

The Whole is Greater than the Sum: A Longitudinal Study of Demographic Influences on Medical Student Assessment Scores

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Abstract

The literature on academic success has contributed to our understanding of positive and negative influences on learners' accomplishments. With some exceptions, however, their subjects have been school pupils, who represent the community at large. Relatively few studies have examined tertiary education students, and these studies generally focus on subsets of a particular factor in isolation.

Taking a systems theory view, we addressed the question: What factors regarding the learner contribute to the teaching and learning 'system'? Using mixed methods, this longitudinal study explores a range of demographic characteristics that influenced the assessment scores of medical students through their five-year curriculum.

For the initial analysis we used the general linear model. A generalised estimating equation was used to analyse the characteristics collectively to assess their influence relative to each other. Students' and staff members' opinions on these factors were also explored through thematic analysis.

Of the nine factors investigated, only four appeared statistically to exert independent influences on students' academic achievements. These four influences (high school attended, previous higher education experience, the sequence of tests through the years, final school-leaving marks) seemed to

apply throughout the five year course. The variety of our interviewees' responses helped us to understand the nuances of these influences.

While not negating the findings of studies on isolated factors, this study does also challenge the validity of such analyses. The use of a different methodology – two layers of statistical analysis, plus qualitative data – allowed us to demarcate which of the factors examined appeared to be of overall significance in the system related to student achievement in assessments, and to understand why that might be so.

Keywords: demographic influence, medical students, student achievements, learner accomplishments

Introduction

'Each curriculum has specific requirements, favoring students with specific capacities related to motivation, competence, and sociodemographic factors' (Frischenschlager, Haidinger, & Mitterauer 2005: 59). This study, and others (Bloch 2009; Breier & Wildschut 2006; Christie, Butler & Potterton 2007; Coleman 1966; Kusurkar *et al.* 2010) examine factors influencing academic success. They document the effects of learners' age, culture, ethnicity, gender, health, language, and socioeconomic status, and of schools' ethos, leadership, staffing and physical resources.

The literature on academic success has contributed to our understanding of positive and negative influences on learners' accomplishments. With some exceptions, however, their subjects have been school pupils, who are representative of the community at large; relatively few studies have examined tertiary education students, who are a selected academic population. Additionally, such studies generally focus on subsets of a particular factor, and quantify the effects associated with these subsets in isolation. In reality, every learner represents a combination of several interacting factors. While yet more studies of single characteristics may contribute further pieces of the complex mosaic that is academic achievement, they are not likely to help us to understand how the pieces fit together, or how they interact to produce a positive or negative effect overall.

The medical school described in this study has been racially integrated for some 20 of its 60 years of existence. Undergraduate students

are currently admitted under a race-based quota, which contributes to the diversity of the academic community and brings its own challenges and contestations.

This article describes the first phase of a larger study (Sommerville 2012) using mixed methods to explore and describe demographic characteristics that might influence the assessment scores of medical undergraduates. To investigate the extent of factors' influence, we have examined students' marks in assessments throughout their five-year curriculum, rather than at a single point in time.

We describe the literature on demographic factors influencing academic achievement, and the methodology we used to examine these factors. The statistical method employed to compare aspects within each factor and that used to examine factors in combination are explained, and students' and staff members' opinions on these factors are illustrated. In conclusion we discuss the implications of the factors that appeared statistically to exert independent influences on students' academic achievements.

Elements Relating to Success or Failure in Higher Education

A number of factors appear to influence learners' academic achievements. Fraser & Killen (2005) and also Ngidi (2007) conducted studies at three South African universities, choosing a historically white, a historically black and a distance education institution. At the two contact universities, six of the top ten items identified by both students and lecturers as contributing to students' academic success had to do with motivation and application. The remainder of the students' factors covered similar aspects, while those of the lecturers included one item related to cognitive skill i.e. logical reasoning ability. Both students (33rd of 34 items) and lecturers (29th of 34) ranked general academic ability relatively low.

Relating to failure, three factors were common to both students and lecturers, although ranked differently. These factors related to students' application to their studies. The students included two aspects related to cognitive ability in their top ten. These were 'inability to perform well' and 'inability to distinguish between important and unimportant information'. The lecturers included two cognitive factors in their top ten: 'failure to attain the required depth of understanding' and 'inability to use higher order

thinking'. Students and lecturers ranked 'lack of academic ability' as 36th and 16th respectively.

We find it telling that most of the factors perceived as significant were not cognitive. This suggests that students' backgrounds in a broad sense may be significant with regard to their engagement with their studies, and thus may influence their academic achievement. Kuh's review of the literature on student success (2006) describes 11 background characteristics that provide its foundation, only one of these 11 – academic intensity in high school – relating directly to students' cognitive ability. Kuh *et al.* (2006) acknowledge the dominance of Tinto in this field; although Tinto's initial approach was in terms of student failure (Tinto 1987), we note that more recently (Tinto 2005: 2) he addressed student success, making the point that 'student success, however defined, is built upon success in one course at a time'.

The literature appears equivocal as to whether or not previous higher education experience (as distinct from age) is a significant influence on academic performance. A meta-analysis (Ferguson, James & Madeley 2002) suggests that past academic performance – without separating higher from secondary education – is a significant influence on future achievement, as one might expect. A study looking specifically at medical students with prior degrees concludes that age may be a more substantial influence than having a degree (Wilkinson, Wells & Bushnell 2004) regarding approaches to learning, motivation and attitudes, rather than marks. Others have commented on the risk of younger students allowing more mature students to take over the process in small-group learning (Benbow & McMahon 2001), but again this would not necessarily be reflected in the students' marks.

