DMISRS Project Survey 2019

Understanding the support mechanisms available to first-year mathematics students at 16 universities participating in the 2019 DMISRS Project.

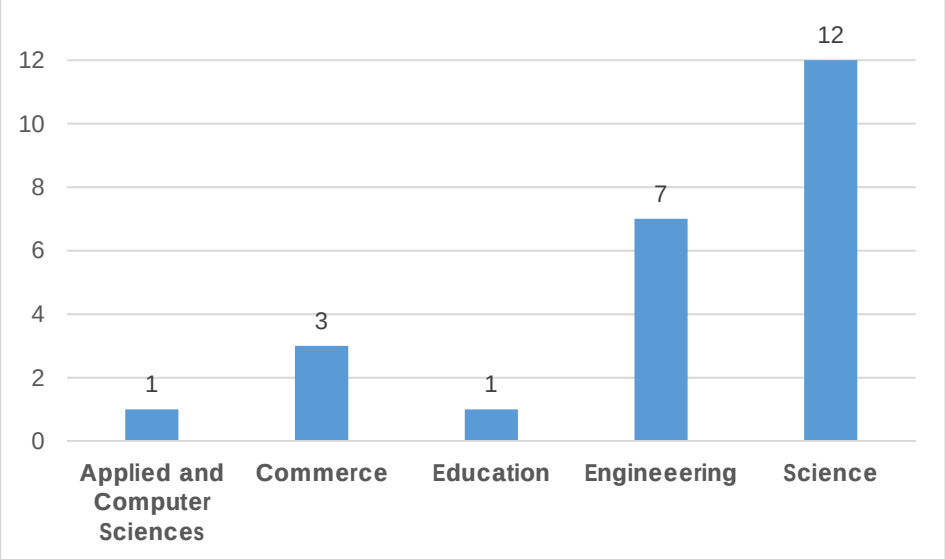
University Information

Twenty-four respondents from 16 universities completed the DMISRS Survey from April to June in 2019. These universities include:

1. Cape Peninsula University of Technology
2. Central University of Technology
3. Mangosuthu University of Technology
4. Nelson Mandela University
5. North-West University
6. Rhodes University
7. Sol Plaatje University
8. Tshwane University of Technology
9. University of Cape Town
10. University of South Africa
11. University of the Western Cape
12. University of the Witwatersrand
13. University of Venda
14. University of Zululand
15. Vaal University of Technology
16. Walter Sisulu University

Most respondents work in the Sciences faculty; Figure 1 displays the number of respondents per faculty.

Figure 1. Number of Respondents per Faculty.

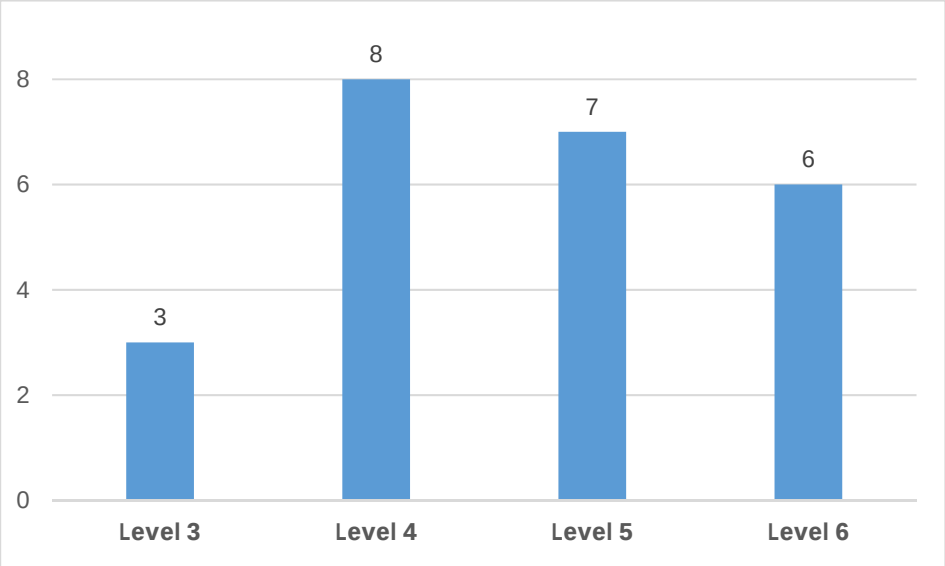


The most frequently assigned textbooks are those by James Stewart. For a full list of textbooks per university/faculty, please see Appendix A.

