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Increase Success by Decreasing Admission for Maths– Fairytale or Reality?

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***Abstract*—**South Africa is facing a crisis with not being able to produce enough graduates in the scarce skills areas to sustain economic growth. The crisis is fuelled by a school system that does not produce enough potential students with Mathematics, Accounting and Science. Since the introduction of the new school curriculum in 2008, there is no longer an option to take pure maths on a standard grade level. Instead, only two mathematical subjects are offered: pure maths (which is on par with higher grade maths) and mathematical literacy. It is compulsory to take one or the other. As a result, lees student finishes Grade 12 with pure mathematics every year. This national problem needs urgent attention if South Africa is to make any headway in critical skills development as mathematics is a gateway to scarce skills professions. Higher education institutions initiated several initiatives in an attempt to address the above, including preparatory courses, bridging programmes and extended curricula with foundation provisions. In view of the above, and government policy directives to broaden access in the scarce skills areas to increase student throughput, foundation provision was introduced for Commerce and Information Technology programmes at the Vaal Triangle Campus (VTC) of North-West University (NWU) in 2010. Students enrolling for extended programmes do not comply with the minimum prerequisites for the normal programmes. The question then arises as to whether these programmes have the intended impact? This paper reports the results of a two year longitudinal study, tracking the first year academic achievement of the two cohorts of enrolments since 2010. The results provide valuable insight into the structuring of an extended programme and its potential impact.

***Keywords*—**Access, extended programmes, foundation provision, mathematics.

I. Introduction

SOUTH Africa's National Qualifications Framework recognises three broad bands of education: General Education and Training, Further Education and Training, and Higher Education and Training.

School life spans 13 years or grades, from grade 0, otherwise known as grade R or "reception year", through to grade 12 or "matric" – the year of matriculation. Since 2009, the national Department of Education has been split into two ministries: Basic Education, and Higher Education and Training. The Ministry of Basic Education focuses on primary and secondary education, as well as early childhood development centres. The Ministry of Higher Education and Training is responsible for tertiary education up to doctorate level, technical and vocational training, as well as adult basic education and training [2]. The Umalusi Council which is appointed by the minister of Higher Education, sets and monitors standards for general and further education and training, whilst the Council of Higher Education keeps an eye on higher education and training, including accreditation and quality assurance [5].

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According to Unicef [22] the majority of South Africa's secondary school learners fail to reach proficiency levels in mathematics and science, and when compared to other nations in global tests, the mathematics and science achievements of learners at grade 3 were significantly below average. South Africa's Institute of Chartered Accountants (SAICA) expressed concern about school results saying it is a national problem that needs urgent attention if South Africa is to make any headway in critical skills development. Mathematics is a gateway to the accountancy and science professions [10]. Information Systems, computer science, business statistics, economics, financial management, costing, management accounting techniques and financial accounting are all fields that require thorough and solid knowledge of mathematics. Even a greater concern is the view of Basic Education officials who publicly declared that while the results in maths, physical sciences and accounting are concerning, it is not the purpose of schooling to prepare for university [14].

Various studies identified causes for low achievement in mathematics. Two primary causes identified are curricula and socio-economic circumstances [16], [23]. The first problem manifests in the inadequate articulation between secondary school and tertiary levels of education. Socio-economic differences result in categories of students that have generally not been equipped with key academic approaches and experiences which are taken for granted and which are essential for traditional higher education programmes [11], [16]. This gave expression to the term "articulation gap". This study however did not dwell on the reasons for underpreparedness, but on interventions to address the problem. At the beginning of 2010, extended programmes were introduced at the Vaal Triangle Campus of the North-West University, to try and support underprepared students.