Elements Relating to Success or Failure in School

Christie *et al.* (2007: 9) reported that '...it is likely that the school attended may have more predictive value for post-school educational success than individuals' capabilities and effort'. The complex factors affecting education have been noted (Ball & Bruner 2006; Coleman 1966; Forde 2007; Henig *et al.* 1999; Simkins & Paterson 2005). Certainly, there are schools in South Africa that have been identified as being effective despite their having the same socioeconomic challenges as do other schools with a lower commitment

to education (Christie *et al.* 2007). Simkins and Paterson (2005) ascribe 10 – 30% of the variance that they found in language and mathematics performance of South African high school learners to the schools themselves. Bloch (2009) shows that the effects of poor schooling carry through to university: he records a 45% drop-out rate overall and notes that 67% of black students take longer than expected to complete their degrees. Haeck *et al.* (1997) and Yeld (2003) both point out that schooling affects higher education achievement. In terms of the quality of schools, Simkins and Paterson (2005), and Bruner (2006), comment on the tendency for the perceived disadvantages of rural schooling to be aggravated by urbanisation. This tendency may be part of the explanation for the ‘elusiveness of education reform’ noted by Henig *et al.* (1999). Forde (2007) writes of the struggles of black high school students on the Cape Flats (on the outskirts of Cape Town) to succeed despite a home background of hunger, lack of resources, and family responsibilities, and a school environment of rundown buildings, too many pupils, and too few desks, books and teachers. Ball’s (2006) book echoes this description. Kohr *et al.* (2007) compare achievement in mathematics in various Pennsylvanian high schools with respect to socioeconomic status, sex and race. They find no differences attributable to sex, but that white students generally fared better than black students, and that black students were disproportionately disadvantaged in schools serving low socioeconomic areas. These findings appear to confirm exactly one of the findings of Coleman’s (1966) landmark study from forty years previously, which documented that race and socioeconomic disadvantage were commonly linked and that Afro-American students tended to do worse in schools serving that group exclusively.

It is evident from the range of topics dealt with in the literature on teaching and learning that several factors may influence academic achievement. Essack *et al.* (2010) analysed student throughput data in various health sciences, from the perspective of institutional support. In this article, we address a number of demographic factors and their interaction, which may serve to identify both successful students and those who may need assistance.

Methodology

Ethics approval and gatekeepers’ permission were obtained from the University of KwaZulu-Natal (UKZN). Interviewees gave written informed

consent. Taking a systems theory view that each element in a system affects, and is in turn affected by, other elements (Laszlo & Krippner 1998), and bearing in mind the work of Essack *et al.* (2010) on the aspects of teaching, we addressed the question: What factors regarding the *learner* contribute to the teaching and learning ‘system’? We used mixed methods, delineating quantitatively which demographic factors were influential, and illuminating these qualitatively by the reasons given by respondents for the significance of these demographics. (In terms of Greene *et al.* (1989), this study would be categorised as ‘Complementarity’, corresponding to the ‘crystallisation’ of Richardson and St. Pierre (2005). Just as different facets of a crystal give different views of the interior, so quantitative and qualitative methods provide complementary insights into the object of study. Following the systems theory research sequence (Laszlo & Krippner 1998), we explored the existence of discrete entities, striving for understanding of these factors in order to integrate the perspectives thus gained into an understanding of the whole. The authors, as members of staff, had extensive contact with students, but were not directly responsible for assessments. We have each worked at the medical school over a number of years and consider ourselves informed interpreters (Eisner’s (1998) ‘connoisseurs’) of the qualitative information that our respondents shared with us.

Quantitative

We documented the assessment marks of a complete first-year medical class as a convenience sample, and followed them for the five years of their programme. To enable direct comparisons to be made, we traced only those students who progressed with the cohort; students who dropped out or failed were not followed any further. We did not include all assessment marks in the first three years, when material was assessed a second time at the end of each semester. Thus, the marks analysed represent students’ first summative assessments at each stage, whether theoretical or clinical. Marks were analysed in terms of various demographic parameters available to us through objective records. Data such as students’ attitudes, home backgrounds, etc., were not included due to reservations about the accuracy of these data in our setting (Simkins & Paterson: 2005). The data gathered were:

Race’ (categorised according to the apartheid system: Black/ White/

Indian/ Coloured)

First Language

Sex

Age in first year

Source of finance (self or family/scholarship or bursary/ NSFAS¹ support)

Academic status (fresh out of school / higher education experience/graduate)

High school (categorised by socioeconomic quintile²)

Successive test marks (six to eight per year over the five year programme)

‘Matric points’³

Data were uploaded into MS Excel® spreadsheets, collated into one dataset, rendered anonymous by removal of identifying information, and transferred to SPSS®. For the initial analysis we used the general linear model (GLM), which is an all-embracing term that includes comparative tests such as the t test, ANOVA and regression analysis (Field: 2009: 350), and can include matrices representing sets of data to make multiple comparisons (Trochim 2006). The relationships between demographic characteristics and

¹ The National Student Financial Aid Scheme of South Africa was established by act of parliament in 1999 ‘to ensure that students, who have the potential, but cannot afford to fund their own studies, will have access to funding for tertiary education’. Available at: (https://www.nsfas.org.za/web/view/students/student_home/student_home).

² An indication of the socioeconomic status of the community surrounding the school – used by the government in calculating differential funding of schools based on ‘income, unemployment rates and the level of education of the community’. Available at: (http://www.create-rpc.org/pdf_documents/Policy_Brief_7.pdf).

³ For reasons of simplicity and transparency, the medical school grants admission to prospective students (primarily according to a ‘race’-based quota) secondarily on a point system based upon their school-leaving examinations (with extra weight being allocated to mathematics, science and biology marks).

A Longitudinal Study of Demographic Influences on Assessment Scores

the students' 32 test scores over the five years⁴ were examined, the programme taking assessment marks and subsets of a single characteristic for each separate analysis.