Current Use of the NBTs

Most respondents report that NSC Level 4 is required in order for students to be eligible to register for their mathematics course (see Figure 2).

Figure 2. Number of respondents per NSC Level requirement.



Only 38% of participating universities require that prospective students write the NBTs, and 33% write the MAT test. The majority of universities (88%) do not use the NBT results for student placement, or to identify support needs (75%).

Among those respondents who do use the NBTs to identify support needs, they do so in the following ways:

- "If the NBT results are poor, students are put into Extended Studies or a four year programme with lots of support."
- "Our students are subjected to internal profiling test on academic literacy and mathematics which is then followed by an intense week programme on

challenging sections / gaps identified in this test. Tutorial and extra classes are conducted throughout the year as a form of extra support."

- "Interventions."
- "Mostly with placement of students who need to decant from MAM1000W to MAM1005H."
- "Organising help from Mathematics Centre."

Only 3 respondents feel that certain topics can be omitted from the course:

- "Topics that do not have any connection with contexts encountered in other non-mathematics disciplines can be omitted. Topics of a purely theoretical nature can safely be avoided."
- "From 1st semester: Applications of the mean value theorem. Anything beyond the basics of binomial theorem. From 2nd semester: Taylor series (or at least anything beyond the basics). The matrix representing a linear map. I am not familiar enough with all the places in the engineering degree where the content of these courses is required. I don't believe there is consensus among engineers on what maths should be taught in first year."

Respondents identified a wide array of topics that students generally struggle with. Basic high school competencies were commonly noted by 5 (21%) respondents. Other gaps include: differentiability, curve sketching, logarithms, fractions, calculus, limits, absolute values, among others.

Identification of these problems generally stemmed from multiple sources, including the students themselves, as well as test, exam, and assignment performance, and from lecturers' and tutors' observations.

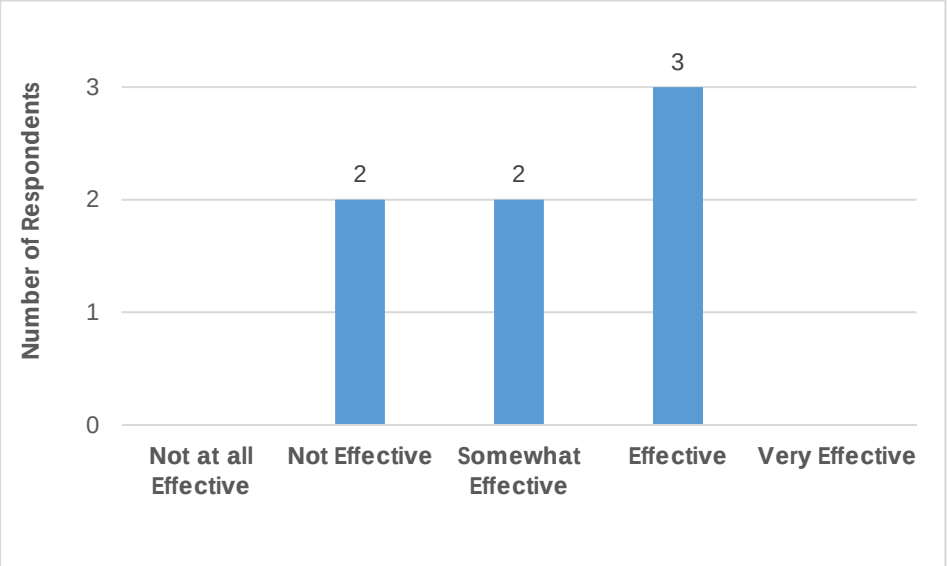
Types of Student Support

Special Sessions

Only 7 of the respondents reported implementing special sessions with their students. Topics vary, including: current content (lectures and tutorials); calculus; absolute values; inverses; and the definition of concepts. These sessions are not compulsory at the majority of universities, and are mostly facilitated by the lecturer who will lecture the students for the rest of the year. Participation is voluntary at 3 universities, forms a

part of orientation at 1 university, and is performance-based at 3 universities. Respondents' rating of the sessions' effectiveness varied, as seen in Figure 3.

Figure 3. Respondents' rating of special sessions' effectiveness.

