Coping with a Diverse Student Body in Engineering Education

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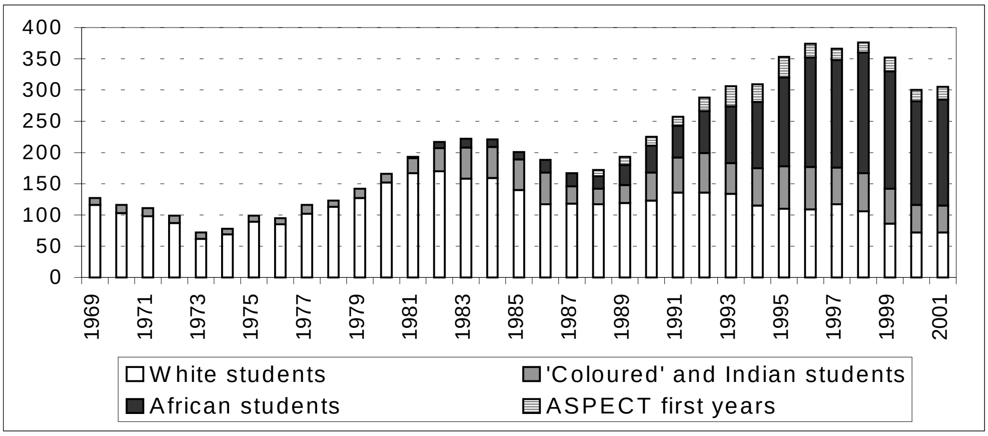
ABSTRACT
The increasing diversity in our student body over the past fifteen years has forced us to re-examine the teaching and learning process in our undergraduate programme. This paper first describes the extent of the change in student demographics. It then deals with the three major responses to these changes. The first response was a major revamp of the curriculum that focussed on reduction of overload, streamlining and a more logical development from one year to the next. The second response was to improve the teaching and learning process, including introduction of collaborative learning, workshops for lecturers and tutors, and reflective journal tasks. The third response was research in engineering education in which we have, among other things, examined students' understanding of fundamental concepts. The paper ends by evaluating the impact of these changes on student performance, which has improved for all groups, but particularly for those from disadvantaged backgrounds.

INTRODUCTION
The Department of Chemical Engineering at the University of Cape Town (UCT) has experienced a dramatic shift in student demographics over the past ten years. This has been accompanied by a significant increase in total student numbers. Figure 1 shows the student population in the department over the past thirty years. The department has grown in two phases, the first in the early 1980s, from an average student population of around 100 in the 1970s to around 200 in the 1980s, and the second in the early 1990's, to around 350 in the second half of the 1990s. A typical first year intake of 30 in the 1970s grew to 50 in the 1980s and to 90 students a year in the 1990s.

Figure 1. UCT Chemical Engineering Department total student numbers and demographics.



In Figure 1, white students are those of European extraction, and African students are ethnic African students, who were only allowed by the previous government to enter UCT in 1981. The third group represents students from ethnic groups other than white or African (largely people classified in South Africa as 'coloured' or of Indian descent). Under the apartheid dispensation students from these last groups were only able to enter UCT prior to 1981 in programmes like engineering which were not offered at black universities, and then only after having applied for the necessary 'permit'. In this paper black refers to all ethnic groups other than white. Note that while we do not wish to perpetuate these classifications from the past, they are necessary for defining educational disadvantage, because of the separation of schooling by these groupings under apartheid. The ASPECT first years are almost exclusively African students who are on a special academic support programme which will be described later.

It will be noted in Figure 1 that the growth in the 1980s was largely due to more students in the 'coloured'/Indian category, with a relatively small number of African students, whereas the major growth in the 1990s was entirely due to increased numbers of African students. The student intake has changed from 91% white and 9% 'coloured'/Indian in the 1970s, to 69% white, 17% 'coloured'/Indian, and 14% African in the 1980s, and then to 32% white, 19% 'coloured'/Indian and 49% African in the 1990s.

While these statistics give some idea of the diversity in our classes, they mask the diversity within each of the groups. Over the last few years our intake of around 90 students had between 16 and 19 different home languages (including a variety of European and African languages as well as some Asian ones), and they came from between 8 and 10 different countries. Another factor is our sense that a higher proportion of African students are the first in their family to undergo tertiary education. This is a factor which needs to be quantified to make it a meaningful variable.