The students enrolling in the extended programmes do not comply with the minimum maths prerequisites for the normal programmes, since their matric results for mathematics are usually just below the minimum requirements. Extended programmes are fundemented in the believe that tertiary success are lying not only in "fixing" the underprepared students but also "fixing" higher education's 'inaccessibility' to students [23]. Three extended programmes were introduced in commerce and information technology programmes, that include foundation provision in Problem Solving, Mathematics, Programming, Accounting and Statistics. This study reports on the implementation of the Commerce programme in Economics and International trade. The duration of the extended programme is four years, instead of the normal three years for a Bachelor's degree. The questions that arise are: did it open access and did it increase success? The background of Maths and Mathematical Literacy as enablers for degree studies is provided. This is followed by an overview of foundational provision and the implementation thereof at the NWU. The implementation and impact of foundational provision has many facets, but this study focuses on the Maths, with specific analysis if its impact on access and success. The evidence on which future curriculum interventions will be based varies from strong, generalisable data derived from representative national surveys, to small scale descriptive studies based on actual student performance such as this study. The verifications of extended programme interventions are required so that these collective and cumulative findings can serve as the basis for a firm national picture.

II. Further Education

South Africa relies on the matric pass rate as a significant marker of what's going on in its schools. In 2012, 224 635 of the country's 496 090 matric students wrote mathematics and fewer than half of these, 46.3%, passed with at least 30%. Less than 20% scored 50% or more. On top of this, almost half of the students did not write mathematics.

Furthermore, there are massive disparities in performance between schools within the South African system, to a large extent structured by a history of poverty and deprivation, with African schools overwhelmingly represented in the poor performing category [21]. The South African school sector can be characterised as a high cost, high participation, low quality system [7], [24]. The large number of learners taking Mathematical Literacy is alarming, since Mathematics is a prerequisite for most of the scarce skills courses and prospective jobs needed for economic growth.

Before the new curriculum was introduced in 2008, learners could choose to take Maths on Higher Grade level, Standard Grade level or not at all. The "not at all" part is the daunting statistic. There were as many as 40% of learners who were taking no Maths at all during 2000 -2005. Furthermore, about half the learners who took Maths were taking it on the Standard Grade level. Over the period 2000 to 2005, the average percentage of learners out of the entire cohort of Matric exam candidates who got a mere pass in Higher Grade Maths was a dismal 5.2%. Forcing learners to do Higher Grade Maths, "in order to keep all options open for tertiary education" was a common trend that actually set learners back, because failing Maths meant that there was no option for tertiary education at all, hence the introduction of Mathematical Literacy [16].

Looking at the current situation, there is no longer an option to take Pure Maths on a Standard Grade level. Instead, only two mathematical subjects are offered: Pure Maths (which is on par with Higher Grade Maths) and Mathematical Literacy. It is compulsory to take one or the other. This means that every single Matric candidate is now getting some sort of mathematical education. Five years after the introduction of ML, serious concerns are raised.

The way Mathematical Literacy (ML) is implemented at school level does not successfully prepare students for the tertiary environment. In general, students with Mathematical Literacy (ML) as a National Senior Certificate subject do not perform well in their Bachelor degree subjects, especially the Bachelor of Commerce degree [17]. Mathematical Literacy does not empower students with the minimum mathematical competencies as expected. They do not understand basic mathematical concepts, terminology and operations, and overall their basic calculation and problem solving skills are poor. They also do not understand formulas and sometimes even do not understand the symbols in the formulae. Apart from mathematical techniques needed in modules such as Economics, these students do not possess the necessary logical reasoning skills and problem solving strategies that are developed by Mathematics as a subject. All of these aspects need substantial enhancement if students are to achieve success in their degree studies [8].

A. *Maths vs. Maths Literacy*

In the curriculum statement, the Department of Education gives their definition of Mathematical Literacy (ML): ML provides learners with an awareness and understanding of the role that mathematics plays in the modern world. ML is a subject driven by life-related applications of mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems. Table I contains a summary of the learning outcomes of ML and Maths [3], [4].