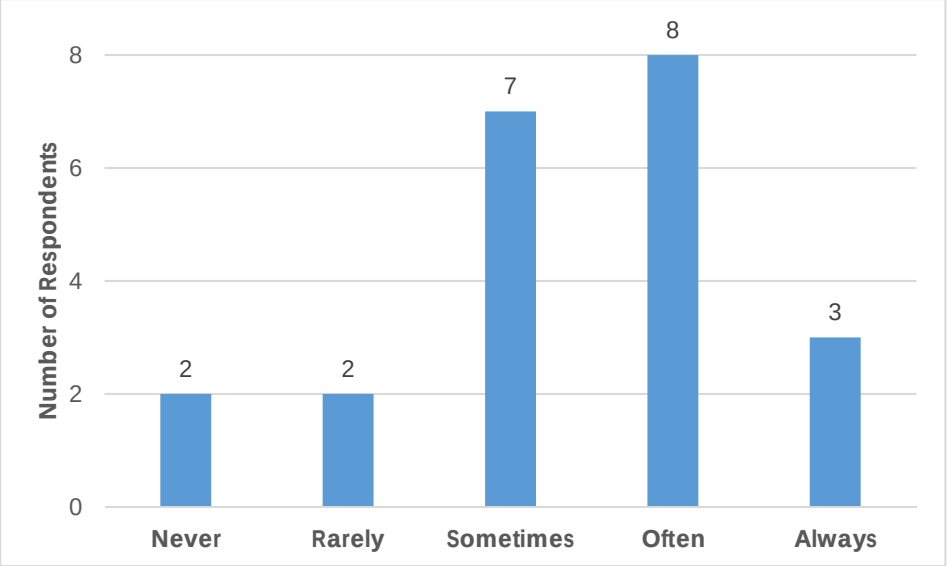


Tutorials

All but 2 universities report offering tutorials to students once lectures have commenced. Tutorials are compulsory at most of these universities (82%). The majority of universities cover current lecture material in their tutorials. Content is chosen based on the course outline, lecturer and tutor observations, and student needs. Tutorials seem to be generally well-attended, as reported by most respondents. Attendance ranges from 60% to 100% attendance.

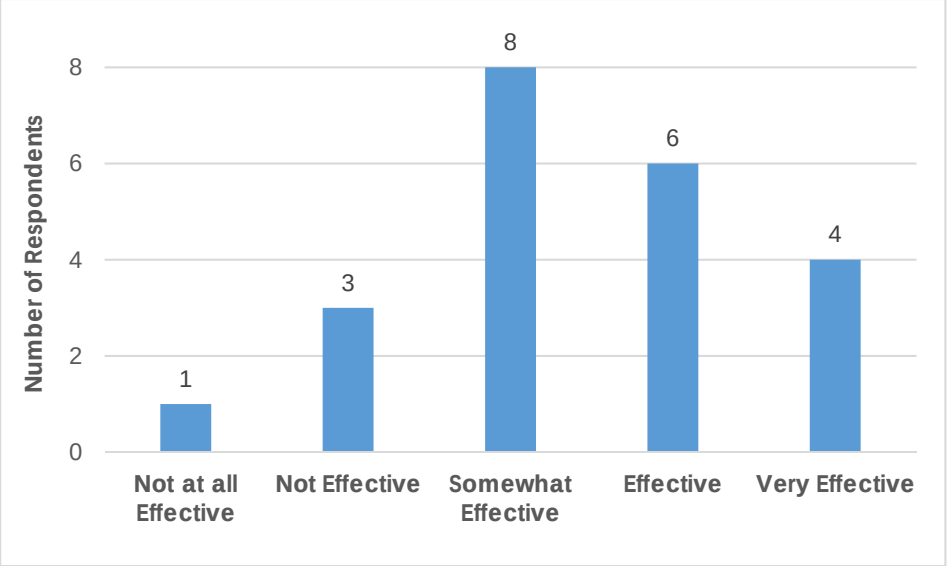
Tutors are most commonly undergraduate students, postgraduate students or lecturers, and are trained by the majority of universities (90%). Most respondents reported that tutors are *often*, or *sometimes*, available to answer student questions. If tutors are not available, students turn to lecturers with their questions.

Figure 4. How often tutors are available to answer students' questions (outside of tutorial sessions).



As for the effectiveness of this type of student intervention, most respondents rated tutorials as *somewhat effective* in supporting students (see Figure 5).

Figure 5. Respondents' rating of tutorials' effectiveness.