Apart from the linguistic and cultural differences attested by these statistics, there is another more significant source of variance within the class from an educational viewpoint, namely their educational background. Many of the South African African students spent most, if not all, of their schooling in the notorious Department of Education and Training (DET, the department designated to provide education for African students under apartheid). This left them particularly poorly prepared for tertiary education, especially because of their weak background in mathematics and physical science, which comes to the fore in a demanding technical discipline such as chemical engineering.

This educational disadvantage meant that African students were faring particularly badly in our programme. This has been seen in both a low retention rate for African students and their taking much longer to graduate. These issues have caused us great concern over the past fifteen years. This paper will seek to describe what we have done to address the difficulties experienced by these students, and also to analyse what success we have had in this regard.

A baseline which I will use for comparison is an unpublished study I did in the early 1980s in which I analysed the success of our student intake over the years 1962 to 1977. This study revealed that only 55% of our intake graduated in chemical engineering, and this proportion was the same for both white and 'coloured'/Indian students. The average time to graduate was, however, distinctly different – it was 4.65 years for white students and 5.9 years for 'coloured'/Indian students (details of this analysis are given later in the section on Impact). This study also revealed that the average time spent in the department by students who eventually dropped out of chemical engineering was 2.9 years (this figure was not broken down demographically). While these figures were of concern to us, the number of students involved was small and there was little pressure on us to do something to address the problems behind them.

In making comparisons with the past it is important to note that there are many variables which affect student success which are out of our control, such as changes in the school education system. One significant change is the proportion of African students spending a good number of years in formerly white schools. This is another variable which needs to be quantified in the future.

Some of these variables are also not readily amenable to measurement. For example, the environment which the first African students entered in the early 1980s was almost exclusively white and one which they found alien. Now, although the staff are still largely white, the majority of undergraduate students are African and many of the university residences are largely African.

Another very important variable is the effect on student success of lack of finance. We see this particularly with students who lose their bursaries when they do poorly one year – the year without support seems almost inevitably to be even worse than the one before.

This paper will describe the initiatives undertaken by both the Faculty of Engineering and the Department of Chemical Engineering in response to these challenges. There have been three major initiatives, which I will deal with in turn:

- changing the structure of what is taught (curriculum revision),
- changing the teaching and learning process (largely in-course improvements), and
- research in engineering education (which informs the first two).

The paper continues by evaluating quantitatively the success of what we have done, using the latest data on success rates, and then draws conclusions.

CURRICULUM REVISION

A range of initiatives have been undertaken, at a university-wide level, a faculty level, and a departmental level. These include the establishment of an Academic Support Programme in the university (of which the Engineering ASPECT Programme has been a significant part), an Engineering Faculty curriculum review project initiated in 1992, and departmental initiatives.

Faculty Academic Support Programme (ASPECT)

The first major response to the increasing diversity in our student body was the initiation in 1988 of a faculty academic support programme, ASPECT (Academic Support Programme in Engineering at Cape Town).

ASPECT spreads the curriculum for the first two years over three years. It provides both additional input on key skills as well as special teaching and support in critical first year courses such as mathematics and physics. The special teaching involves spreading coverage of material over more lectures. The support takes the form of structured collaborative workshops as well as personal support. ASPECT students write the same class tests and examinations as students in the regular courses. The final 2 years of the degree programme are completed without further support.

ASPECT provides access to the Faculty for students who do not meet its normal entrance criteria (although in chemical engineering virtually all ASPECT students meet the normal criteria). Originally all students in ASPECT were sponsored by industry, which paid an extra levy to fund the programme. While it seemed that the first cohorts of students resented being in ASPECT, the success of ASPECT has led to pressure from other African students to gain entry to it, and in 1994 ASPECT was opened to any student who wished to join the programme. The number of students entering ASPECT has doubled, with many of them not sponsored for ASPECT. In addition to ASPECT there are many African students in the regular programmes (around 5% of the African intake), many of whom experience difficulty.

ASPECT has proved to be a most successful programme which has been used as a model for academic support in other disciplines at UCT as well as in other institutions in South Africa.

