



Closing the gap between secondary school and higher education

The story of a Mathematics and Science University Preparation Programme in South Africa

Anneke Müller, Stellenbosch University Centre for Pedagogy

Over the course of the 20th century, the type of skills people needed to feed economic growth evolved. In the so-called industrial economy, people worked primarily in factories, whereas during the knowledge economy, the need for people 'to think' grew. "No longer hired hands, they hired heads", says Dov Seidman (2014)¹. The knowledge economy's need for 'head' skills led to an increased participation of people in higher education (HE) (Osborne & Shuttleworth, 2004; Kuh, Kinzie, Schuh, & Whitt, 2005). This rise in the number of people entering HE not only puts pressure on the availability of places and resources at institutions (Lee, 2010), but the system is also faced with issues such as how to deal with a more diverse student population.

As in the rest of the world, many South African learners are, however, inadequately or ill-prepared for HE² (Negash, Olusola, & Colucci, 2011; Osborne M. , 2003; Letseka, 2009; Scott, Tolson, & Huang, 2011; Spaul, 2013). Alternative access routes to HE have developed internationally to address this challenge of ill-preparedness (Mabila, Malatje, Addo-Bediako, Kazini, & Mathabatha, 2006; Osborne & Shuttleworth, 2004).

Access programmes vary between countries and by type of programmes offered. Lee (2010), for one, categorises these programmes into pre-entry, entry and post-entry programmes. What all access programmes have in common, though, is that these programmes take students one step closer to entering HE and that students have to invest additional effort and time to successfully access HE.

¹ To indicate how this changes, Seidman, notes that we are currently in the "human economy" where the most valuable workers are those with hearts (Seidman, 2014). The know-how that is needed to be successful is humanity.

² The reasons for this will not be discussed in this article. It is a topic in its own right.



I find the term 'epistemological access' very useful to discuss access as it implies activity by the student. This term was coined by the late South African philosopher of education, Wally Morrow, to democratise access to HE in the apartheid regime. Morrow describes epistemological access as "[to] learn how to become a participant in an academic practice is to learn the intrinsic disciplines and constitutive standards of the practice" (Morrow, 2009). The way I understand this is that access is a process in which a student, over time learns how to become a learner (student). This is the approach of the university preparation programme, offered at Stellenbosch University in South Africa, and that I discuss in this article. The programme strives to assist students to acquire skills to not only become successful students but also to be lifelong learners.

What is SciMathUS?

SciMathUS³, as already mentioned, is a year-long university preparation programme at Stellenbosch University in South Africa. It affords students from educationally disadvantaged circumstances, who do not meet the entry requirements to be admitted to HE for undergraduate studies in STEM⁴ and Accounting related careers, a second opportunity to do so. Only a Bachelor's pass⁵ in the final National Senior Certificate (NSC) examination qualifies students to enter any tertiary institution in South Africa. Students in SciMathUS therefore redo Mathematics and Physical Sciences in order to improve those results to have the opportunity to reapply for undergraduate studies in HE. Students may also choose to do Mathematics and Accountancy and Introduction to Economy. This group only rewrites NSC Mathematics as the commerce subjects are taught and assessed by Stellenbosch University.

Although the programme offers tuition in line with the school curriculum, it is not a revision year. It prepares the students for independent study in HE.

In order to be successful in HE, the students are expected to work hard from the first day. The students further have to realise the importance of continuous improvement and not only work hard to obtain a good mark in a test or examination. But to be successful at university, students need more than just sound subject knowledge.

³ The acronym is derived from the words Science and Mathematics at Stellenbosch University.

⁴ STEM = Science, Technology, Engineering and Mathematics

⁵ The minimum admission requirement for undergraduate studies in South Africa at the time of this article is a National Senior Certificate (NSC) achievement rating of 4 (adequate achievement, 50%–59%) or better in four subjects chosen from a designated subject list and a minimum of 30% in the language of learning and teaching of the higher education institution concerned (Umalusi, 2015).



They need to be skilled students equipped with well-developed reasoning, interpersonal and problem solving skills. These skills are developed in additional subjects such as Academic Literacy, Study and Thinking Skills. Students have to realise that good time management, the value of a balanced life, good meals, enough rest, the development of self-esteem, to be able to make a valid and valuable contribution during an argument in class, to mention only a few attributes, are just as valuable as improving the scores in Mathematics and Physical Sciences.