The GLM examined *individual* characteristics for their relationships to the students' marks over the five years (e.g. variation between students classified by 'race'). A generalised estimating equation (GEE) was used to analyse these characteristics collectively to assess their influence *relative to each other* (e.g. 'race' and language and school...). The GEE procedure allows repeated measurements to be analysed (e.g. student test marks on 32 occasions), and allows handling of clustered data (Hardin & Hilbe 2008). A GEE is able to test whether one or more factors is an independent influence on students' results. Use of a GEE also confers the advantage of being able to deal with multiple factors and multiple measurements over time, particularly when the time itself is not of primary interest (Liang & Zeger 1986).

Qualitative

When the study cohort was in the third year, halfway through their programme, and had experience of both preclinical and clinical phases, one author (TS) interviewed 19 students purposively chosen to represent the demographics of the class. Interviews were conducted in groups, or, on three occasions, individually. To stimulate discussion, a series of graphs was provided that depicted (past) students' assessment performance portrayed according to the demographic characteristics under study. Six lecturers, chosen from pre-clinical and clinical sciences, and from the spread of race groups represented at the medical school, were interviewed individually in a semi-structured format, and were also asked to comment on the graphs. The comments were recorded, transcribed, returned to the respondents for ratification, and then rendered anonymous. Themes were grouped according to the demographic characteristics studied.

Findings and Discussion

Of the 202 students in the first year class, 146 progressed to 5th year. The de-

⁴ Students who failed a year and dropped back to join the next cohort were not followed further and thus had fewer than 32 test marks analysed.

scriptive statistics, graphical relationships, and results of the multifactorial GEE analysis for the demographic factors explored are presented with the respective respondents' comments. The order of presentation is according to the relative influence of each factor according to the GEE (i.e. combined) analysis.

High School (5 – 11% Influence on Marks)

The high schools previously attended by 127 of the initial cohort of 202 students could be classified according to their quintiles. There were 9 students from quintile 1 (Q1) schools, 4 from Q2, 8 from Q3, 13 from Q4 and 93 from Q5. For the purpose of comparison, we added a 'sixth quintile', comprising 21 students from independent (i.e. non-state) schools.

Figure 1 illustrates that students from Q1 high schools did significantly ($p < 0.001$) worse than the rest, which were indistinguishable from one another. Although the Q1 line approaches the others during 4th year, this is as a result of most of the Q1 students having failed and fallen out of the cohort; the best of that group, who survived through to 4th year, failed that year, hence the Q1 trace ends. Although the other five quintiles appear to converge slightly between the beginning of 1st year and the end of 5th year, attrition of weak students may have had a similar effect to that seen in Q1. Having attended an independent (private) school (Q6) did not confer a particular academic advantage, possibly because resources at such schools are used for extracurricular activities as well as for directly academic pursuits. Finally, although Q2 schools were not statistically distinct from Q3 to Q6 schools, the Q2 line on the graph tends to lie above the others (although there were only four Q2 students and these four might simply have been exceptional individuals).

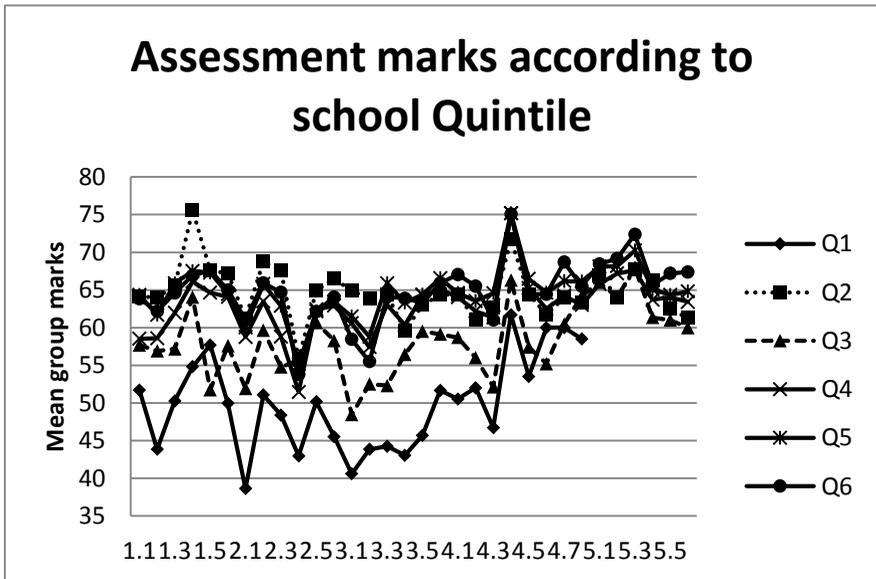


Figure 1 Aggregate Assessment Marks over Five Years According to Students' High School of Origin, Classified by Quintile.

x axis: Successive tests over five years (six tests per year except for eight in year 4).

y axis: Average mark (percentage) for students in each group.

Commenting on the relative capacities of different kinds of school to produce students with ability, one respondent said:

... the [ex-]HoD⁵ schools – I can talk for them – they are generally the ones that are living in the townships. They don't have the money; they go into school and they are very high achievers in terms of academia, because that's the only thing that they have.

Dr Pillay11; 533-536⁶

⁵ HoD: House of Delegates – the former legislative body for Indians.

Dr Pillay also pointed out some of the social circumstances that might have a bearing on schools in different areas.

... you have a lot of problems in townships, with lifestyle problems: the drug addictions; you really work under very difficult conditions in respect of peer pressure, etc., and I don't think it's the same for rural schools, with this alcoholism, parenting that's not there. Although they may not have parents and they may be migrant labourers, the fact that they're rural: they still have some kind of stability. [Mm] and safety.