The Faculty Curriculum Development Project

The curriculum development project undertaken by the UCT Faculty of Engineering between 1992 and 1998 is fully described in Fraser [1]. Only the significant features of the process which this project followed will be presented here.

The project was launched by a Faculty Strategic Planning Workshop held in April 1992. This workshop identified the need to undertake a major review of our curriculum, particularly in view of the significant shift in student population which had already occurred, and the problems being experienced by our African students.

This task was assigned to the Teaching Working Group in the faculty, which was a group of mainly younger staff headed by the author, and including the Faculty Education Development Officer, who was also a member of the ASPECT staff. This group made use of worldwide trends in engineering education in developing a set of principles to guide the curriculum development process. It also drew on the experience of ASPECT as a local laboratory for curriculum innovation.

One of the major issues which we sought to address was the issue of overload, which is a world-wide phenomenon in engineering education [2]. This was particularly brought home to us by a study of the effects of overload on our First Year students [3]. This was addressed by reducing the workload in the mathematics and physics courses, and by replacing the applied mathematics course by a hands-on course in engineering. This course also helped us to improve motivation and bring theory and application closer by moving engineering into the first year of study.

The Teaching Working Group focussed on developing new curricula for the first and second years of study, which were introduced in 1995 and 1996. A workshop was run in May 1995, attended by virtually all the academic staff in the faculty, to develop a set of common principles to be used by departments in development of their third and fourth year curricula.

These developments also had to take cognisance of the financial position of universities in South Africa during this period, which meant there was a decrease in resources available to them. We therefore had to make changes allowing for no increase in staff or other resources.

It is worth pointing out here that one of the reasons why this project was so successful was the involvement of mainstream academic staff (compared to other faculties at UCT where this is largely driven by academic development staff who are relatively junior).

Curriculum Development in the Department of Chemical Engineering

The curriculum development process in the Chemical Engineering Department is covered in Fraser and Harrison [4]. This was spurred on by an accreditation visit from the (UK) Institution of Chemical Engineers in August 1993. The accreditation team was concerned about the breadth of coverage in our programme, and encouraged us to concentrate on the in-depth handling of less material. In addition, we consulted members of our Advisory Board concerning key knowledge, skills and understanding and also had our academic staff rate the importance of each topic covered.

In the chemical engineering curriculum, a systematic developmental approach was made explicit in the ordering of the course content. Emphasis was also placed on the fundamental processes of design, problem solving and communication, on increased hands-on exposure to physical phenomena, on improved articulation between theory and application, on the personal development of students, and on fostering a culture of lifelong learning.

In achieving these objectives we separated the teaching and examining of fundamentals from design, and aimed for a design course in each semester of second year that would explicitly integrate and apply material taught in parallel in the fundamental courses. To lay a solid foundation, problem solving is particularly stressed in the major first and second year courses.

Another important development has been unlocking the curriculum for students who had failed some courses to make progress in one of two basic streams, rather than being held up like they were before (when they had to pass all of second year before they could enter third year). We have arranged our pre-requisites for courses so that those who have succeeded in mass end energy balances can progress in thermodynamics and reactor design (a chemistry-based stream), and those who have succeeded in transport phenomena can progress in solid-fluid operations (a mathematics-based stream).

The curriculum development process did not stop with the curriculum development project that started in 1992 and ended with the new fourth year in 1998. We were particularly concerned that we had not addressed the issue of overload properly in the later years of study.

The issue of overload was subsequently tackled by Alison Lewis, who was teaching our major second-year course. Instead of just doing this independently, she decided to involve the rest of the academic staff in this process. This was done through a workshop in October 1997, led by Jeff Jawitz, the faculty Education Development Officer. In this workshop we examined the history of the course and then developed a set of agreed outcomes for the first half of second year. Finally, on the basis of these outcomes we were able to exclude 25% of the material from the course (despite opposition to removal of certain material by a senior staff member) [5].

This proved to be such a successful model that we followed it up with another workshop in October 1998, also led by Jeff Jawitz, to examine overload in third year, and this also led to a decision to cut 25% of the material out of all our core courses in the second half of second year and both halves of third year.

What has been quite amazing about this process is that there has been a significant shift in attitudes in the department. In July 1996 we held a workshop to try and address the problems our students were experiencing. At that stage the staff were blaming the students for everything that was wrong. Yet by October 1998 staff were taking responsibility for the poor performance of students in third year. We are currently trying to understand what contributed to this significant shift in attitudes.