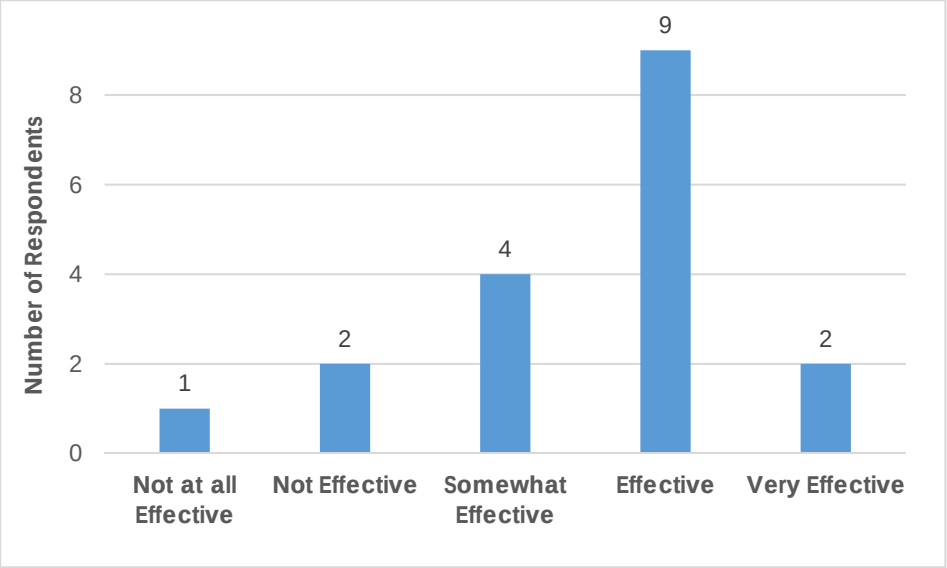
Thirty-six percent of respondents offer additional tutorials to students (e.g. on the weekend) and these typically take the form of 'Whiteboard Workshops'.

Additional Materials

The majority of respondents (75%) report that students are provided with additional material to help bridge knowledge gaps. These materials include: online content (e.g. blog posts and videos); additional study material (e.g. lecture notes, exercises solutions, and examples); and other textbooks. Lecturer observations, student requests

and students' performance help to determine what materials are provided. These materials are typically made available to students through online platforms. Most universities (78%) monitor whether students access these materials, and report good levels of utilisation (60% - 100%). Generally, this intervention is viewed as an *effective* form of student support (Figure 6).

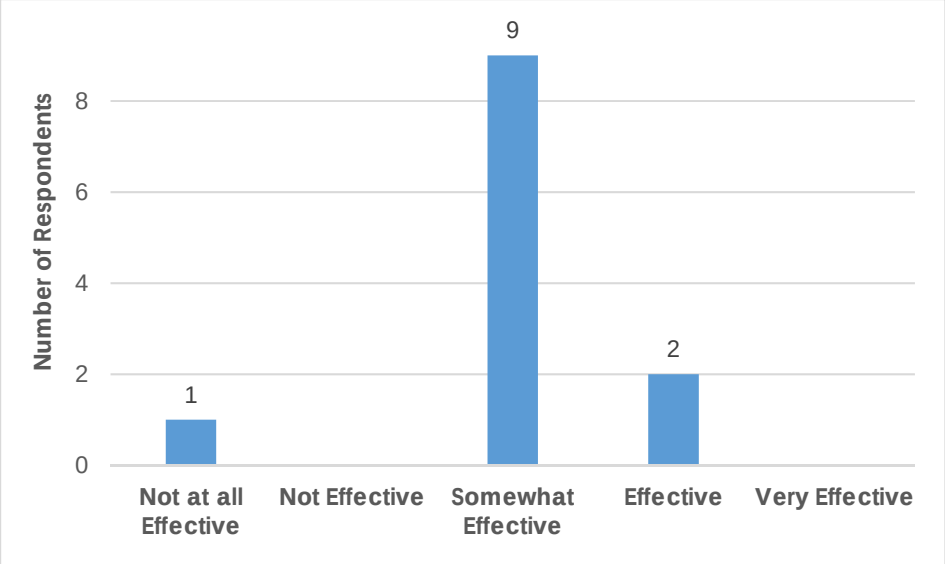
Figure 6. Respondents' rating of additional materials' effectiveness.



Peer Support

Just over half of the survey respondents (58%) report that peer support is available to students, with most of these universities actively encouraging students to form peer-support groups. These groups are typically formed within tutorial groups, or universities have a residence mentor/tutorial system. Groups are mostly led by strong students. Students who join these groups are not necessarily weak students – respondents report a mix of strong and weak students. Current lecture/tutorial content is discussed in the groups. The majority of respondents think that peer groups are a *somewhat effective* form of student support.

