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EXTENDED CURRICULUM PROGRAMS AS A SUPPORT MECHANISM TO ENHANCE SOUTH AFRICAN UNDERGRADUATE SCIENCE STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS

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Abstract

The complexity of the articulation gap between school and higher education posed enormous challenges to institutions of higher learning in South Africa. In response to this predicament, various strategic interventions were adopted with a view to adequately address student under-preparedness for tertiary studies. As a gateway knowledge domain, mathematics forms an integral part of various curriculum programs geared towards the cultivation of skills required by the mainstream economy. However, inadequate student academic performance in mathematics remains a pervasive pedagogic challenge afflicting meaningful enhancement of human capital development through inculcation of critical skills. In recognition of this fundamental challenge, undergraduate science students' academic performance in mathematics was tracked over a two year period as part of a longitudinal study at a South African university with a view to assess the efficacy of the remedial interventions underpinning the concomitant extended curriculum program. The students were enrolled for a degree program in science specialising in Analytical Chemistry. In addition, the students were placed in the extended curriculum program by virtue of their inadequate overall admission score. The student cohort constituted a purposive sample within the context of this study. By its very nature, the intrinsic structure of the concomitant extended curriculum program makes provision for the implementation of remedial interventions to provide critical academic support to the students as they are viewed as at-risk cohort by virtue of their profile. The duration of the extended curriculum program is longer than the normal duration of a mainstream curriculum program. The students were divided into two groups according to the profile of their overall admission score. Analysis of student academic performance in mathematics over the two year period revealed disparity in the performance of the two groups. Students in the group with a comparatively higher overall admission score demonstrated a higher academic performance in mathematics during the period under review. While the students with a comparatively lower overall admission score derived benefits from the remedial interventions put in place, there is a crucial need to reconfigure the inherent structure of the remedial interventions in order to address the performance disparity between the two groups. Theoretical implications for meaningful curriculum reform are discussed.

Keywords: *Articulation gap, remedial interventions, curriculum reform.*

1. Introduction

The complexity of the articulation gap between school and higher education in South Africa remains a fundamental challenge afflicting the provision of higher education particularly in the mathematics, science, engineering and technology arena. South African higher education institutions responded in a variety of ways to student under-preparedness for tertiary studies. Extended curriculum programs were introduced as a support mechanism to enhance the academic performance of undergraduate science students in mathematics in particular. While the dawn of democracy in South Africa engendered significant increase in access to higher education for previously disadvantaged students (Mentz, 2012), inadequate student academic performance in mathematics as a key knowledge remains a key area of concern. It has been acknowledged by a vast array of research studies that persistent problems limit the quality of learning and therefore constrain student success (CHE, 2013; Letseka 2005; Badat, 2009; Scott et al, 2007). Other researchers call for a critical appraisal of the remedial interventions and sociocultural and knowledge practices of universities with a view to improve the overall student academic performance across disciplines (Morrow, 2009; Jansen, 2004; Marshall & Case, 2010).

At a policy level, the National Development Plan (NDP) envisages an overall 23 percent target in undergraduate graduation rate by 2030 (CHE, 2013). This ambitious projection hinges to a large degree

on the critical examination of the impact of institutional policies and conditions on students' academic success (Tinto & Pusser, 2006). It is against this background that this research study primarily focused on the efficacy of extended curriculum programs as a support mechanism to enhance undergraduate science students' academic performance in mathematics as a key knowledge domain.

2. Research design and methodology

This study adopted a cohort design as it involved participants who are united by some commonality or similarity (Healy & Devane, 2011). The cohort consisted of undergraduate students enrolled for an extended curriculum program in Analytical Chemistry during 2017 and 2018. This cohort constituted a purposive sample within the context of this study. The students were divided into two groups according to the profile of their overall admission score. The student academic performance in mathematics was tracked over a two year period as part of a longitudinal study at a South African university with a view to assess the efficacy of the remedial interventions underpinning the concomitant extended curriculum program. The module identification codes for the two groups of students are MATCXA1 and MATCXB1, respectively.

3. Results and discussion

The curriculum content of the Mathematics Module offered is depicted in Table 1 below.

Table 1. Mathematics curriculum content.

