the learners personally knew someone who had been infected by Covid-19, while a small percentage (2%) had been infected themselves (in 2020). Additionally, just over 40% of their parents or guardians' employment was negatively affected by the lockdown. This would have had an impact on the well-being of learners, as well as the support that they received at home, which may have negatively impacted their well-being and their 2020 academic year.

A high percentage of learners agreed that their families had enough information and resources to manage the impact of Covid-19, while a small percentage indicated that they did not. Seventeen percent felt that they needed counselling or psychological support regarding the impact of Covid-19.

These aspects have implications for the efforts that learners may have been able to put into the TDP and their learning in 2020; and highlights why additional support, with a focus on mental health and well-being, through programmes such as the TDP, is crucial going forward. Learner participation in the TDP would have further enhanced their learning in mathematics and science during this time through the provision of lessons, resources and interaction: an opportunity that many learners in the country did not have.

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 and to prepare for higher education; and provides guidance to help learners decide on their future career paths. This report has provided an examination of the Talent Development Programme, through exploring the data collected through a survey administered to the 2020 TDP cohort. It is important to identify ways in which the programme can be enhanced. This section presents some key findings from the study, and thereafter sets out several recommendations.

Key findings

The TDP smart classroom

The Covid-19 pandemic, and the resultant country-wide lockdown and school closures, led to a revised TDP format for 2020. The format which was adopted as an emergency response was the development of an online platform, the TDP smart classroom. The change in format was handled by SUNCEP within a short timeline. As a result, 691 learners were registered on the system for the 2020 TDP.

The provision of laptops/tablets, and data to the TDP participants provided the necessary resources for the learners to be able to effectively participate in the programme. This was crucial as a high percentage of the learners did not have these resources initially. In addition, the resources provided via the smart classroom enabled learners to engage with the mathematics and science content and seek assistance where necessary.

The majority of the 2020 learners indicated that they found the smart classroom easy to use. An accessible and easy to use platform such as this was essential in assisting learners in gaining the benefits of the TDP, in lieu of the three contact sessions during the year held previously. Learners also felt that the TDP would play an important role in their learning during the year, through supporting and extending their school-based learning.

Learners had access to 14 mathematics and 12 science lessons during 2020. At the time of survey administration, the majority had completed at least five mathematics or science lessons, with around 60% having completed seven or more lessons in each subject.

Learner backgrounds

The TDP aims to target learners from medium to low SES households, who traditionally would not have access to additional resources and support. The 2020 learners predominantly came from such households. The parents/guardians of many of the learners had not achieved high levels of education, which has an impact on the educational capital and support learners have available in their homes. Just over a third (37%) usually (always/almost always) spoke English at home, while just over half reported "sometimes" speaking English. For many of these learners, English, the language in which the TDP is presented, is a second, or even third language.

Past achievement in, and present attitudes to, mathematics and science

The TDP targets learners who have achieved high marks in mathematics or science. More than 80% of the learners had achieved a B or higher in the previous year for mathematics (91%) and science (81%). TDP participants are talented learners with the potential to pursue, and excel in, STEM tertiary studies and careers.

The majority of the TDP learners exhibited positive attitudes towards mathematics and science. They enjoy learning these subjects and are confident in their ability to perform well in these subjects. Furthermore, most learners indicated that they would consider pursuing a career in mathematics or science.

Learners' future aspirations

The majority of learners intended to complete a post-graduate degree after finishing matric, with approximately three quarters setting themselves the goal of finishing a Master's or Doctoral degree. This highlights the high level of motivation that these learners have in achieving educational success.

Learning during school closures

Although the learners were unable to attend school during the peak of the Covid-19 pandemic, the majority were able to communicate with their teachers and had access to live/pre-recorded lessons during this time. In addition, many of them were provided with a variety of resources, either electronically or in hard copy. This would have allowed learners to continue with their schoolwork to some extent, ensuring that they were not "left too far behind".

In addition, many learners continued to engage with their schoolwork, and accessed extra subject content via different methods while at home. This engagement beyond ordinary mandated schoolwork highlights that the TDP learners are highly motivated and willing to work hard to achieve success. Generally, learners appear to have a good support system at home in relation to their learning.

Learner's well-being amid Covid-19

Many of the TDP learners were anxious about missing out on school. Although many of them had continued working during the school closures, some learners felt left behind as a result. Approximately half of the learners personally knew someone who had been infected by Covid-19, while a small percentage had been infected themselves. Some of the learners were also indirectly impacted, due to their parents or guardians losing some, or all, of their income because of the lockdown. This would have had an impact on the support that these learners received at home, their motivation to learn and their overall well-being.