Figure 7. Respondents' rating of peer support effectiveness.



Hot Seats

Fifteen universities (63%) implement hot seats, however there is some variation in how respondents understand what constitutes a 'hot seat'. Two respondents said that they do not implement hot seats, but instead offer a Maths Centre. Another commented: "There are not official hot seats. All lecturers are available at all times" – this means that, in these cases, hot seats cannot be differentiated from lecturer support.

Hot seats are mostly available to students every day, and are generally utilised by all students. However, utilisation by students is fairly low (0% - 40%). When asked whether the person who runs the hot seat communicates with lecturers, respondents reported very mixed degrees of communication (Figure 8). Peer support is mostly viewed as *somewhat effective* by respondents.

Figure 8. Frequency of communication between lecturers and the person running the hot seat.

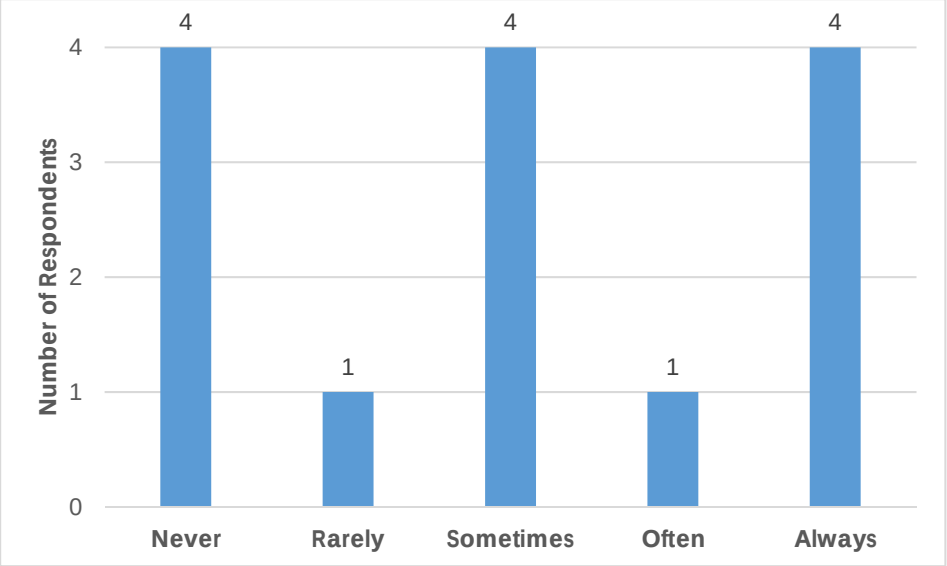
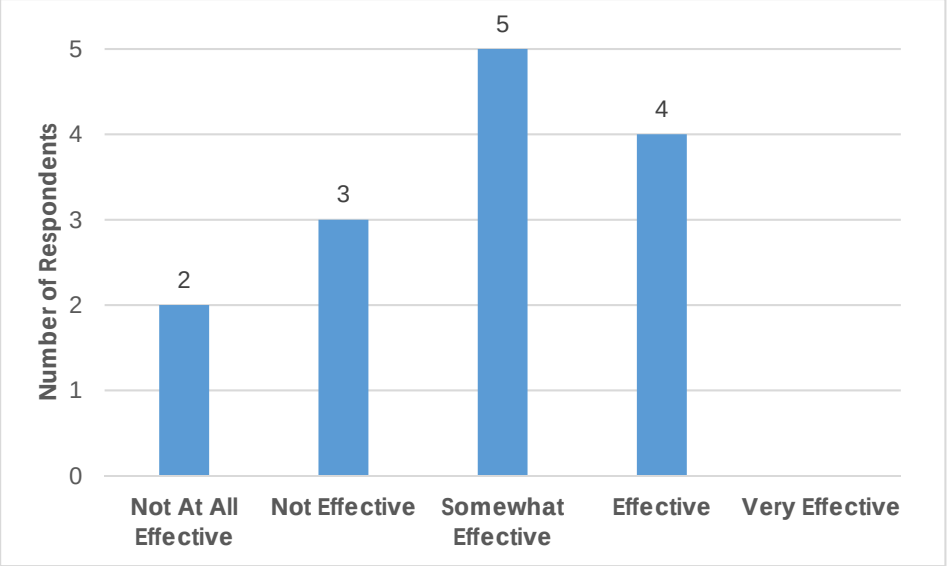


Figure 9. Respondents' rating of hot seat effectiveness.