TABLE I
Learning Outcomes of Mathematics and Mathematical Literacy

Mathematics	Mathematical Literacy
Number and number relationships. When solving problems, the learner is able to recognise, describe, represent and work confidently with numbers and their relationships to estimate, calculate and check solutions.	**Number and operations in context.** The learner is able to use knowledge of numbers and their relationships to investigate a range of different contexts which include financial aspects of personal, business and national issues.
Functions and algebra. The learner is able to investigate, analyse, describe and represent a wide range of functions and solve related problems. The language of algebra will be used as a tool to study the nature of the relationship between specific variables in a situation. The power of algebra is that it provides learners with models to describe and analyse such situations and the analytical tools to obtain additional, unknown information about the situation.	**Functional relationships.** The learner is able to recognise, interpret, describe and represent various functional relationships to solve problems in real and simulated contexts. Functional relationships pervade our society. this learning outcome is designed to give learners opportunities to investigate and make sense of such relationships where they arise in the context of other subjects, work or life-related situations.
Space, shape and measurement. The learner is able to describe,	**Space, shape and measurement.** The learner is able to measure using

MATHEMATICS	MATHEMATICAL LITERACY
represent, analyse and explain properties of shapes in 2-dimensional and 3-dimensional space with justification. Location, visualisation and transformation are important.	appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional shapes and 3-dimensional objects in a variety of orientations and positions.
Data handling and probability. The learner is able to collect, organise, analyse and interpret data to establish statistical and probability models to solve related problems. Learners will master further methods of organising, displaying and analysing data. Measures of central tendency and spread will be explored. A basic appreciation of the difference between data that is normally distributed about a mean and data that is skewed will be developed. Learners will become critically aware of the deliberate abuse in the way data can be represented to support a particular viewpoint.	**Data handling.** The learner is able to collect, summarise, display and analyse data and to apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions. This learning outcome focuses on the role of learners as consumers of interpretations of data. Contexts should be taken from the way data is handled in the media and used to investigate situations.

The difference between Maths and ML can be summarised as follows:

- ML focuses on the role of mathematics in the real world, whereas Mathematics focuses on the discipline of mathematics.
- With ML, relevant current contexts are used, whereas with maths, applications are important, but do not have to be only real life contexts.
- With ML only basic mathematics is needed and a few new concepts are introduced in Grades 10 and 11. In Maths, content is expanded on as the learners progress from one year to another.
- In ML the contexts become more complex from year to year whereas in Maths both the content and contexts become more complex and advanced each year.

Whilst the change in curriculum had noble intentions, higher education enrolment trends proof otherwise. Schoër et al. [19] also questions the merit of the new curriculum and found that the predictive power of matric results significantly decreased since 2008.

III. Higher Education Foundation Provision

The challenge of grappling with barriers that exclude learners from higher education seems to be a worldwide phenomenon [9], [18].Foundation grants were introduced by the Department of Education in 2004 to allow institutions to bid for earmarked funding for foundational provision offered in addition to regular provision. This was in accordance with the new funding framework and in recognition of the role of foundational provision as a strategy for improving success and graduation rates, particularly among students from disadvantaged educational backgrounds [5], [6]. Various degrees of success have been reported. Kaburise [12] found little justification to continue with extended programmes as introduced at the University in Venda in 2007, as the completion rate for the first cohort was unsatisfactory low at 15%. Boughey [1] on the other hand, reported on the success achieved by extended programmes offered by institutions.

Research produced in the field of academic development has shown that the provision of additional time is not a sufficient condition to allow underprepared students to succeed. Extended programmes therefore require additional tuition, support as well as more time to be provided [13], [15]. This tuition must be provided in the form of formal courses – although the format of these courses can vary [1]. The primary purpose must be to provide a set of learning activities which are designed to enable students from disadvantaged educational backgrounds to perform successfully in their chosen fields of study. The components of the foundational provision must be intrinsic part of the curriculum of the extended programme and the focus is on support and success and not so much on access. A foundation programme must adhere to the following requirements:

- The programme must be located in a ministerially approved higher education programme.
- Students engaged in foundational provision are registered for a ministerially approved higher education programme.
- Equitable allocation of grants are promoted across institutions by basing allocations partly on objective input measures, including enrolment and credit values, rather than institutional estimates of cost.