Dr Pillay 11; 545-550

Dr Pillay's observations refer to the wider issues of culture that underlie the features of race and schooling. Zodwa, comparing two ends of the state school spectrum – namely former 'Model C' schools that charge fees to enable the hiring of extra teachers to reduce class size and increase the number of subjects offered, and rural African schools suffering from a presumed dearth of resources – saw the advantages of attending the former.

Children that are going to these [ex-] Model C schools and that do form part of the black community – they have it easier, I guess, and it's not that much of motivation. You know you've got back-up; you know you have your parents that are doing certain things for you. And those who are in the rural schools, they really need – they would take any chance to get out and do something with themselves so that they can bring something home. And some of them are really disadvantaged and the best way to – for them forward is to really push hard – and work hard.

Zodwa 1; 626-632

Dr Hlubi observed that there is more to education and learning than the type of school one attended. Despite being able to attend the same schools, external circumstances might differ to such an extent as to confer advantages on one group and disadvantages another group of learners.

The other problem *here* [i.e. at ex-Model C schools] is that – which people have complained about, even in the media – is that students

will be given assignments by the school, while they're still at school, before they even come to university. Now *these* [i.e. Whites and Indians] will go home and look at the newspapers, look at the internet and look in the library and do their assignments and be better prepared. *These* ones [i.e. Blacks] will go back to the township, although they are studying in a Model C school, which is a good school, but they go back to the township; it's not easy to get a newspaper, no computers, no Internet therefore, and no libraries, so *these* [B], it wouldn't be so easy for these to prepare that assignment than this one, therefore *these* [W, I] will be better prepared for university than *these* [B].

Dr Hlubi 13; 495-502

We assume that the government's categorisation of schools into socioeconomically-based quintiles provides an index of the quality and quantity of the resources available to those schools. However, assigning a particular school to a particular quintile does not automatically imply that the school is equivalent to all other schools in that quintile; indeed, it has been shown that some schools in straitened circumstances can deliver good quality teaching while others in similar positions cannot (Christie *et al.* 2007; Chutgar & Kanjee 2009). Numerous advantages and disadvantages of the various types of schools were advanced by the respondents. A student from a school perceived to be disadvantaged may excel in those adverse circumstances, and continue to excel when allowed access to higher education. This is likely to hold, whether the school is disadvantaged in terms of its location (rural) or in terms of its community's socioeconomic status (Q2). The local and international literature affirms that the quality of a school is reflected by the quality of achievement of its students, and that these effects may be long-lasting. What is surprising in this study is the magnitude of the effects (~ 11%).

In the GEE comparative analysis, the high school that a student attended appeared as the greatest influence on test marks. When considered in isolation, Q1 students can be distinguished from all the others, but in the GEE analysis all quintiles were highly significant influences (Q2 however still showing the largest effect). It is disconcerting that, so many years after the stratification of schools on a racial basis came to an end and resource allocation was instituted on a more equitable basis, the effect of having

attended a particular school is seen to loom over its past pupils for up to five years (Figure 1). While the literature supports the importance of schools as an influence, its duration appears not to have been previously documented.

Higher Education Experience (-8 – +8% Influence on Marks)

Of the 202 students in the initial cohort, 166 had come directly from high school, 19 had had a year or more of higher education, 10 had previously completed other degrees, and 7 were repeating the year. The marks of these four groups in successive tests are depicted in Figure 2.

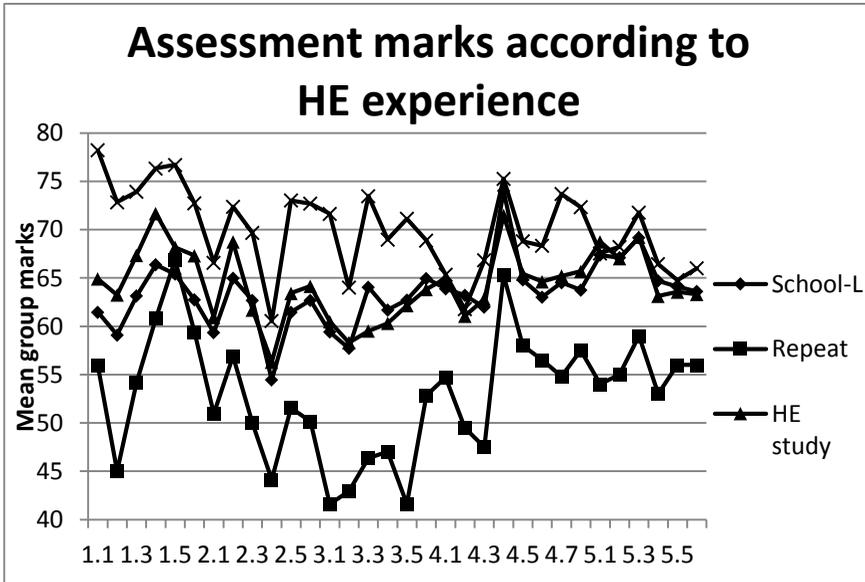


Figure 2: Assessment Results over Five Years According to Student Status in 1st Year.

School-L = school-leavers

Repeat = students repeating 1st year

HE Study = those who had already commenced some higher study

A Longitudinal Study of Demographic Influences on Assessment Scores

Degree = those who had previously completed a degree

Axes: as above

Analysis confirmed that students' previous academic status made a significant impact ($p = 0.002$) on their test marks. Because of small numbers in some of the groups, post-hoc tests could not be performed to determine exactly what the differences were between the groups. It can be seen that those seven students who were repeating 1st year continued to perform poorly. The exception was the test at the end of Theme 1.5. The greater clinical relevance of that Theme (Reproductive Health) might have helped these weak students. However, when they encountered new content in 2nd and 3rd year, their marks progressively deteriorated. The apparent improvement in the later years can be ascribed to students falling out of the cohort; only one survived to 5th year (but failed two assessments in that year).