From 1999 to 2001 we undertook a further process, which was to modify our curriculum to an outcomes basis. This is because this is the way our degree is to be accredited in the future, but we saw it as an opportunity to continue what we had already begun and take it to a new level. This process was undertaken largely through a series of workshops, led by Jeff Jawitz. We first developed a set of high-level outcomes, then broke these down into components. Next we developed a set of criteria for judging each outcome component

IMPROVEMENTS TO TEACHING AND LEARNING

The curriculum changes outlined above were accompanied by improvements to teaching methods. Reduction of content in the physics first year course allowed for inclusion of weekly problem-solving exercises. The mathematics first year course included a weekly problem-solving workshop. The first year engineering courses are largely run as a series of hands-on projects to give students a feel for engineering [6].

I was also responsible for organising a number of teaching workshops at UCT which were attended by some of our academic staff, together with other academics from UCT and other institutions in the region. The following workshops have been run over the past few years:

- "Effective Teaching", run by Richard Felder and Rebeccah Brent (in 1996 & 1999),
- "Creative Problem Solving", run by Scott Fogler (in 1997), and
- "Collaborative Learning", run by Karl Smith (in 1995).

Both Richard Felder and Scott Fogler are noted engineering educators from the USA, and Karl Smith is another respected engineering educator from the USA, well-known for his work on collaborative learning.

Within our department there have also been a number of initiatives to improve teaching. The most significant have been in relation to the running of our weekly tutorial sessions. In 1991 I introduced collaborative study groups into our major second year course, in an attempt to improve the success of African students in the course [7]. This was based on the reports of the success of such an approach in Minority Engineering Programmes in the USA. This had a significant effect on the success of the African students, and also led to an improvement in the success of the rest of the student body as well. This system was reviewed in 1996 by my colleague Jenni Case, leading to a better way of handling collaborative groups in tutorials, particularly by reducing the size of the groups [8].

At the same time we also put more effort into training our tutors so they could function more effectively in the tutorial sessions [8]. The most effective aspect of this was running pre-tutorial preparation sessions with the tutors.

In the first year engineering course, we also put a lot of emphasis on student personal development, helping them make the transition from school to university. We also take a lot of trouble to get to know the students personally, and to help them to get to know one another. This is started at the beginning of the academic year, so that they can develop good working relationships with their peers. Some research we did on the effects of this indicate that the relationships developed in this course in first year carry over both into other courses in first year, and into subsequent years [9].

Another innovation has been the use of journal tasks in our second year courses. These were introduced to second year students in the first semester of 1998 by Jenni Case and Alison Lewis, in order to promote reflection and metacognition in the students. Although the tasks were optional (for bonus class marks) the majority of students completed them, and reported benefits in terms of personal and conceptual development [10].

RESEARCH IN ENGINEERING EDUCATION

Another significant development in the department has been research in engineering education. This has led to a number of the improvements outlined above. It also underpins our efforts at curriculum and teaching reform, and lends credence to what is being proposed.

Our research in engineering education has been greatly enhanced by a donation from Caltex Oil (SA) (Pty) Ltd in 1992 which enabled us to establish an Education Development Officer post in the department. This post was occupied by Wendy Kaschula from 1994 to 1995. Wendy had a master's degree in chemical engineering and an interest in education. Both Wendy and I were conscious of our lack of expertise in the theory of education, so when she moved on we sought someone with this expertise, and in 1996 appointed Jenni Case, who had a masters degree in science education, to this post. Much of what we have achieved since then can be attributed to the contribution which Jenni has made to our work.

One focus of our research has been student understanding of fundamental concepts. This is the subject of a parallel paper at this congress [11]. The first study we did was on student understanding of moles [12, 13]. This led to the development of a set of activities to help students understand this concept better. These activities have now been incorporated into our first year course. The next study was on student understanding of energy. This was undertaken in three phases:

- The first phase was a phenomenographic study of student understanding of energy in solution, using the dissolution of three different salts in water as a basis [14]. This project was undertaken by Jazlin Ebenezer of the University of Manitoba in Winnipeg.
- The second phase was a digraph analysis of student writings about energy [15]. This work was done by Xuifeng Liu of the University of Prince Edward Island.
- The third phase was probing student understanding through student reactions to three different energy scenarios. This particular study was a project undertaken by a pair of final-year project students [16]. This was the first time a pair of fourth year students had done an education project.