To achieve these goals, all foundation courses or modules are assigned credit values as part of an approved degree or diploma programme [2]. Since extended programmes are based on one of the institution's ministerially approved undergraduate programmes, extended programmes qualify for state funding.

Because students following an extended curriculum programme are expected to do additional work, the institutional are required to specify that the curriculum of an extended programme is longer than the minimum time set for the relevant regular curriculum. Upon graduation, there is however no distinction made between student that followed the normal and the extended curricula. The duration of the extension of the curriculum must be at least six months and not more than one academic year. As will be indicated in the next section, an additional year has been added to the programme.

Foundational provision is divided into components. i.e. formal courses, which are subject to the same design, presentation, assessment, administration and quality assurance standards as are regular courses. Foundation courses can take various forms that are valid for different educational purposes and target groups [2], [6]. Three common forms are:

– a fully foundational course which is preparatory to the regular first-level course in the subject concerned;
– an extended course which combines regular course material with substantial foundational material and is substantially linger in duration that the corresponding regular course;
– an augmented course which covers all the material of a regular course and has the same duration, but is taught

separately and integrates substantial foundation material through additional formally-timetables contact time.

The term "foundation programme" is the offering of modules, courses or other curricular elements that are intended to equip underprepared students with academic foundations that will enable them to successfully complete a higher education qualification. Foundations provision focuses particularly on basic concepts, content and learning approaches that foster advanced learning. Foundational provision is intended primarily to facilitate the academic development of students whose prior learning has been adversely affected by educational or social inequalities. Foundations provision is thus aimed at facilitating equity of access and outcomes.

IV. Theoretical Foundation

It is clear that the focus for higher education must be higher education itself and, as has been stated previously, on the major variables in its control – the structures, conditions and practices that have a major effect on student performance [20].

Foundation/extended programmes are not '*remedial*' in the traditional sense of redoing the work of the previous level, which in this case would be schooling. They build on the reality that the majority of students take at least an extra year to complete a degree and seek to use this extra time sensibly. While ensuring that all work in extended programmes is at an appropriately demanding, higher education level, extended programmes look forward to future demands and focus on conceptual development and key academic skills, such as academic, quantitative and computer literacy [24]

One of the major lessons learned from early work in academic development is that introducing additional tutorials or generally improving teaching can only address the needs of the most marginally underprepared students. A further important lesson is that simply developing stand-alone courses (for example, 'Academic Literacy'), while leaving mainstream courses untouched, is not effective, since transferring the knowledge and skills from the one context (often highly supportive and carefully designed) to the real context of large classes, packed curricula of the normal programme, is a difficult and most often unsuccessful task, for both students and staff. Long years of experience, captured in research findings, has started to convince the academic sector that the kinds of changes that are needed, require fundamental structural change, as well as a radical rethinking of the mainstream educational process. Increased access with success can simply not be achieved through some fiddling on the margins with supernumerary remedial courses [20], [23], [24]. It is for the aforementioned reason that funding is allocated to foundation programmes.

B. Extended Programme Design

The following key principles were used during programme design:

– in the determination of learning outcomes, a forward-looking approach was adopted;
– in the instructional design, provision is made for the appropriate support at the right time - for this reason some of the foundation modules are presented in the second year;
– student support in the form of supplemental instruction and additional contact teaching time are part of all modules of the extended programme;
– additional contact time is scheduled for core modules;
– senior students are assigned to first-year students as mentors.

Stand alone courses were designed. Table II contains a summary of the programme design. The outcomes of these courses are directly linked to the mainstream courses and there is an overlap between the outcomes. All the courses marked with an (F) are foundation courses. It is important to note that although these students attend foundation modules, the normal course modules are attended together with other students and they are assessed in exactly the same way as students in the normal programme. Although they enter with a lower competency base, they exit by mastering the same learning outcomes. All courses from the normal programme are included in the extended programme. Students in the extended programme write the same examination papers as students in the normal programme. Although these students enter the system as "underprepared" and receive more support during the course of their studies, they exit with the achievement of the same set of learning outcomes.