Students directly from high school progressed adequately over the years, and both those with a year or more of previous exposure to higher-level study, and those who had previously completed degrees, excelled. A general pattern of dips at tests 2.1, 2.4 and 3.2 can be seen (see also Figure 3 – assessment averages). Although the gap between school-leavers and those with prior higher experience narrowed over the course of the programme, degreed students tended to maintain an advantage throughout.

Those students with limited higher experience tended in most tests to perform slightly better than did the school-leavers. This contradicts the view previously expressed, that students who were 'not good enough' to be selected for medicine on the basis of their school-leaving exams had found a 'back door' into medical school. These students, accepted by transfer from other degree programmes, established by their results that they did in fact have the capacity to cope with medical studies.

Comments on the relative achievements of the four groups of students reflected the expectation that students with some prior higher experience would perform much better.

I always have just thought that they would be the upper notch. Even during exam stress time, those that we do stay with around close, they are our friends – they have it all planned out. We're like 'OK, I'm still struggling'.

Zodwa 1; 519-52

I was expecting that the mature students would do better, because they are familiar with tertiary learning...

Dr Hlubi 13; 408-409

Those, like Lungi, who came to medical school with a prior degree, viewed students coming directly from school as being too young and inexperienced.

I think for, like the students that are coming from high school, it might have been a bit of a shock for them, and a bit of, like 'Wow – what's going on?' because for them, I remember in high school, we used to sit down from 8 to 6, get lectures, and the teacher would be there to solve the solutions and go through everything with you, and you study whatever's in the class. There's no – if you do a little extra work – the cum laude questions type of thing. So for them I think it might have been a bit of a difficult thing because you also have to remember it's not just about studying; it's about the, the mental maturity of the person.

Lungi 3; 37-43

There was a sense that students repeating 1st year were destined to struggle academically.

The repeats struggle is because they were isolated, or lost souls or –?

Dr Pillay 11; 438-439

In terms of those that are repeats, this is in keeping with what one observed in practice. [Mm] these repeat students tended to do very badly when they came to the clinical years and it's this group of students that there were a lot of failures and repeats, and even their performance was very poor.

Dr Hlubi 13; 401-404

Given that respondents were commenting on a (previous) graph that showed little distinction between school-leavers and mature students, the paucity of explanations for the latter's greater success in medical studies is

understandable. Our judgement, nevertheless, is that the various explanations advanced could well be valid for the groups of students referred to in this section. Apart from being intuitively believable, they agree with the evidence from the literature. Students' higher education background was the second most influential parameter in the GEE model. Having already completed a degree or having spent *any* time previously in higher education conferred an advantage – a completed degree having the greater impact. Not surprisingly, repeating 1st year (although this entailed previous – and highly pertinent – higher education experience) had a negative effect compared to entering directly from high school.

Sequence of Tests (2 – 3% Difference to Marks)

Of the 202 students who began 1st year medical studies together, the 146 who completed the five-year programme scored an average of 62.2% over the 32 assessments. This mark varied from test to test (Figure 3).

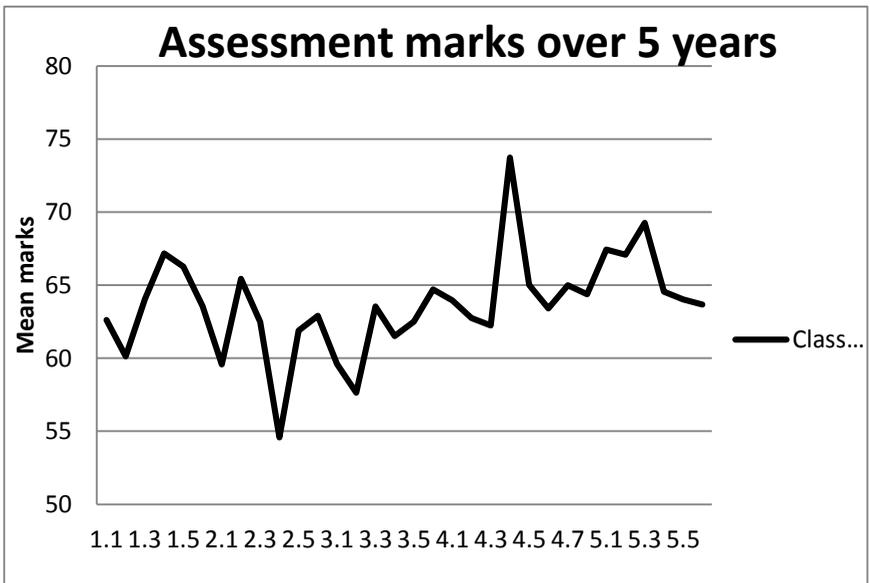


Figure 3: Class Average Assessment Marks over Five Years.

Axes as before.

Over the five years, a difference of almost 20% was evident between the lowest (2.4) and the highest (4.4) class average. Theme 2.4 ('Body in motion') is recognised to be a difficult Theme, as are the others with relatively low marks: 2.1 ('Cardiorespiratory') and 3.2 ('Cell dysfunction'), all of which contain content and concepts that students tend to find difficult. Those who teach Block 4.4 (Forensic Medicine) put a great deal of thought and effort into teaching their subject.