The study of student understanding of energy proved to be much more difficult than the one on moles, because energy is a much more conceptual subject, and it has different meanings in everyday usage and in science, and even across different scientific disciplines. We are still in the process of integrating what we have learned in these studies into how we teach energy.

In 2001 we ran another student project, this time on ratio and proportion. This showed that student difficulties with ratio were not so much due to different reasoning patterns, as to different concepts of ratio, either as relative numbers of objects or relative sizes of objects.

Jenni Case completed her PhD on the influence of the learning environment on how students learn in our major second year course in 2001 [17]. Following on Alison Lewis' curriculum restructuring described earlier, she was able to implement an approach to teaching which focused on students' conceptual understanding of the subject and metacognitive (learning) development. Jenni's research investigated students' perceptions of these actions, and also sought to explain instances where students' conceptual development was insufficient to ensure passing at the end of the course [18].

Another research theme has been started recently. This is a study into factors affecting student success. The first phase of this study looked at how students in our third year recover from failure [19]. The second phase was a master's project, in which Evelyn Dhliwayo examined the development of problem solving skills in chemical engineering students [20]. The reason for the shift in focus from success on its own to problem solving is because of the crucial importance of problem solving to success in chemical engineering studies.

IMPACT OF INITIATIVES

With so much happening simultaneously, it is difficult to separate the impact of each initiative. There are also other factors which have had an effect, such as having a number of African students from other African countries in the class. Our sense is that these students have had an important effect on their classes, although this is difficult to quantify. In this section I will first examine course and year success rates, then retention data, and finally some other measures of improvement.

Course and year success rates

The success rates of our students in key core courses as well as average success rates in academic years has been examined in detail elsewhere [21]. Here it is sufficient to note that the average success rate increases from 65% in second year to 80% in third year and 92% in final year, which is what one would expect should happen. Something else that emerges form this data is that success rates tend to decrease with increasing class size. Individual course success rates fluctuate much more than year averages, in a way that is not always explicable.

Retention

The overall success rates of students are shown in Table 1 below, for the periods 1962-1977 and 1988-1993 (these being the year of intake). ASPECT students are excluded from this analysis. Average success over the period 1962-1977 was 55,0%, and 29,0% of the intake graduated in four years. Between 1988 and 1996 the same overall levels were achieved, with average success at 54,6%, and 30,0% graduating in four years. This is remarkable, given the massive change in demographics between these two periods. Our long-term aim is to bring the success of all students up to 70%.

Table 1: Percentage of graduates (by year of intake: 1962-1977 and 1988-1996)

Year of intake	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	Av
% graduated	53	33	51	55	59	62	49	56	63	65	44	58	58	68	48	58	55.0
% graduated in 4 years	33	23	24	28	37	23	18	34	34	29	33	17	35	32	31	33	29.0
White students	16	9	18	19	26	14	19	13	18	10	8	5	14	25	14	17	
'Coloured'/Indian students	0	1	1	3	1	2	0	5	2	1	0	2	1	1	0	2	

Year of intake	1988	1989	1990	1991	1992	1993	1994	1995*	1996*	88-96
% graduated	58	46	49	57	48	48	63	73	49	54.6
% graduated in 4 years	24	28	32	28	21	26	25	32	20	30.0
White students	22	20	27	26	14	15	15	28	19	
'Coloured'/Indian students	1	1	8	8	12	6	6	21	7	
African students	3	5	6	3	2	8	8	13	10	

* Some students from these intake years are still in the system

Table 2 shows the average time to graduate for the intake years 1962-1977, broken down demographically. This average was stable despite the minimum entry requirement for the faculty being raised from E's in Mathematics and Physical Science to D's for both in 1971. During this time there were 90% white students and 10% 'coloured'/Indian students in the intake. Note the average time to graduation of 4,65 years for white students and 5,90 years for 'coloured'/Indian students.