TABLE II
Programme Design of Bachelor of Commerce (Economics and International trade)

	Year 1	Year 2	Year 3	Year 4
Semester 1	Accounting special (F)			
	Foundation Mathematics (F)	Foundation Statistics (F)		
	Critical thinking skills(F)	Introduction to Marketing Management	International Trade Geography	
	Business Management	Introduction to Programming	Introduction to Service Management	Product decisions
	Academic Literacy	Professional Skills Development	Introduction to Risk management	Fiscal and monetary policy
	Introduction to Economics	International Trade	Macro Economics	Applied ethics
Semester 2	Accounting special (F)	Foundation Statistics (F)	Understanding the Economic World	Economic Analysis
	Foundation Mathematics (F)	Procurement Management	Consumer Behaviour	Development Economics
	Business Management	Analytical Thinking (F)	Corporate Finance	International Business Communication
	Basic macro and micro economics	Mathematical Techniques	Micro Economics	
	Academic Literacy	International Finance		
	Statistics for Managerial Sciences			

As this paper focuses on Mathematics, the learning outcomes of the Foundation and normal first year Mathematics modules are outlined below:

Foundation mathematics is a standalone course running over two semesters of the academic year which is preparatory for the regular first level course in Mathematics in order to achieve a level of mathematical skills. The courses combine some aspects of regular course material with substantial foundation provision.

- demonstrate knowledge on an introductory level of functions, exponential laws, logarithmic laws, limit laws and other basic theorems;
- demonstrate knowledge of different types of graphs, solving systems of linear equations, linear programming problems in two variables, limits, analysing the rate of change of functions;
- apply and demonstrate mathematical concepts and properties by simplifying expressions and solving linear and quadratic equations and linear and quadratic inequalities.

Algebra and Analysis I is the normal first-year course with the following outcomes: Demonstrate fundamental knowledge of basic set theory and logic, the system of integer and real numbers, mathematical induction, permutations and combinations and the binomial theorem, the concept of functions, circle measure and trigonometric functions, inverse functions and inverse trigonometric functions, polynomials in one variable, rational functions, partial fractions, vectors and the operations between vectors, complex numbers, representations by polar coordinates, limits, continuity and differentiability of standard functions, indefinite integrals of simple functions, the theorem of L'Hospital and its applications, the use of derivatives in optimisation and in sketching curves; demonstrate problem solving skills by analysing familiar and unfamiliar problems, by using the knowledge of techniques to apply set notation and logic to systems of numbers, by proving theorems with mathematical induction, by determining the number of arrangements and selections from a set, by developing powers of first degree polynomials, by finding the limits, by using the theorem of L'Hospital, by calculating derivatives and indefinite integrals of simple functions and sketching the functions, by formulating optimisation and vectors, and sketching curves in polar coordinates.

In the next section the performance of students are analysed. The following marks of students were used

- Matric result. A distinction is made between Maths and ML;
- The final mark for Mathematics Techniques (hereafter referred to university maths).

As students in the extended programme only complete this course in their second year of study, two cohorts of students (2010 and 2011) were tracked. The results are categorized as the year in which the university maths paper was written. All results thus refer to the 2011 and 2012 data set.

VI. Performance Analysis

Levene's test and the t-test for equality of means were used to test the significance of the differences between the variables. The results are indicated in Table III. Since the difference between The Matric maths results and university results proofed to be statistically significant, the other lurking variables were not included in the findings.

TABLE III
LEVENE'S TESTS FOR EQUALITY OF VARIANCES

	Levene's Tests for equality of Variances		**T-test for equality of means**	
2011	**F**	**p-value**	**T**	**Df**
University Maths Equal variances assumed Equal variances not assumed	1.269	.261	-2.344 -2.300	499 358.134
Matric Mark Equal variances assumed Equal variances not assumed	31.215	.000	3.317 3.143	499 321.410
2012	**F**	**p-value**	**T**	**Df**
University Maths Equal variances assumed Equal variances not assumed	8.629	.003	-4.957 -4.935	1023 987.838
Matric Mark Equal variances assumed Equal variances not assumed	43.983	.000	3.450 3.415	1023 940.903

For the 2011 data set, Levene's test for equality of variances for the matric results has a significance of 0.000. This means that the variances are not equal and results should be read from the "equal variances not assumed" row. For the 2012 data set, both the university maths as well as the matric mark, has a p-value less than 0.05, indicating that in both cases the variances are not equal. The results for t-test for equality of means are summarized in Table IV.