Functions and relation
Algebraic graphs
The binomial
Determinants
Transcendental functions
Exponents and the exponential function
Logarithms
Graphs of the exponential and logarithmic functions
Formulae
Trigonometric function
The meaning of complex numbers
Algebraic operations with complex numbers
Differentiation
Limits of functions
Rates of change
Rules for differentiation
Derivatives of transcendental functions
Higher derivatives
Applications of differentiation
Integration

Academic performance demonstrated by the two groups during 2017 and 2018 is illustrated in Figure 1 and Figure 2 below. While the academic performance during 2017 for MATCXA1 was satisfactory, the academic performance for MATCXB1 remained inadequate as reflected in Figure 1. The academic performance trend exhibited by the two groups during 2018 remained largely similar. In particular, students belonging to the group MATCXB1demonstrated notable inadequate academic performance. This performance trend appeared to be commensurate with the profile of the two groups in terms of their overall admission score. Students in MATCXA1 group were admitted on the basis of a higher admission score as compared to students in the MATCXB1 group. A research study conducted by McDonough (1997) found that students from low socio-economic backgrounds usually attend high schools that are poorly resourced and students are not well prepared for university and may have no career guidance services. The performance trend demonstrated by the two cohorts can also partly be attributed to the complexity of the cognitive demands associated with the mathematics curriculum content itself as well as the contextual factors such as the institutional culture. This notion is consistent with the assertion that the social and academic institutional culture ought to provide a conducive teaching and learning atmosphere that makes provision for diverse cultural capital and adapts to diverse student needs (Thomas, 2002). In addition, various research studies posit that contextual factors such as equity of opportunity and outcomes critically depends on supportive institutional environment, culture, curriculum innovation, appropriate induction and support in academic learning (Badat, 2010; Boughey, 2005; Scott, 2013; Gorinski & Abernety, 2007). According to Letseka (2005), inadequate academic performance can be attributed to other key factors which include the dysfunctionality of the education system and student

under-preparedness for higher education. There is a crucial need for key remedial interventions embedded within the extended curriculum programs to be responsive to students' academic needs in order to break down barriers that inhibit meaningful learning.

Figure 1. Student academic performance during 2017.

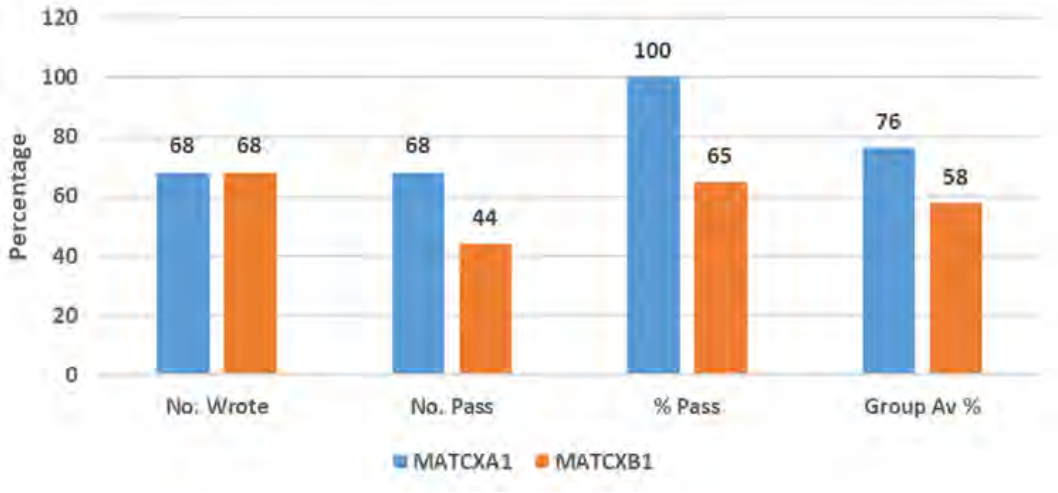
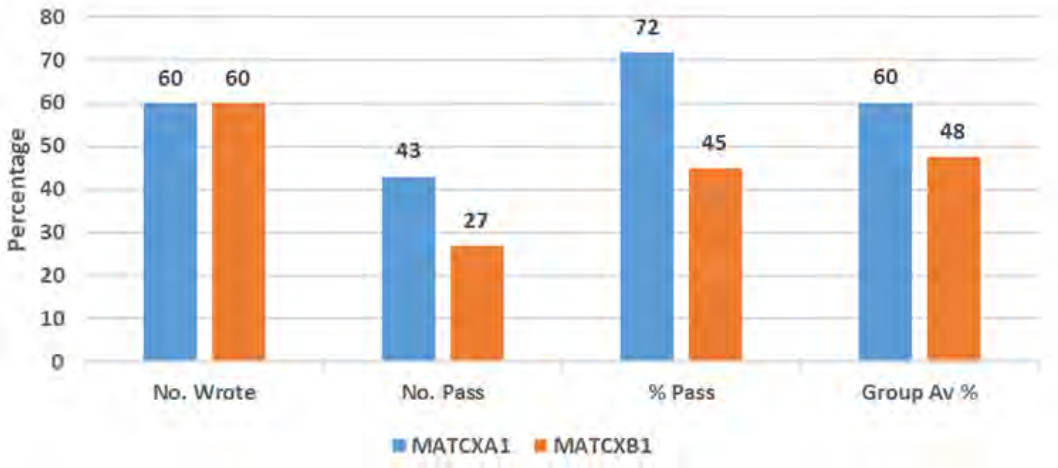


Figure 2. Student academic performance during 2018.