Data for 1988 to 1995 is shown in Table 3, where it is broken down demographically as well. The average time to graduate during the intake years 1988 to 1995 was 4.76, almost identical to the past. This is quite remarkable, given the shift in demographics. Note that the average time to graduate over this period for white students was 4.49 years, whereas for 'coloured'/Indian students it was 4.91 years and for African students it was 5.50 years – these differences are significant. The time to graduation for the white and 'coloured'/Indian groups have dropped compared to earlier, especially the 'coloured'/Indian group (by nearly a year).

Our aim is to bring the average time to graduate for all students down to 4.5 years.

Table 2: Average time to graduation from year of intake, 1962-1977

Intake year	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	Av
White	4.6	4.2	4.6	4.8	4.5	4.8	5.0	4.2	4.7	4.6	4.3	4.8	4.7	4.8	4.6	4.5	4.65
'Coloured'/Indian	-	5.0	6.0	5.7	4.0	5.5	-	7.2	5.0	9.0	-	5.5	4.0	6.0	-	5.0	5.90
Overall	4.6	4.3	4.7	5.0	4.5	4.9	5.0	5.1	4.8	5.0	4.3	5.0	4.7	4.9	4.6	4.5	4.75

Table 3: Average time to graduation from year of intake, 1988-1996 (excluding Aspect students)

Intake year	1988	1989	1990	1991	1992	1993	1994	1995*	1996*	Average
White	4.7	4.5	4.3	4.4	4.4	4.5	4.2	4.7	4.6	4.48
'Coloured'/Indian	5.0	4.0	4.6	5.1	5.2	5.3	5.3	5.0	5.1	4.96
African	5.3	5.6	5.8	4.7	6.5	5.9	4.7	5.4	5.1	5.44
Overall	4.8	4.6	4.6	4.6	4.8	4.9	4.7	5.0	4.8	4.76

* Some students from these intake years are still in the system

The average time spent in the department by students who leave without graduating is shown in Table 4, for the intake years 1988 to 1995. For the period 1962-1977, the average time spent in the department by leavers was 2.9 years.

The average length of time leaving students spent in the department for the 1998-1996 intake years was 1.77 years. The demographic breakdown indicates significant differences: African students spent the longest before leaving (1.94 years), and 'coloured'/Indian students the shortest (1.55 years), with white students between (1.82 years). These figures are considerably less than the historical value of 2.9 years.

Table 4: Average time spent in the system by leavers, 1988-1996 (excluding ASPECT students).

Intake year	1988	1989	1990	1991	1992	1993	1994	1995	1996	Average
White students	1.45	1.38	2.05	2.31	1.92	1.54	1.54	2.00	2.17	1.82
'Coloured'/Indian students	1.20	1.42	1.92	2.10	1.00	1.40	1.52	1.67	1.70	1.55
African students	1.67	2.17	2.90	1.60	1.92	1.50	1.59	1.69	2.41	1.94
Average years	1.42	1.55	2.21	2.11	1.60	1.50	1.55	1.78	2.18	1.77

Table 5 shows the numbers leaving, together with how many of them obtained other degrees from UCT (38% of the leavers over the years shown). This means that 69% of our intake have graduated from UCT during this period. There is no detailed information about students transferring to Technikons, but our experience is that these numbers are increasing, and that they generally seem to do well there.

Table 5: Numbers of students leaving chemical engineering

Intake year	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
White students	11	13	20	13	13	13	7	7	6	103
‘Coloured’/Indian students	5	12	13	10	4	5	5	3	10	67
African students	3	6	10	5	13	14	12	13	22	98
Total students	19	31	43	28	30	32	24	23	38	268
Graduated in other faculties	9	13	15	9	12	11	11	8	5	93

The percentage of the intake leaving chemical engineering is shown in Table 6. It averaged 45% over the intake period 1988 to 1996, compared to 55% for the period 1962-1977. Further, for the intake years 1994 and 1995, a marked decrease in leavers is seen.

Table 6: Percentage of intake leaving Chemical Engineering (1962-1977 and 1988-1996).

