Int. J. Engng Ed. Vol. 8, No. 5, pp. 328–335, 1992
Printed in Great Britain.

0742–0269/91 $3.00+0.00

Engineering Students from Educationally Disadvantaged Backgrounds: Assumptions, Research Conclusions, and Curriculum Responses*

J. H. F. MEYER
A. R. SASS
Teaching Methods Unit and Academic Support Programme in Engineering, University of Cape Town, Rondebosch 7700, *South Africa*

This paper examines the dynamics of an engineering curriculum in transition. The forces acting on it are: a first year intake of students in which there is a yearly increasing proportion of 'non-traditional' students, many of whom come from a school background that has disadvantaged them educationally; a need to be more productive in terms of graduating African Black engineers; and a desire to evaluate and improve the quality of undergraduate student learning. The details of an academic support programme in engineering are described, as are those of a complementary educational research programme on student learning that has informed the programme since its inception. Some basic assumptions concerning the study behaviour of educationally disadvantaged students are examined and shown to be false—particularly the assumed group characteristics of such students and assumed exclusivity among them of theoretically disturbing forms of 'at risk' study behaviour associated with academic failure or low achievement. This paper concludes with the recent observation that some 'traditional' engineering students also manifest such forms of 'at risk' study behaviour—a phenomenon that has important implications for future undergraduate teaching.

INTRODUCTION

THERE is an urgent need in South Africa to produce more engineers, and to make engineering education more productive. According to a report on the crisis in engineering education [1], South Africa only produces about 35 engineers per million population which compares very unfavourably with its major trading partner countries (Japan: 500, United States: 370, Germany: 340, Great Britain: 250, Australia: 220). Furthermore, to put our own national statistics into a demographic perspective, none of the 908 university degrees and diplomas in engineering awarded in South Africa in 1975 went to African Blacks who constitute more than two-thirds of the population. Ten years later, 1542 engineering qualifications were awarded, but only 25 of them to African Blacks, which means that qualified African Blacks contributed less than two per cent, to the national engineering infrastructure [2].

Important and prevailing causes resulting in the unacceptably low numbers of African Blacks entering engineering programmes are the high failure rate, and the poor school-leaving performance of students from schools that cater predominantly for African Blacks. The typical statistics in this respect are equally sobering. In 1989, for example, of the 176 780 candidates whose results were available at the end of that year, less than 0.05 per cent gained 'A' or 'B' aggregates [3].

The problems the major universities face centre on admitting students from disadvantaged educational backgrounds, and ensuring that as many of them as possible graduate without lowering the presently high academic standards. (The University of Cape Town enjoys a special relationship with the Association of Commonwealth Universities—the curricula, systems and standards of engineering education at the University, conform to the general pattern of British universities and professional institutions. For example, the civil and chemical engineering departments are accredited, and their graduates are therefore eligible for exemption from the British professional examinations.)

While this background is probably unique to South Africa, the problems and challenges that it presents are not. There is a concerted effort in many developed countries to widen access to higher education and to admit 'non-traditional' students. There is also a growing realisation that higher education is an expensive resource that

* Paper accepted 25 September 1992.

should be subjected to quality control and assessment. Assessing the quality or relevance of undergraduate curricula and, in particular, assessing the quality of student learning, are two important processes that are addressed in this paper in the developing context of engineering students from educationally disadvantaged backgrounds who gain access to university via special admissions criteria.

ACADEMIC SUPPORT PROGRAMMES

The changing demography in the school-leaving population (a small decrease in White pupils and a large increase in Black pupils) and the demands of a developing economy, have given rise to an urgent need to admit and graduate more African Blacks in engineering. In 1991, only 52 per cent of the 409 first year students that enrolled in engineering at the University of Cape Town were 'traditional' White students. Among the remaining 48 per cent, there was a significant proportion of 'non-traditional' students that, through no fault of their own, were the product of poor schooling that ill prepared them for university study. As a consequence, special Academic Support Programmes have been initiated in some South African universities for students entering university at a perceived educational disadvantage. (Such students are referred to further on simply as 'disadvantaged students'.) These programmes have, over the ten years of their existence, grown considerably, both in terms of the diversity of their academic support activities and, more particularly, in terms of student numbers. They have focused the important problems surrounding admission procedures on the concept, and the recognition, of academic potential. Precisely what constitutes potential in conceptual terms, particularly in terms of engineering education, is difficult to determine objectively. There is, nevertheless, a pragmatic view that it is possible to identify in any prospective university student coming from an educationally disadvantaged background a set of personal, academic and other attributes which, in a learning context of adequate academic and other support, can serve as a foundation for academic development in engineering.