Recommendations

The recommendations presented are based on the researchers' findings.

TDP format

Given the success of the online teaching platforms, the HSRC suggests that the TDP adopt a blended model from 2022 onwards, incorporating the integrated LMS as the online platform, and face-to-face interactions, to allow learners to gain the benefits from both formats.

Addressing the spread of TDP schools

The spread of schools which the TDP learners are selected from is uneven across the provinces. We suggest more careful consideration of the spread of schools that learners are selected from, so that there is a more even spread of schools across the country.

Considering learners' backgrounds

It is important to consider learners' backgrounds in terms of parental education, availability of home resources, and home language. This will be particularly important in the Covid and post-Covid context, where more disadvantaged learners may require additional interventions or support strategies.

Establishing a TDP network

The development of the online platform provides an opportunity to promote a TDP network, through which current and past participants can engage with each other in relation to tertiary studies and career pathways. In addition, inviting previous participants to talk about their experiences would enable current learners to gain insight into future opportunities. Enabling this type of ongoing interaction may add value to the longer-term impact of the programme.

Establishing partnerships

Partnerships between the TDP and participants' schools may facilitate learning opportunities for these learners, as well as other learners, particularly in a Covid and post-Covid landscape.

Interaction between TDP participants and local universities in relation to STEM programmes offered and bursary opportunities is important. This can be facilitated via the online platform, through a chat function or live interactive sessions.

Engaging parents/families

Where possible, organisers should engage with the families of the participants regarding their involvement in the programme, and their potential tertiary and career opportunities This will provide further support for these learners at home. This could be facilitated through short online sessions or recorded videos aimed at participants' parents/guardians on the TDP platform.

Incorporate well-being support

As a result of the impact of the Covid-19 pandemic on learners' mental, and possibly physical, health and well-being, the TDP should consider incorporating some form of related support as a means of ensuring learners' continued success and well-being. This could be built into the programme through online presentations or the provision of resources that are related to aspects such as coping with stress.

Providing resources

The DSI or organisers should consider continuing to provide learners with laptops/tablets and data when, or if, the contact sessions resume for the programme. These are resources which will enable learners to engage with the TDP material throughout the year and will set them up for their studies when they may be unable to afford such resources.

Appendix A: How TDP smart classroom lessons will assist learning

Further answers to the questions: "In what ways do you think the TDP smart classroom lessons will assist in your mathematics and science learning this year?"

"These lessons will help me on how to approach the questions, analysis and understand them in order to be able to answer. They will assist me in obtaining level 7 in Maths and Science this year".

"It's been a strenuous academic period, but the TDP smart classroom has afforded me the opportunity to learn and evolve in terms of my Mathematical and scientific application. It has provided me with alternatives to the standard classroom knowledge and has proved insurmountably essential in my academic journey. I am an elite scholar and I am now fully confident in my ability to solve even the most advanced aspects of these subjects. I am yet to set a foot wrong since the commencement of the programme. It's an astounding success".

"My thinking capability went up due to TDP, they are the best of the best".

"I think I will get a better chance of getting distinctions in maths and science and with 90% average and above. I prefer to obtain quality results. The TDP smart lessons helped me a lot. I have discovered my weaknesses and I have worked on that. For example in physical sciences I was not aware that in each and every topic one need to ask a question related to the chapter and at the end I must make sure that I get the answer to that. This class assists me a lot. I even know some strategies of solving problems and relate that to real life applications and honestly I was not aware of that before. Such questions used to show me flames but now they don't anymore. I am quiet sure that this year I will obtain 90% average in both subjects (Mathematics and Science".

"The lessons often cover hard questions which require out of the box thinking and I feel as if I'm developing this skill with each lesson. I feel this will assist me in tackling my examinations".

"I really enjoy being in my maths and physics classes. I wake up every morning thinking how amazing class is going to be. TDP is an amazing help this year as there are some concepts I'm struggling with but I do understand them just need an additional help with it. I've heard about TDP and when I found out I was part of it I was happy. TDP has helped a lot this year especially when I lost my grandmother recently I wasn't able to go to school and do my work as usual but TDP really helped. I'm so grateful and thankful of the organisers of TDP. My maths and physics knowledge has drastically increased and the methods that our tutors use are so helpful and awesome. Not only do I keep this methods for myself but I also show my other classmates and they are so impressed with it. It is really amazing what opportunities TDP create for learners I'm so proud of it and really it's a privilege".