As seen in the graph, compared to 1st year (year average: 64.0%) students' marks were poorer in 2nd year (year average: 61.1%). They improved again in 3rd year (year average: 61.6%), continued to do so in 4th year (65.1%), and maintained that level in 5th year (66.0%). This decline in 2nd year – particularly in light of the relatively small contribution of 'matric points' as a factor (see the following section) – suggests that the transition from high school to university may have been less momentous from 1st to 2nd year. The failure rates in the five years (based on end-of-Theme test results combined with end-of-semester exam results) reinforce this perception: there were 7 failures in 1st year (plus 2 who left for other reasons), 9 (plus 1) in 2nd year, 23 (plus 1) in 3rd year, 13 in 4th year and 2 in 5th year. Of the student interviewees, only Krish and Marcus remarked (without comment) on the fact that the 2nd year marks were lower than those of 1st year, but offered no explanation for this. Drs Pillay and Hlubi speculated that there might have been difficulties with particular Themes, while Dr Patel focused on the fact that the marks generally increased again after 2nd year, implying that the students took two years to become accustomed to the programme.

Then you can look at what the Theme was and what could be the problem if there was a difference.

Dr Pillay 11; 353-354

I can only postulate as they went into 2nd year they were more – there was more information they needed to put in, together with the prior knowledge that they had been getting, and also possibly with the confusion – when you learn about the cardiovascular system here and you think you've mastered it and then someone comes with the urogenital system and confuses you further and says the control of the blood pressure also has to do with the kidney and other things – could be; it's just a postulation. Dr Hlubi 13; 370-375

OK, so we reckon that this thing goes up from 2nd year because the students are more *au fait* with what's going on and the mechanisms of assessment and so on.

Dr Patel 12; 870-1

The sequence of Theme tests over the five years studied was revealed by the GEE to be the third most weighty factor. The slight upward trend with time implies that the increasing age of the students over that period, which the literature associates with improving assessment marks, may be a factor here; it may reflect students' increasing cognitive skills. The variation between Theme test marks raises the question of whether Themes' content and/or the assessment thereof were appropriately aligned; a matter of the difficulty in standardising the level of difficulty of successive Themes' tests.

'Matric Points' (1% Difference to Marks)

The 187 students who wrote a South African school-leaving examination had a median matric point score of 44.5, with a range of 25 – 50. We have compared those above and below the median score to illustrate the influence of that parameter (Figure 4).

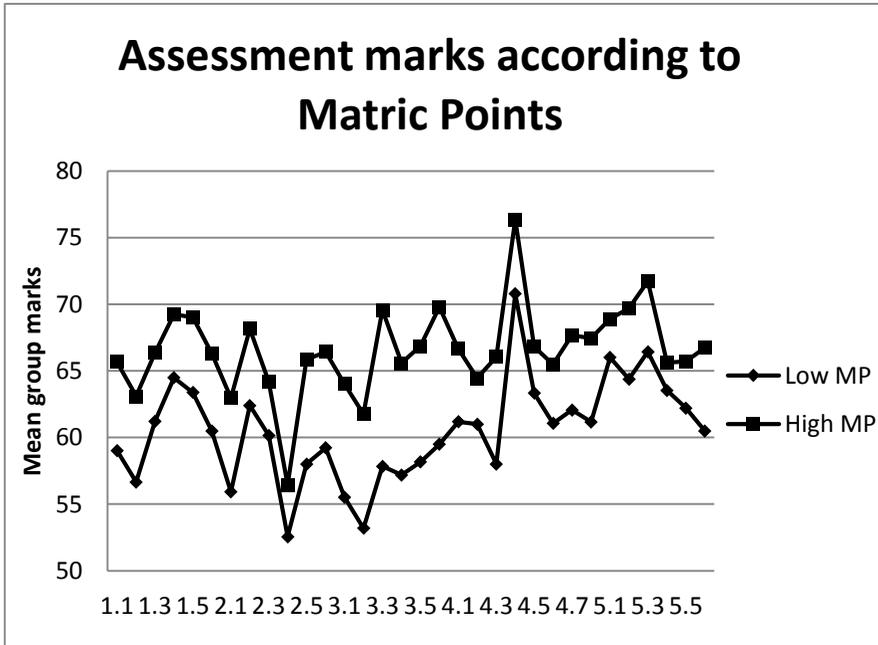


Figure 4: Assessment Results over Five Years According to Matric Point Score

High MP = Upper half of class

Low MP = Lower half of class

Axes as before

The GLM comparison showed a highly significant ($p < 0.001$) difference between these two subgroups, but since the matric point scores were highly skewed toward the upper end of the range, the validity of a direct comparison on this basis is questionable. The actual effect of a student’s matric point score in the GEE comparison was in any case small compared to other parameters. It remains a truism that past academic achievement predicts future academic achievement (Ferguson *et al.* 2002); however, once in the post-matric academic world, school achievements are evidently of less importance. (Respondents were not asked to comment on this relationship, since we did not have a graphical representation of this parameter from the previous study.)

Combined Comparisons

In contrast to the four factors described above, in the GEE comparison, the influence of the other five demographic parameters studied (Race, Sex, Finance, Age, Language) disappeared when all nine were combined. Significant differences were seen between 'race' groups when those groups alone were analysed using the GLM. We find it remarkable that in a cohort of students displaying a range of diversity in each of the five factors mentioned above, none of the factors was seen, by GEE analysis, to exert a significant effect in comparison to the rest. We do not contend that race, language, sex, age and financial status are not substantial, and are sometimes crippling, concerns for learners, nor that vigorous efforts to address these issues are fruitless. The end result of our analysis, however, is that these factors do not appear in the aggregate to have influenced students' academic performance as measured in the tests we examined. We argue that the GEE, by combining factors, better reflects the dynamics in reality than does the isolated examination of single factors.

Conclusion

The study we report on explored in greater depth, at a higher educational level, with a different methodology, and across a larger number of influences known to bear on learners' academic performance, than previous studies. Although such performance and its assessment may be thought of as a purely cognitive construct, in fact most factors found to exert an influence were, in this and other published studies, non-cognitive.