In terms of past experience in non-engineering academic support programmes, the underlying assumption of disadvantage, embodied in the concept of potential, has historically been one of a contained deficit that can be remedied by appropriate means. A disadvantaged student has usually been stereotyped as one who, by virtue of poor quality teaching or interrupted schooling, may be deficient in the practice of general academic skills, unskilled in written and spoken English, or in the level of conceptual understanding, particularly in science and mathematics. Such deficiencies were thus typically identified in terms of various study or linguistic skills. The presumption was that these skills could be added on to regular academic curricula, by way of various support mechanisms, such as coaching on how to take notes, write essays, prepare for examinations, participate in tutorial discussions, use the library, as well as providing extra tutorial support in key subjects like mathematics. The assumption was that students would benefit from such activities and, thus empowered, would be able to pursue their university studies on an equitable basis with 'traditional' students. This assumption has generally not been supported for reasons attributable partly to the inadequacy of study skills as a remedy for the problems in hand, and partly to the manner in which many of the most important learning problems have been decontextualised.

STUDY SKILLS APPROACHES IN HIGHER EDUCATION

In general, the value of adopting a study skills approach in higher education is open to serious question [4]. It needs to be recognised, in particular, that 'added on' study-skills strategies intended to compensate for learning 'deficits' are only partially adequate responses to the challenges presented by the accession of disadvantaged students to higher education. Many of these skills are rooted in inappropriate applications of behavioural psychology, or are simply proselytised on the basis of personal belief. Some of them are positively dangerous in terms of fostering theoretically-desirable approaches to studying. They engender, instead, an inadequate conception of learning with a narrow, calculating focus that ruthlessly exploits every strategy likely to help students pass examinations.

It is not surprising that the value of study skills is questioned, given our developing understanding of how students manifest individual differences in the way in which they perceive their own learning, its content and its context. This reservation is not directed to the provision of study skills as such, but rather at the manner in which the advocacy of such skills has tended to be divorced from the context of learning and the student perceptions of that context.

Disadvantaged students often articulate unsophisticated conceptions of learning. They may manifest theoretically undesirable approaches to studying that are characterised by a pathological dependence on finely-honed skills such as the ability to memorise information or guess correctly in examinations. Skills-based intervention intended to alter undesirable learning behaviour that is perceived by the individuals concerned to actually be appropriate and successful (by virtue of having helped them succeed at school) runs the risk of simply reinforcing and refining such study behaviour; students may simply appropriate those skills and insights on offer that are congruent with their existing conception of learning and the study behaviour that accompanies it. The problem is

compounded by the fact that many of the students in question are not aware of the limitations of their own study behaviour, or the existence of alternative and theoretically more desirable approaches. Coerced exposure to study skills training is therefore likely to be unappreciated, even perceived to be discriminatory, especially when such exposure and the effort involved, carries no credit towards the course itself.

THE CONTEXT OF LEARNING

The pervasive influence of the context of learning, on the approach taken to learning, has been extensively documented elsewhere [5]. Any empirical endeavour that fails to contextualize manifestations of learning behaviour is virtually useless in conceptual terms [6]. It is therefore dangerous to argue, as many have done and still do, that the learning problems of disadvantaged students can be addressed independently of the objective context in which they arise, and of the subjective context as perceived by the students themselves. Many study skills interventions have failed precisely because they failed to address either the content, or the context, of the academic discipline in which the skills are to be practised, or the study environment in which the students find themselves.

The most important lesson that has emerged from many unsuccessful attempts to assist disadvantaged students is the need to provide supportive study environments and a learning culture to go with them. The vast majority of disadvantaged students have not had the opportunity to benefit from either of these influences.

IMPORTANT ASSUMPTIONS CONCERNING DISADVANTAGED STUDENTS

There is a prevailing and understandable assumption among academic support practitioners that all disadvantaged students entering university have similar learning needs (for example, in terms of study skills) and therefore that they should all be subjected to the same form of academic support. Not surprisingly, growth in academic support has, as a consequence, largely been a linear response to increasing numbers of students along the lines of 'more of the same'.

An equally important assumption is that the learning problems associated with such students are not reflected in 'traditional' students who have not been similarly disadvantaged. Such problems therefore need to be dealt with as a separate issue in undergraduate teaching, and, as a consequence, academic support activities have tended to co-exist alongside the regular undergraduate curriculum rather than being a part of it. The practice of regular undergraduate teaching has thus largely been insulated from that of academic support.