Intake year	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	Av
White	45	69	49	49	41	39	49	52	31	38	53	50	42	32	46	39	45
‘Coloured’/Indian	100	0	50	0	50	33	100	0	67	0	100	0	50	0	100	60	45
Overall	47	67	49	45	41	38	51	44	38	35	56	42	42	32	52	42	45

Intake year	1988	1989	1990	1991	1992	1993	1994	1995	1996	Average
White	33	39	43	33	52	46	32	20	24	37
‘Coloured’/Indian	83	92	62	56	22	45	45	19	59	53
African	50	55	63	63	87	64	60	38	69	60
Total	42	54	51	43	52	52	38	27	51	45

The demographic breakdown shows that historically both the white and ‘coloured’/Indian groups had the same proportion leaving (45%), whereas recently this has changed to 37% of white students leaving, 53% of ‘coloured’/Indian students, and 60% of African students. The improvement in retention of white students is encouraging, whereas the decrease in retention of ‘coloured’/Indian students is of concern. The poor retention of African students is cause for even more concern.

The drop in retention of the ‘coloured’/Indian group is significant. A possible reason for this change is that previous government apartheid policy meant these students could only study at UCT if they were in engineering, and not in science. This would have prevented some who would otherwise have done so from switching to science. Now that this restriction no longer applies, many students from this group do make this switch.

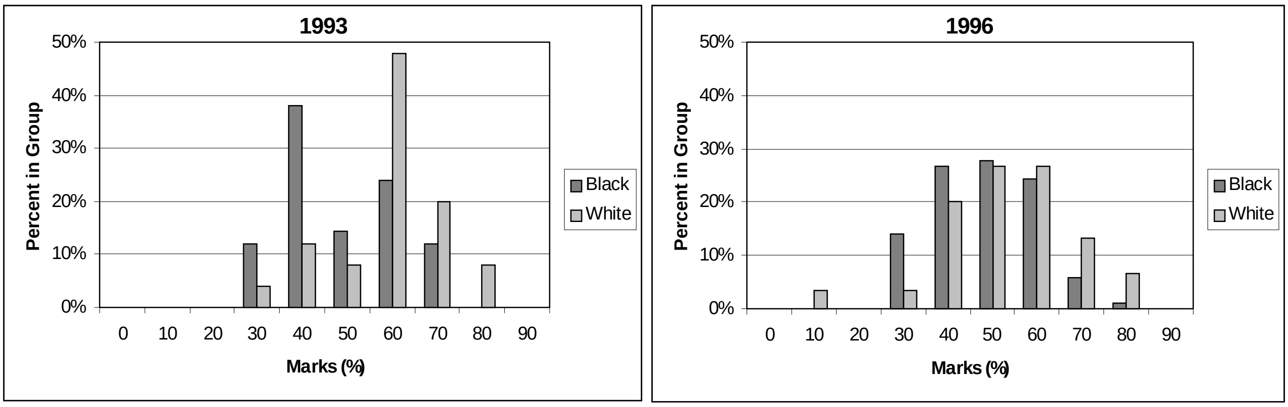
Other measures

We now have a significant number of African students doing well, with some graduating with honours. The 1999 graduating class was a good example of this, with some of the top prizes going to black students.

The effect of introducing collaborative study groups in our major second year course from 1991 onwards was analysed using a success model for the different groups of students in the course [7]. This showed that, compared to previous performance in the course, black students' success improved by 65%, while that of white students only improved by 15%.

Another quantitative measure is the distribution of marks in our major second year course. Figure 2 compares the distribution of marks for African students with white students, for 1993 and 1996. Figure 2 clearly shows a distinct difference between the two groups in 1993, which has greatly diminished by 1996.

Figure 2. Demographic mark distribution in major second year course, 1993 and 1996.



These measures taken together show that even early on in our efforts at improving success there are indications that our efforts are being successful. We will need to wait until we have sufficient data for the intake from 1995 onwards to confirm these trends.

Some concern has been expressed that we might have been lowering standards to achieve these results. The marginal increase in success of the white students, who could be seen as a control group, would seem to indicate that this has not been the case.

CONCLUSIONS

I cannot identify a single factor which alone has led to the improvements in student success reported above. It seems that what has occurred has been due to the cumulative effect of all that we have done. It also needs to be stressed that these changes took place over a number of years – there are no quick-fix solutions to these kinds of situations.

In conclusion, I think we can claim to have gone some way to addressing the problems created by the wide diversity of students in our programme, particularly as far as educational background is concerned. I trust that others will be able to learn from our experience, and be encouraged to persist even when change seems slow in coming.

ACKNOWLEDGMENTS

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