Lecturer Support

Most universities offer lecturer support to students (92%) on a daily basis (68%). This can take the form of emails, consultations and drop-ins, WhatsApp, and online chat rooms. All students typically make use of this offering. Respondents perceive this type of support to be manageable for lecturers, and think that this is an effective mechanism of support for students.

Figure 10. Degree to which lecturers can manage this type of support.

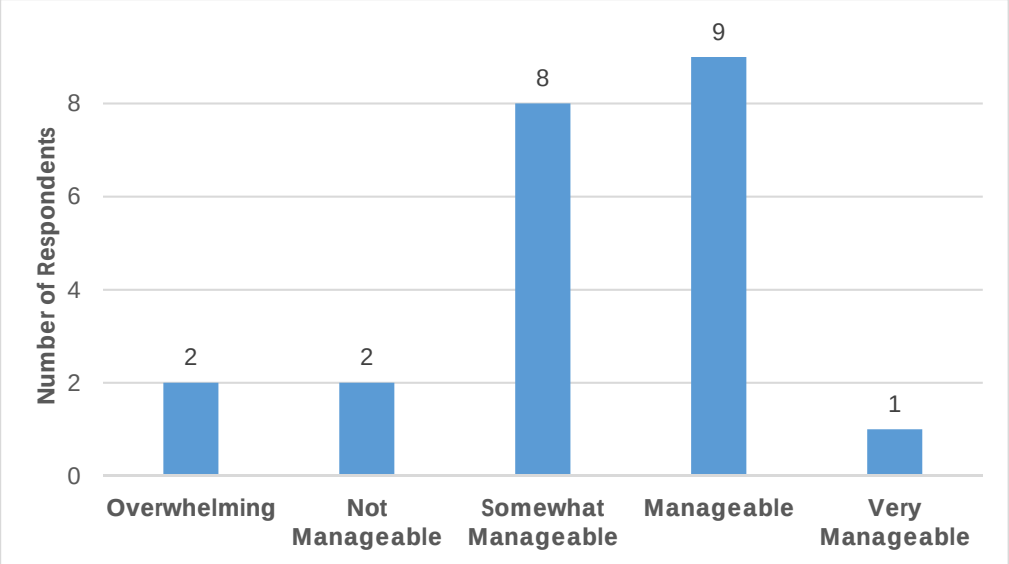
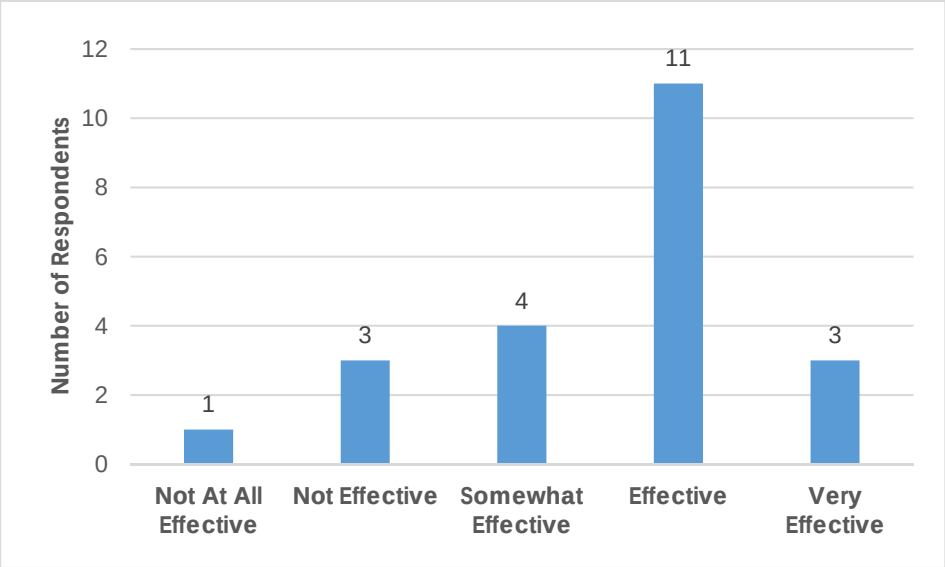


Figure 11. Respondents' rating of lecturer support effectiveness.



Additional Support

Three respondents mentioned additional support available to students at their universities:

- "Student Development Support in each faculty."
- "The [University's] Learning and Teaching Development Department have workshops with the students."
- "Maths Centre available for students."