TABLE IV
T-TESTS FOR EQUALITY OF MEANS

2011	**p-value**	**Mean difference**	**Std. Error difference**
University Maths Equal variances assumed Equal variances not assumed	0.19 .022	-4.970 -4.970	2.120 2.161
Matric Mark Equal variances assumed Equal variances not assumed	.001 .002	4.582 4.582	1.382 1.458
2012	**p-value**	**Mean difference**	**Std. Error difference**
University Maths Equal variances assumed Equal variances not assumed	.000 .000	-3.937 -3.937	.794 .798
Matric Mark Equal variances assumed Equal variances not assumed	.001 .001	3.522 3.522	.104 .105

For the 2011 data set, the results are statistically significant on a 5% point of meaning. For the 2012 data set the confidence level is 1%.

Having confirmed the validity of the data sets, a further analysis of the student performance is conducted. In Table III the number of enrolled students is summarised, as well as the average for Grade 12 Maths/ML and their performance in university maths.. The success rate of each cohort of students is indicated in the last column. Success rate is used in the context of course rather than programme performance and refers to the percentage of passes in relation to the total course registration. It is clear that the Grade12 ML results are not a good predictor for student performance in Maths. In 2011, a total of 6 students (12%) manage to obtain a higher score for Maths than ML. In 2011 the average mark for ML was 16.8% lower than the mark for Maths 1 and in 2012 the difference increased to 19.5%. What is however clearly evident from the results, is that students, who for some reason chose not the do pure maths at School, has the potential to complete a Mathematics 1 course at University level. The success rate of students in the extended programme, with ML, is higher than the success rate of students who met the minimum requirements for entering the normal programme. These students did not have additional support during their first year of study. Fig. 1 clearly indicates that students who took pure Maths as school level, and did not perform well (less than 40%), still performed better at University with proper foundational provision, than student who took ML and obtained a high score.

TABLE V
ENROLMENT SUMMARY

School Subject	Year	No of students	Grade 12 avg	First year avg	Success rate
BCom					
Maths	2011	25	52%	55.1%	76%
	2012	29	51.4%	58.7%	79.3%
Extended BCom					
Maths	2011	41	38.4%	63.7%	92.7%
	2012	191	36.7%	63.5%	89.5%
Maths Literacy	2011	49	74.4%	57.6%	79.6%
	2012	142	76.4%	56.9%	79.6%

It is clear that the introduction of extended programmes significantly contributed to a growth in student numbers. Whilst the student numbers in the normal programme grew with 16.7% in two years, the enrolment growth in the extended programme was 270% over the same period. These students would not be allowed to enrol for the BCom programme was it not for the lowering of admission requirements and the acceptance of ML and not pure Maths.