THE PROGRAMME

It is important to test these assumptions and this has been done in the Academic Support Programme in Engineering at the University of Cape Town (hereinafter referred to as the Programme). A number of exciting challenges have thus been addressed and the Programme has accelerated rapidly out of the traditional mould of academic support and its underlying assumptions. It has, in particular, sought from its inception to inform its own educational practice and test its own assumptions concerning educational disadvantage against a complementary programme of appropriate educational research. At the same time, it has built upon the hard-won experience of academic support programmes in other academic disciplines. This paper outlines the character of the Programme, presents its educational philosophy, highlights relevant research conclusions emanating from it, and describes how it has responded dynamically to them.

The salient, and some of the unique, features of the Programme [7] are as follows: the Programme, in addition to providing a bridge for students from school systems that have not prepared them adequately for university study, seeks to provide a holistic university study environment that meets all their personal needs; all students are in residence and they all enjoy full bursary support that covers university fees as well as reasonable recreational, travel and other material expenses. In the case of some of the larger industrial sponsors, their commitment extends to graduation and beyond with a guarantee of subsequent employment. All students are thus free of any financial and accommodation pressures, and most from a fear of future unemployment.

In structural terms, the Programme expands the first two years of the regular four year engineering degree programme into three years. This reduced curriculum allows for intensive academic support. Apart from additional exposure to conventional teaching, considerable emphasis is placed on peer group learning activity by means of co-operative study groups and workshops. Students are thus encouraged to work together from the outset thereby contributing to the creation of a learning culture that extends beyond the classroom into the residences. In 1992, sixty five students were accommodated in the first year of study; this extends over a twelve month period starting in February each year.

The academic components of the Programme are based at the University and follow its regular academic calendar. The students concerned all sit the same examinations as the students in the regular programme. There is, thus, no perception of condescending discrimination. The supplementary components of the Programme (such as laboratory/workshop experience and visits to industry) are accommodated after the June and November examination periods, and are based at a

technikon. (Technikons are institutions of higher education whose qualifications are vocationally, rather than academically, oriented.) The work experience component of the Programme takes place during the vacation periods and is arranged in co-operation with sponsors or other companies.

In their first year, students register for three full credit carrying courses that all count towards the degree, namely, mathematics, technical communication, and applied mathematics. The technical communication course is a special course made up of an engineering drawing component and a language and communication component where certain skills are taught and practised in the context of engineering. By special arrangement, those students who wish to, and those who have not made satisfactory progress, may transfer to a Technikon after the mid-year class tests to continue with a Diploma in Engineering. At the end of their first year, students who have passed all three courses will have a number of options available to them: to proceed to the second year in engineering, to transfer to another degree programme within the University (for example, in the Science Faculty) or to transfer to a Technikon. The latter option may also be available to students who have not been successful in all three courses. Thus, there is considerable flexibility in allowing students to develop their potential academically or vocationally and every effort is made to ensure that an informed choice is made in each individual case. Failure in terms of university engineering is thus not absolute; there can be a second and equally rewarding career opportunity.

Students who continue with university engineering complete, in their second year, the remaining first year courses and one major second year course. In most cases this will be an engineering-oriented course in mathematics. Thereafter, the Programme continues to provide additional tutorial and non-academic support during this year. During the third year, students complete the remaining second year courses, and the Programme again continues to provide additional support for a selected number of these courses where required. The final two years of the undergraduate degree are completed in the mainstream without further academic assistance from the Programme.

COMPLEMENTARY RESEARCH ON STUDENT LEARNING

The research carried out on engineering students in the Programme has focused on the manifestation of qualitative individual differences in the manner in which students engage typical learning tasks in higher education. Much of the work that has been undertaken and reported, to date, has been aimed at extending specific aspects of learning theory into practical settings; more specifically, to conceptualise, interpret and classify individual patterns of study behaviour that are typically manifested, and to use these manifestations as a basis for assisting students to develop, where possible, more theoretically desirable forms of study behaviour. There is, thus, a commitment to the qualitative improvement of student learning that carries with it the development of an ability, on the part of the student, to reflect and think about how learning tasks are being consciously approached and engaged.