Alternative Support

Many respondents described the alternative mechanisms that their institutions have in place for those students not coping; most take the form of extended programmes. These are provided per university in Appendix B.

Changes to Student Support

Half of the respondents feel that no changes should be made to their current student support offerings, with one commenting: “students need to make more use of the current support services”. Another respondent also emphasised the need for improved self-monitoring among students, and a more meaningful understanding of students’ cues among both staff and students: “Students take time to realise that they are not coping. Often when they do realise it, it is often too late to remedy the situation. I feel we do not utilise assessments effectively and do not teach students how to assess themselves. I also feel that words such as "understand", "yes", "ok" and signals such as nodding are used loosely by both teachers and learners and student learn too late in the year that these cue have not meaning in themselves.”

Among those who feel these services could be improved, the need for more tutors was commonly noted. One respondent mentioned that this is difficult, as their engineering course does not produce enough postgraduate students.

Focused attention on individual students was also noted, with one respondent saying: “One-to-one consultations are very valuable but time consuming. I suspect I would be more effective if I replaced 80% of my 8 am lectures with online lectures, and made it a requirement for students to make a 5-10 minute consultation with me once a week to report on their progress”.

One respondent suggested that more online support could be made available, given students have access to adequate internet connectivity and infrastructure.

Lastly, one respondent noted that resource guides are not provided for common content problems. This is important, given how many students appear to struggle with high school competencies: “We have not yet developed resource guides for topics known to be problematic, especially topics done in high school”.

Thirteen respondents (54%) feel as though they need support in order to change their student support services. Most noted the need for more tutors. Other needs that can be potentially addressed in DMISRS workshops include:

- Assessing the effectiveness of student support services;
- Budgeting information that can support innovative strategies;
- Links to helpful resources (e.g. Khan Academy, videos, free online quizzes, etc.)
- Motivating senior students to become tutors; and
- Time management skills.

Two respondents noted that the type of research included in the DMISRS project would be beneficial, inadvertently highlighting the need for this project:

"Having a compulsion to examine data like NBT results and an analysis of student performance per question in tests, such as for contributing to a paper or longitudinal paper on student difficulties in first year mathematics across the country. When the semester gets busy, it is easy for good-to-do things to be put off as must-do things fill our time."

"Suggestions have been made to capture student performance per question during tests in order to have information on topics that students struggle with. This information is useful for the next cohort of students but not to the student writing the test. It would be beneficial to find out how students who are struggling can have their fortunes turned without having to repeat a year. Do other universities allow for second takes on tests, etc? How do weak students get assistance that is immediate and effective."

Uses of MAT Test Data

Respondents were asked what kind of useful information the MAT Test could provide universities. Most respondents declined to answer, with one asking what a MAT Test is. Other respondents said that the MAT Test could help identify students': "cognitive levels"; ability to learn new content and "quality of thinking"; and potential for drop-out. Others rather explained why it, and the NBTs, are not used: students have to pay for them and parents complain about this.

Appendix A: Textbooks

Respondent's Faculty	Textbook
Education	prepared study guide
Science	1. Stewart Calculus: Early Transcendentals (8th Edition), James Stewart. Brooks/Cole Publishing Company.
	2. Thomasâ€™ Calculus (12th Edition), Thomas B George; Wier D Maurice and Hass R Joel. Pearson Education.
Science	Calculus, James Stewart, Metric Edition
Science	I am in Chemistry, so use Ebbing, "general Chemistry"
Science	Discrete Mathematics with Applications, Fourth Edition, Susanna S. Epp
Science	Calculus Early transcendentals by Jemas Stewart 5th edition
Science	Calculus: Concepts and Contexts.3, James Stewart, Thomson Brooks/Cole.
Engineering	Calculus, 8th edition, James Stewart
Science	Stewart 8th
Engineering	Calculus (Volume 1) EJ Herman and G Strang Published by OpenStax
Science	Thomas" Calculus Early Transcendentals, Weir Hass, Thirteenth Edition in SI Units
	Elementary Linear Algebra, Howard Anton and Chris Rorres, Ninth Edition
Engineering	WASHINGTON AJ: Basic Technical Mathematics with Calculus
	(Pearson International Edition) Ninth Ed. (AJW)
Science	Basic Technical Mathematics with Calculus (11th Ed.) by Allyn J. Washington
Engineering	ENGINEERING MATHEMATICS - CROFT ET AL