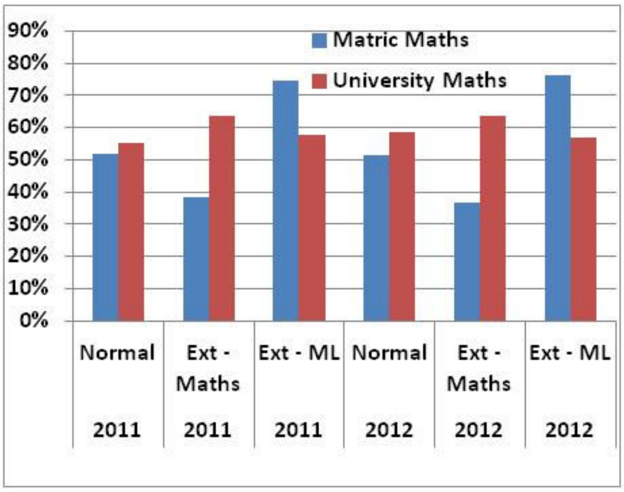
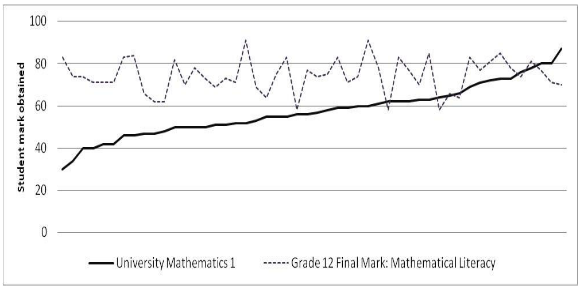
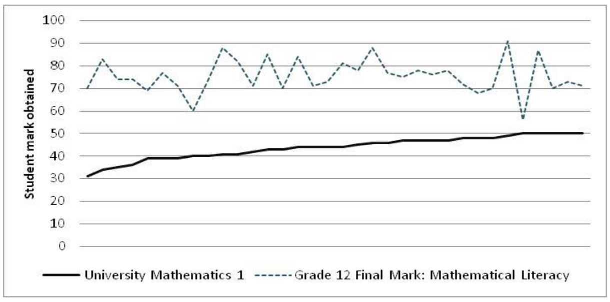


Fig. 1 Average of student performance



(a) 2011

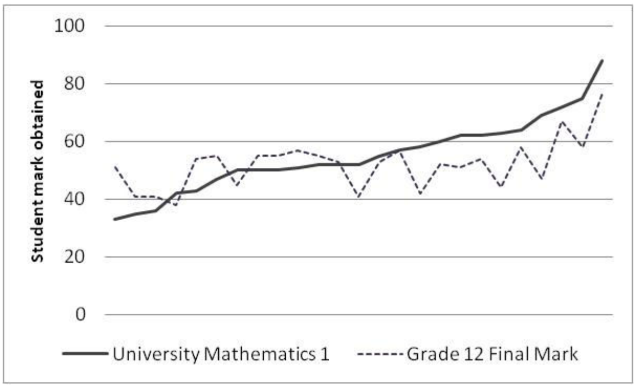


(b) 2012

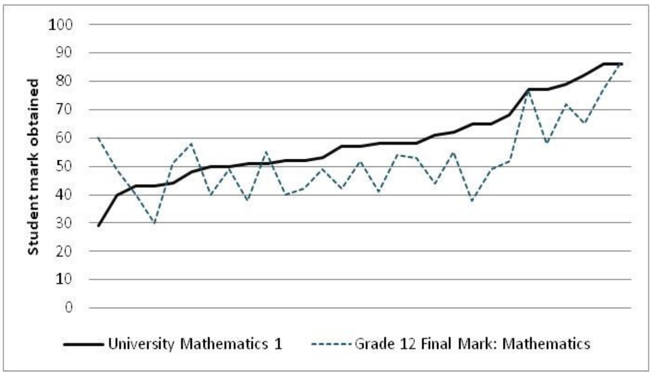
Fig. 2 Performance of students in extended programme with ML in Grade 12

Fig. 2 contains two line graphs that graphically illustrate the individual performance of students in Grade 12 ML versus University maths for the two consecutive first year intakes. It is clear that ML marks are significantly higher than their performance in university maths.

Fig. 3 and fig 4 contain line graphs that graphically illustrate the performance of students in Grade 12 Mathematics versus University Maths for two consecutive first year intakes. The first set of graphs is for enrolments in the normal programme, whilst the second set of graphs is drawn from the results of students in the extended programme.