The academic performance across the various percentage bands during 2017 is illustrated in Figure 3 and Figure 4 below. The academic performance of the majority of students (54%) fell within the 75%-100% band in relation to group MATCXA1. However, the academic performance of a substantial number of students in this group fell within the 50%-74%. The academic performance in relation to group MATCXB1 presented a mixed picture across the percentage bands with the performance of a significant majority falling within the 50%-74% band. The complexity of the articulation gap between school and higher education afflicts meaningful provision of instruction that is responsive to the critical needs of students. This predicament ought to be viewed within the context of the seriousness of the need to address the articulation gap between the demands of higher education and the preparedness of school leavers for tertiary studies. Kuh, Kinzie, Bridges and Hayek (2007) advocate for early interventions and continued support to students as these key undertakings would serve to provide meaningful opportunities for students to engage in beneficial educational activities which make it possible for students to connect with others within the institutional environment. As observed by the Department of Higher Education and Training (2011), meaningful efficacy of extended curriculum programs can be achieved through sustained focus on the improvement of the quality and impact of learning and teaching resources for meaningful pedagogical access.

Figure 3. Academic performance across various percentage bands during 2017: MATCXA1.

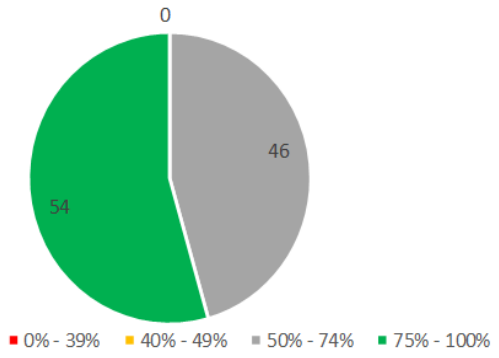
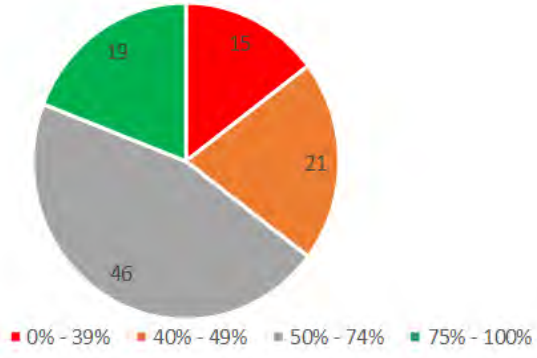


Figure 4. Academic performance across various percentage bands during 2017: MATCXB1.



As reflected in Figure 5 and Figure 6 below, the academic performance of a substantial number of students during 2018 fell within the 50%-74% band. The overal academic performance of the MATCXB1 group remained strikingly inadequate.

Figure 5. Academic performance across various percentage bands during 2018: MATCXA1.

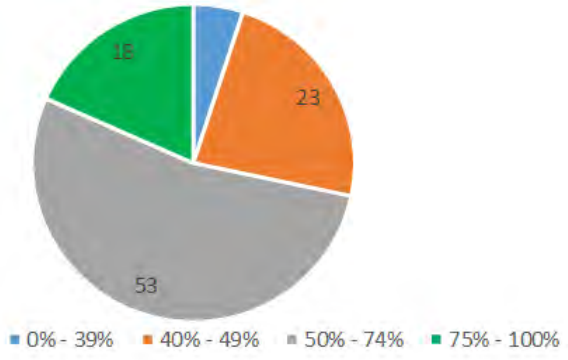
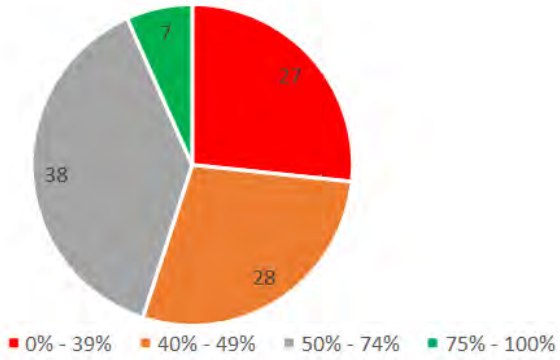


Figure 6. Academic performance across various percentage bands during2018: MATCXB1.



4. Conclusions

There is a crucial need for the inherent structure of extended curriculum programs and the concomitant remedial interventions to cater for diversity in terms of the profile of students entering universities. This key strategic imperative calls for the reconfiguration of the structural nature of remedial interventions employed in order to enhance student academic performance. While extended curriculum programs proved beneficial to students since their inception, there is a need for constant monitoring in order to ensure their efficacy going forward. As a key strategic imperative, extended curriculum programs ought to be characterised by provision of adequate resources and well-organised learning opportunities that would serve to maximise students' academic experience required for meaningful human capital development.

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