Engineering	Mathematics (Level 1) (First Edition) WSU; Kruglak, H. & Moore, J.T. Theory and Problems of Basic Mathematics with applications to Science and Technology.
Commerce	Mathematics for Economics and Business by Rebecca Taylor & Simon Hawkins. 2008. McGraw-Hill Higher Education: Berkshire.
	Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences by EF Haeussler, JR, RS Paul, RJ Wood. 2008. 12th Edition. Pearson. New York.
	Mathematic for Economics students by Derek Yu. 2017. Van Schaik Publishers. Braamfontein.
Science	Calculus Concepts and contexts (4th Edition, 2009), James Stewart, Publisher Brooks Cole (USA)
Engineering	James Stewart 8th Edition
Engineering	Engineering Mathematics Through Applications, K Singh
Commerce	none
Science	Calculus (Metric version), James Stewart, 8th Edition, Published by Cengage Learning
Commerce	Finite Mathematics by Stefan Waner, Steven Costenoble
Science	MAM1005H and MAM1006H both use Calculus: Early Transcendentals by James Stewart.
	Other textbooks and resources are also used which are freely available online
Applied and Computer Sciences	Mathematics for Engineering Students RS Lebelo RK Mahlobo (Maths 3), Mathemastics 2 for Vaal University of Technology, L Rundora, J Mobongwe, Mathematics 1 for University of Technology Students J. Owusu-Mensah, C.R. Makhalemele (eds)

Appendix B: Alternative Support

Mechanisms of Support for Struggling Students (Provided by Survey Respondents)
Through mentoring at individual level (at five students to a tutor)
Students can do Maths in Extended studies, but if they are dong mainstream Maths, there support/augmentation is availble, as discussed earlier. Students are identified by the NSC and NBT (when available) results, and after class tests. STudents attend tutorials, where study skills, mathematicals skills, etc are dealt with.
Students register for the extended curriculum program. In addition, students who do not obtain a certain mark in the June tests are advised but not compelled to decant to the extended program. However, despite the decanting the pass rate in the mainstream module is still very low.
Students are allowed to repeat the course only once
Aspirant students with level 3-4 NSC are allowed to register for a science course. The number of these registrations are limited based on the earmarked government funding made available for a specific year. The first normal academic year is spread over two years for these students. Thereafter they can promote to the second year mainstream mathematics. Only in one course (Geology) do students promote to a second year ECP without mathematics. Also in the case of the Chemistry course the second year ECP is the last year of mathematics. All other courses promote students who are successful at the end of their second ECP year to mainstream mathematics. As can be expected ECP students struggle in the mainstream as the academic support they enjoyed in ECP is mostly absent. For example these students are not allowed to study logic, and is openly rediculed when they do not fair as well as those mainstream students who did an additional course in logic (I am speaking from my last interviews with ECP students in the mainstream). However, this year (2019) attempts are made to give extra classes to all students struggling in the mainstream. Also first year mainstream (3 year programme) students (selected on their school performance at level 5+ NCS) who do not pass the mid-year tests are advised to decant to a 4-year stream equivalent to the ECP stream.
Students can repeat a semester course keeping the same credit load or choose to decrease their registered modules from 5 to 3 with double time for maths and physics. Some students don't reduce their load due to external pressures (bursaries, family). This model tries to avoid students failing modules. Failure is lower in first year for students who reduce their load but some

students need more time. We have a boot camp for students writing the supp exam before the start of the next semester, but this is limited to students with a minimum of 40%. There could be provision made for students to space out their maths beyond the 13 weeks of the semester and take the supp exam 5+ weeks later when the supp exam is written.
Decant process after the first or third test. It is voluntary, but highly encouraged.
We have an extended programme (ECP)
The students take Maths at a slower pace (1 yr for 1 semester). Mathematics knowledge of the students are very weak when they arrive at WSU, therefore they benefit by a slower pace.
The university offers some diploma and certificate courses which can prepare students for degree programmes.
Students can go to ASPECT (Extended Programme), based on the first class test marks.
We used to give the same course every Semester, this was done because there were two intakes, it also gave students who failed a second chance much faster. I also noticed that some students cancelled the subject a few weeks into the Semester if they felt that they were not ready knowing that the same subject will be in the second Semester. This also increased student numbers at a particular time. The ECPs are being used to take the subjects at a slower pace. There is also one technique that we use for weaker students; design the half the course to be taken in the first semester and the other half in the second Semester, this allows students to learn the concepts effectively.
There is no slower option for MAM1010F and MAM1012S, only repeat courses for these two courses respectively in the semester that follows after the above courses have taken place.