(a) 2011

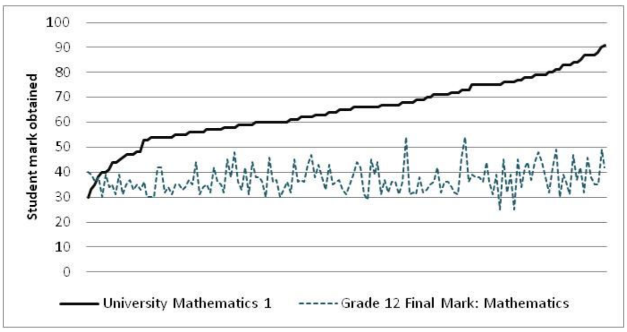


(b) 2012

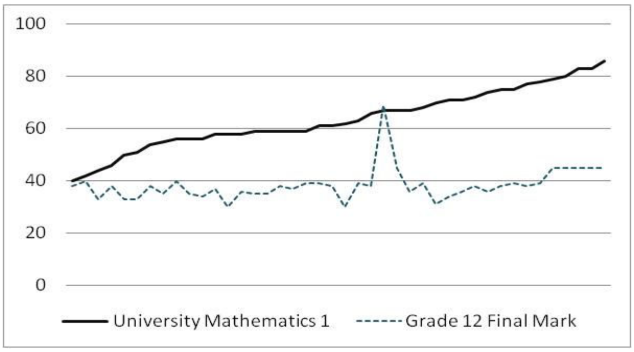
Fig. 3 Performance of students in the normal programme with Gr 12 Maths

The following can be deducted from the graphs:

- The University maths results in Fig. 3 correlate best with the Grade 12 results. One can therefore conclude that a Grade 12 Maths result of more than 40% prepare students sufficiently for University Maths.
- The majority of borderline case students, who just met the minimum requirements to enter into the normal programme, did not pass university maths. If these at-risk students could be indentified beforehand and placed in the extended programmes, their chance for success would be enhanced.



(a) 2011



(b) 2012

Fig. 4 Performance of student in the extended programme with Gr 12 Maths

The results in fig. 4 are clear evidence of the success of the extended programme. The following can be deducted from the graph:

- These students entered university without meeting the minimum requirements for mathematics. They completed 2 maths foundational provision courses (offered over a year), before enrolling for University Maths. Fig. 4 displays the final results in University maths.
- The performance of the student is on average much higher than student who entered university with ML. It is clear that students who entered the system with a Mathematics result of less than 40%, still perform better in a degree programme with maths as part of the curriculum, than students who entered the Commerce degree qualification, with a Mathematical literacy mark of more than 70%.

The above results confirm that a well designed extended curricula with appropriate foundation provision has the potential to increase the success rate of students in higher education. There was a tremendous growth in student numbers, confirming that extended programmes can be used to increase access without compromising quality.

V. Conclusion

This study confirmed that an extended programme with integrated foundation provision can open access with an equal focus on success. Higher education institutions are the bridge between the school system and the world of work; therefore they can neither ignore the realities of the school system, nor the demands from the economy. The ideal long-term solution will be to provide input and contribute towards the development of appropriate learning outcomes in Mathematics in the school system to ensure a seamless articulation from School to University. For the foreseeable future higher education will have to take ownership of the demands on its doorstep. Sufficient support, a forward looking curriculum, sufficient attention to critical thinking skills and logical problems solving, are building blocks that can be successfully introduced at university level. A limitation of the study is that a cohort of students that enrolled for the extended programme, has not graduated. A cohort study would provide a comprehensive picture of student's journey through the complete programme and would be empirical proof of how extended programmes can contribute towards addressing a national problem.

It is clear that students who entered the system with a Mathematics result of less than 40%, still performed better in a degree programme with maths as part of the curriculum, than students who entered the commerce degree, with a Mathematical Literacy mark of more than 70%. This raises a serious questions about the offering a school subject, including the word "Mathematics", which clearly do not provide a sound Mathematical foundation. These findings suggest that a name change by removing the word "Mathematical" as part of the name "Mathematical Literacy", since the current name is misleading. A proposed name can be "Numeracy".

Whatever the reasons for underprepared students in Maths, the challenge that universities must face in South Africa today is to increase opportunities for students to enter degree programmes in scarce skills areas with a focus on maintaining and further enhancing academic quality. The findings of this study are a positive indicator that it is possible. These preliminary results provide strong impetus for the introduction of four-year degree curriculum for those students deemed to need it.

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