"It will increase my maths and science marks this year and it makes me to understand clearly so I could share my knowledge or information with my classmates I'm very greatful to TDP for the opportunity".

"I'll be more prepared for complex or challenge questions. My problem solving skills and understanding of application will have improved. And it will be easier to think broader or analyse questions".

"It helped me gain a greater understanding of the topic and the work covered... It also helped me find different ways to solve some of the harder problems not yet asked at school. The work done and covered by the TDP and the worksheets given to us to complete, improves my ability to understand any problem that may be given by the teacher. Although it might sometimes be hard to get a grip of what's going on at the start of the lesson, when the lesson is complete my understanding of the topic really is better than it was before. I think it will help me achieve 100% in physics and mathematics, although the last term is a combination of the years results I'm planning on at least scoring full marks for the tests that are own the way".

"TDP has managed to broaden my meta cognition through its world-class lecturers and that has been managed to raise my confidence when I approach you order questions and I believe that all these skills will come very handy come the finals exams".

"They are very much of great use when it comes to revising my schoolwork and enhancing the level of trust and confidence I have in myself when actually studying and writing any tests at school or at home. UhmΓÇª I must say that ever since I started with the TDP smart classes, I have been at ease and now I can confidently tackle any problem I come against. I also learnt not to limit myself but to always think out of the box when doing science and math past question papers because when I first attempted the TDP worksheets I was

amazed at the level of intellect they require when actually tackling those problems. I am very grateful for programs like TDP,I have learnt a lot and also confident that I will get an "A" on both Mathematics and Physics".

"Apart from the intuitive user interface and the understandable content the tutors are really good at their jobs".
"TDP smart classroom lessons helped a lot because I found out that I had mistakes in some of the topics. I had time to go back and look at them , where did I go wrong clearly. So TDP is very helpful. Some mistakes we do as learner's the tutor really overcame them . I even had time to look back at Euclidean Geometry. What I mean basically TDP SMART CLASSROOM helps you to overcome your obstacles you out bust when doing homework, writing exams and what not. WE thank you TDP for inviting us in this awesome program".

"I am confident that I can get at least 85% for both maths and physics so that I can be able to apply for Actuarial science at either UCT or University of Stellenbosch. And I am 100% sure that with the help of TDP smart class I will achieve my goals and be one of the the top achievers come for 2021 matriculants".

"Since I would like to consider a career that requires mathematics and science, I feel it is very important for me to use this program to propel me to doing better".

"I believe that the TDP lessons provide an excellent opportunity to consolidate concepts which we, as learners, have learnt throughout the course of the year; and apply them practically in high order questions to test our cognitive ability. Furthermore, the TDP lessons have served as an excellent tool for study and practice (mastery)".

"The TDP lessons have helped me to gain a better understanding on work I may or may not have totally grasped in class. It has also helped me not to fall behind during the whole pandemic.so, I expect these classes to help me further my understanding and boost my results".

"It is easy to do revision since the topics are well separated and well broken down within each uploaded video on the TDP account".

"It will assist to reinforce my skills and critical thinking skills based on everything i had learned so far and achieve more than i had expected. The lessons are helpful and more advanced as we are given quite challenging problems which force us to apply the principles and think outside the box so far which we had learned".

"I have fallen in love more with maths and sciences, especially sciences, since it was one of my weaknesses. This will help me choose a career".

"Reinforce what was taught in the shortened time frame we had this year as matriculants. As well as revision and explanations on the correct thought processes needed to solve higher order questions in exams".

"It also assists in interpreting and analysing higher cognitive questions, this leads to a greater understanding of the subject at hand and therefore answering the question correctly".

"...It also helps by giving one shorter methods to work out an answer, which will give one more time in the exam to complete other questions and ultimately finish the exam. There are also certain advice and clues given during each lesson on certain topics which helps one get the answer more easier and quicker".

"TDP smart classroom lessons helped a lot because I found out that I had mistakes in some of the topics. I had time to go back and look at them, where did I go wrong clearly. So TDP is very helpful ".

"I think being exposed to more higher order questions allows me to have more confidence going into writing an exam/test. I also enjoy how they explain some of these questions and the tips they give on how to approach them without feeling overwhelmed".

"At school we don't have much time to go into detail in some of the topics we learn, especially in science, but our tutors here derive the topics which helps me to have so much information to that particular subject".