Our use of mixed methods and two layers of statistical analysis has allowed us to delineate which of the factors examined appeared to be of overall significance in the system related to student achievement in assessments, and to understand why that might be so. We do not suggest that sophisticated statistical manoeuvres negate the considerable understanding that qualitative methods bring to light on research topics. We do, however, suggest that gathering as many types of data as are available and combining them may yield significantly greater insights, since synthesis may construct a more meaningful picture than analysis of its components.

This study shows some congruence and some surprising contrasts with the literature. The type of high school attended, learners' previous

higher education experience, the sequence of tests through the years, and school-leaving exam results, were independently significant factors when combined with the other factors available to us. With the unexpected exception of the test marks, the other three factors agree with findings in other contexts. On the other hand, ‘race’, language, age, sex, and financial assistance become inconsequential when combined in one comparison, despite some of these other factors showing significant effects when considered *on their own* and despite respondents’ and other researchers’ perceptions of their importance. It is intriguing that, amongst demographic variables that have been shown to be influential in various settings, so many turned out *not* to be independently influential on the performance of this select group of higher-level students. Essack *et al.* (2012) concluded that, amongst students studying other health sciences at UKZN, race, English as second language (as proxy measure for disadvantage), and matric points (as proxy measure for admission via alternate access) were all significant factors. These arose in a study related to the institution’s quality of teaching, and were discerned in patterns of class results. Our study, while not negating these findings, challenges the validity of isolated factor analysis.

As systems theory suggests, we found that various elements of our construct of influential factors were interdependent. We have described the context – at the medical school in question, and in the world of education broadly – of our study. In this analysis, the constituent parts of significance are fourfold. Students’ previous high schools – with the understanding that even within quintiles there may be geographical differences, with their own sociological differences in communities and individual families – may provide an escape from the poverty trap, and thus a motivation to succeed in adverse circumstances, as described by Zodwa. However, in general, their high school exerts a large and long-lasting influence over most students. A prior degree, or even incomplete higher education experience, provided that the experience is successful, conveys a sense of familiarity and calm maturity compared to the ferment of the new matriculant. The wide variation in class marks over successive assessments was unanticipated; this is not a student characteristic, but an attribute of the teaching and assessment process. Whether it relates to student engagement with the course content, or to inability to standardise assessment instruments, is unclear. Students’ matric point scores, as indicators of their performance at higher education level, are an unsurprising factor; what is remarkable is the meagre contribution that this

factor makes.

The final step in systems theory is to embed the understanding we have gained functionally within the whole. This, we suggest, rests with alerting us as staff members to the fact that students from certain types of schools may require additional assistance to progress through higher education. Since a prior degree evidently confers a number of benefits, there may be an argument for a 'pre-med' degree, as required in other parts of the world. Attention to the standard, type, and difficulty of questions is likely to smooth the irregular path of assessment. Finally, the significance of students' matric point scores, which may reflect innate academic ability and prior educational experience, cautions, in this medical school at least, against broadening admission criteria by reducing the level at which students are accepted.

The questions that arise from the present study relate to both the theory and practice of this kind of educational research. What is one to make of the wealth of studies of individual factors that show meaningful distinctions between groups of learners when categorised according to one factor alone, when, in comparison with further factors, some appear to overshadow others? Do what appear to be contradictory findings throw into question the trustworthiness of one's data? Should one be wary of applying to an institution's selection criteria, or the pedagogic practice of its staff, findings derived from a particular approach? Should policy based on such tendentious topics as 'transformation', 'disadvantage' or 'redress' await the outcome of large multifactorial studies? Certainly, this study, conducted in one faculty of one institution at one level of education, could usefully be repeated in other faculties, institutions and levels. We concede that our use of such demographic characteristics as are recorded by UKZN was strategic and that the difficulty of gathering reliable data on, for example, learners' home backgrounds is well known (Coleman: 1966; Simkins & Paterson 2005). Nonetheless, we believe that similar studies are feasible. In practical terms, repeating a longitudinal trace of assessment results to ascertain whether the pattern revealed in this study is constant, could and should be undertaken. This study specifically excluded the subsequent assessment scores of those who dropped out of the cohort. While a study of factors relating to failure rather than success would be unlikely to yield sufficient numbers for statistical analysis, qualitative investigation could garner important information. As we noted when introducing Fraser and Killian's and Ngidi's

studies, the factors that affect failure may not merely be the converse of those that contribute to success.

This study suggests avenues for further exploration and raises our awareness of influences on teaching and learning in higher education. It adds to our current understanding of the multiple interactions around that conceptual system, and that the whole is indeed greater than the mere sum of its separate parts.

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References

- Ball, A.F. 2006. *Multicultural Strategies for Educational and Social Change: Carriers of the Truth in the United States and South Africa*. New York & London: Teachers College Press.
- Benbow, E.W. & R.F.T McMahon 2001. Mature Students? In Schwartz, Peter, Stewart Mennin & Graham Webb (eds.): *Problem-based Learning: Case Studies, Experience and Practice*. London: KoganPage.
- Bloch, G. 2009. *The Toxic Mix: What's Wrong with South Africa's Schools and How to Fix it*. Cape Town: Tafelberg.
- Breier, M. & A. Wildschut 2006. *Doctors in a Divided Society. The Profession and Education of Medical Practitioners in South Africa*. Cape Town: HSRC Press.
- Bruner, J.S. 2006. *In Search of Pedagogy*. Volume I. London: Routledge.
- Christie, Pam, Dawn Butler & Mark Potterton 2007. *Schools that Work*. Report to the Minister of Education. Department of Education, South Africa.
- Chutgar, A. & A. Kanjee 2009. School Money Funding the Flaws. *HSRC Review*, 7. Available at: http://www.hsrc.ac.za/HSRC_Review_Article-175.phtml. (Accessed on 15 September 2010.)