Additionally, students complete a basic computer skills course designed to orient them to ICT skills required at the undergraduate level.

The programme follows an active learning pedagogical approach. Active learning is defined on a number of international universities' web sites as "a process whereby students engage in activities, such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of class content. Cooperative learning, problem-based learning, and the use of case methods and simulations are some approaches that promote active learning."

Active learning in SciMathUS also entails a shift from what educators teach to what students learn; lecturers act as facilitators and actively manage the learning process as this occurs in class. The programme expects the students to take responsibility for their own learning and to become actively involved in the learning process. This challenges them to discover how they learn, how others learn, how to find and apply appropriate learning resources and strategies and to learn how to think critically. This approach further emphasizes self-directed learning as the students have to reflect upon and control their own learning activities: skills necessary in HE and critical to lifelong learning.

Active learning in SciMathUS is also expressed in the presentation of research projects in Mathematics and Physical Sciences or Economy at the end of the academic year. Apart from submitting written assignments, they have to exhibit their presentation skills (verbally and technically) when they present their work to the rest of the class.

Success of the programme

Since 2001, the SciMathUS students have on average improved their results in each of the core subjects by more than 15 percentage points. There are regularly students who manage to improve their results by more than 30 percentage points.



About 100 students are accommodated in this programme per year. Over the past 15 years, just more than 1000 students have qualified to access HE after they had successfully completed this programme. On average 75% of the students per intake enrol at Stellenbosch University in degree programmes such as Health and Medicine, Engineering, Natural and Agricultural Sciences as well as in Economic and Management Sciences.

The programme attempts to keep track of all former students but only has verified data on students who enrol at Stellenbosch University. Tracking students at other higher education institutions is a huge challenge as the data is not available. What further complicates the tracking of students or reporting on the progress of the students as a cohort, is that not all the SciMathUS students enrol at SU directly after finishing the programme successfully. Some do so later.

In the process of collating the statistics about former students, it has become very clear that there are many students who have to overcome many difficulties and obstacles while studying. This is confirmed in a study by Lourens (2013) about student experiences at Stellenbosch University and in line with findings of numerous international studies such as those by Pascarella, Pierson, Wolniak and Terenzini (2004), Tierney, Colyar and Corwin (2003), Tierney and Colyar (2009) and Tinto (2006-2007; 2012) over time.

Most of the SciMathUS students are so-called "first generation" university students. Some of them are under huge pressure to perform well and to finish as soon as possible so that they can start supporting the rest of the family. Some are even expected to do so while they are studying. Some students leave the university after a year or more with nothing but a huge debt. Others leave to earn something and may return when they have sufficient funds to continue with their studies, to this institution, sometimes even at a different institution. Others just do not return at all. Only a small number of students manage to finish their degree programmes in the minimum number of years required to do so⁶.

The programme, however, is excited about each student who successfully completes his or her degrees (some even with a distinction in a specific subject), even if it takes a year longer. One third of the students who enrolled at SU graduated with first qualifications at SU between 2005 and 2014. This is 30% of the total number of students.

⁶ The reasons for this are numerous but will not be discussed in this article. Volumes of literature about access and success put forward by the multitude of research studies about this emphasise the complexity of the issue and this is also acknowledged by this author. Success and performance cannot be discussed without acknowledging the factors that influence them.



A number of them are still enrolled, working towards graduation. A further 30% of these first graduates also obtained a second qualification and a third of this group, a third degree. SciMathUS is extremely proud of its two former students who completed PhD-degrees at the end of 2014. It is enormously encouraging to see how people's lives change from one without hope to one where the sky is the limit.

One former SciMathUS student, who obtained a Master's degree in Science earlier in 2015 and who is enrolled in a programme towards obtaining a PhD, says the unlimited support and motivation she received during the year-long programme, contributed to her success.

"SciMathUS has given me a second chance to get the marks I needed to be accepted into the study programme of my choice, and ultimately, it opened the door to a world I never knew outside of the community I lived in, where my future prospects were bleak at best."

Anneke Müller is Marketing Manager at the Stellenbosch University Centre for Pedagogy (www.suncep.sun.ac.za). She is interested in student access and success. This originates from being involved in SciMathUS, the Science and Mathematics bridging programme at Stellenbosch University in South Africa for the past 15 years. She is responsible for the marketing of, and fundraising for the programme.

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