A Longitudinal Study of Demographic Influences on Assessment Scores

- Coleman, J.S. 1966. *Equality of Educational Opportunity*. Washington: U.S. Department of Health, Education, and Welfare.
- Eisner, E.W. 1998. *The Enlightened Eye: Qualitative Enquiry and the Enhancement of Educational Practice*. Upper Saddle River: Prentice-Hall.
- Essack, Sabiha Y., Indrani Naidoo & Glen Barnes 2010. Government Funding as Leverage for Quality Teaching and Learning: A South African Perspective. *Higher Education Management and Policy* 22,3: 1-13.
- Essack, Sabiha, Y. *et al.* 2012. Quality Teaching and Learning in the Health Sciences. *South African Journal of Higher Education* 26,5: 960-972.
- Ferguson, E., D. James & L. Madeley 2002. Factors Associated with Success in Medical School: Systematic Review of the Literature. *British Medical Journal* 324: 952-957.
- Field, A. 2009. *Discovering Statistics Using SPSS*. 3rd Edition. London: SAGE.
- Forde, F. 2007. It's all a Question of Class. *Mail & Guardian*, 10 March 2007. Available at: https://listserv.umd.edu/cgi-bin/wa?A3=ind0703&L=intedupol&P=2679602&E=1&B=-----%3D_Next_Part_000_001A_01C77226.CEBE4C10&T=text%2Fhtml.
- Fraser, W. & R. Killen 2005. The Perceptions of Students and Lecturers of Some Factors Affecting Academic Performance at Two South African Universities. *Perspectives in Education* 23,1: 25-40.
- Frischenschlager, O., G. Haidinger & L. Mitterauer 2005. Factors Associated with Academic Success at Vienna Medical School: Prospective Survey. *Croatian Medical Journal* 46,1: 58-65
- Greene, J.C., V.J. Caracelli & W.F. Graham 1989. Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis* 11:255-274.
- Haeck, W. *et al.* 1997. A Developmental Approach to Mathematics Testing for University Admissions and Course Placement. *Educational Studies in Mathematics* 33: 71-91
- Hardin, J.W. & J.M. Hilbe 2008. Generalized Estimating Equations. *Wiley Online Library*. Available at: <http://onlinelibrary.wiley.com/doi/10.1002/9780471462422.eoct485/full.doi:10.1002/970471462422.eoct485>.
- Henig, J.R. *et al.* 1999. *The Colour of School Reform: Race, Politics, and the Challenge of Urban Education*. Princeton: Princeton University Press.

- Kohr, R.L. *et al.* 2007. The Relationship of Race, Class and Gender with Mathematics Achievement for Fifth-, Eighth-, and Eleventh-Grade Students in Pennsylvanian Schools. In Landry, B. (ed.): *Race, Gender, and Class: Theory and Methods of Analysis*. Upper Saddle River, N.J.: Pearson Prentice Hall.
- Kuh, G.D. *et al.* 2006. *What Matters to Student Success: A Review of the Literature*. National Postsecondary Education Cooperative.
- Kusurkar, R. *et al.* 2010. Effects of Age, Gender and Educational Background on Strength of Motivation for Medical School. *Advances in Health Sciences Education* 15,3: 303-313
- Laszlo, A. & S. Krippner 1998. Systems Theories: Their Origin, Foundations, and Development. In Jordan, J.S. (ed.): *Systems Theories and a Priori Aspects of Perception*. Amsterdam: Elsevier Science.
- Liang, K.Y. & S.L. Zeger 1986. Longitudinal Analysis Using Generalized Linear Models. *Biometrika* 73,1: 13-22.
- Ngidi, D.P. 2007. Students' and Lecturers' Perceptions of Some Factors Influencing Students' Academic Success or Failure at a Historically Black University in South Africa. *South African Journal of Higher Education* 21,4: 717-732.
- Richardson, L. & E.A. St Pierre 2005. Writing: A Method of Enquiry. In Denzin, N.K. & Y.S. Lincoln (eds.): *Sage Handbook of Qualitative Research*. 3rd Edition. Thousand Oaks: Sage.
- Simkins, C. & A. Paterson 2005. *Learner Performance in South Africa Social and Economic Determinants of Success in Language and Mathematics*. Pretoria: Human Sciences Research Council.
- Sommerville, T.E. 2012. *People and Pedagogy: Problem-based Learning in the MBChB Curriculum at UKZN Medical School*. Doctoral Thesis. Durban: University of KwaZulu-Natal.
- Tinto, V. 1987. *Leaving College: Rethinking the Causes and Cures of Student Attrition*. Chicago: University of Chicago Press.
- Tinto, Vincent 2005. Taking Student Success Seriously: Rethinking the First Year of College. Available at: <http://www.purdue.edu/foundationsofexcellence/documents/FOE%20Documents/Taking%20Success%20Seriously.pdf>.
- Trochim, W.M.K. 2006. General Linear Model. Available at: <http://www.socialresearchmethods.net/kb/genlin.php>.
- Wilkinson, T.J., J.E. Wells & J.A. Bushnell 2004. Are Differences between

A Longitudinal Study of Demographic Influences on Assessment Scores

Graduates and Undergraduates in a Medical Course due to Age or Prior Degree? *Medical Education* 38: 1141-1146

Yeld, N. 2003. Academic Literacy and Numeracy Profiles: An Analysis of Some Results from the AARP and TELP Tests of Incoming Students (2001/2002 entry years). In Withers, J. & H. Griesel (eds.): *Into Higher Education – Perspectives on Entry Thresholds and Enrolment Systems*. Pretoria: SAUVCA-CTP Higher Education Admissions Project.

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