In carrying out this research, a conceptual model of student learning has been employed that emanates partly from students' own perceptions and experiences of higher education and partly from cognitive psychology [8]. In essence, this model emphasises the association between student perceptions of the context of learning, the study approach taken, and the learning outcome. Numerous quantitative studies of student learning have established strong empirical support for the conceptual basis of this model and its validity has been demonstrated in a wide variety of higher education contexts. There is no doubt that conclusions from research on student learning in higher education have implications for many different educational practices [9].

In order to inform educational practice, however, it has to be demonstrated that research on student learning, and any conclusions that emanate from it, can be effectively extended to the level of the individual student. To this end, a considerable amount of research has been devoted to the development and the application of an individual-difference model of student learning, that can inform an evaluation of individual student learning in the classroom [10], [11].

A study carried out on the first intake of students admitted to the Programme in 1988, reported considerable progress in extending previous group-level conclusions of research on student learning. The important empirical manifestation of qualitatively contrasting studying approaches at an individual level was established using an individual-difference statistical model [12]. In essence, this study illustrated quite clearly the possibility of identifying, in particular, individuals within a group of students who, from a conceptual interpretation of their self-reported study behaviour, could be regarded as being academically at risk. These conclusions were based on the manifestation early on their first year of theoretically disturbing manifestations in the manner in which such at risk students perceived the context of learning, and how they perceived the engagement of learning tasks within such a personal context. Not surprisingly, the majority of such students either failed their first year or performed very poorly.

In a follow-up study carried out on the second group of students admitted to the Programme, the stability of a more sophisticated conceptualization of study behaviour was explored [13]. The conclusions of this second study were that, in some individuals, distinctive patterns of contextualised

study behaviour (termed study orchestrations) were remarkably and unexpectedly stable. They appeared to be impervious to influences within the Programme that were implicitly expected to alter them. It therefore became necessary to establish whether this stability in study orchestration was evident in the transition from school to university.

DIFFERENTIAL FORMS OF ENTRY STUDY BEHAVIOUR

The two most recently reported studies undertaken at the University of Cape Town [14], [15] have reported important extensions to this work. They have investigated in some detail the interpretation, and the conceptual classification, of individual qualitative differences manifested in terms of study orchestrations—particularly in the transition from school to university. A number of important and, in some cases, disturbing conclusions have been reached that are essentially concerned with the phenomenon of students who, in spite of stringent selection procedures, enter university with pathologically disturbing forms of study orchestrations which, in many individual cases, prevail throughout the first year and inevitably lead to academic failure or low achievement. It needs to be re-emphasised that, in the case of engineering, the majority of African Black academic support students gained university entrance qualifications from a poor school system. Given that only the best of these students tend to get selected, it is even more disturbing to observe the proportion of these students, who reassuringly enter university with manifestations of theoretically desirable study behaviour but who, in the same supportive academic environment, also fail. These are not two facets of the same intervention problem as initially perceived within the operational context of the Programme.

The manifestation of fundamentally different and qualitatively contrasting forms of individual differences in significant subgroups of highly selected students gaining admission to university is disturbing. In the case of disadvantaged students, it severely challenges any assumptions of presumed group characteristics requiring a uniform response. To complicate matters further, a study undertaken in 1992 on the entry level study behaviour of the entire first year engineering student population at the University of Cape Town, indicates that this manifestation is not confined to disadvantaged students; it has been verified that manifestations of at risk study behaviour also occur on entry among some 'traditional' students.

Undergraduate teaching does not cater for such differential forms of entry level study behaviour. An increasing volume of experience suggests that such qualitatively differing subgroups of individuals require fundamentally different forms of educational intervention. These need to be integrated into any existing academic support activity if the individuals involved are to realise any academic potential they may possess. Indeed, the interpretation of the concept of potential and the problem of how to recognise its presence and development, are likely to be difficult and controversial issues to resolve in terms of both 'traditional' and 'non-traditional' students.

There are very real limitations on the number of students that can be admitted to undergraduate study and an admissions place is a scarce resource that needs to be allocated and managed with great care. The hidden cost of student failure in professional disciplines such as Engineering can approach levels that exceed $30 000 per student if the costs implicit in selection, placement and comprehensive bursary support are taken into account. Students who enter their first year of study with pathologically disturbing forms of study behaviour that are, in many extreme cases, conceptually incoherent, are precluded by definition from deriving personal meaning and understanding from what they learn. They frequently possess unsophisticated conceptions of learning and, typically, they adopt minimalist, reproductive and totally inadequate forms of studying. Intuitively, such students at best have limited potential.

Students who, contrastingly, manifest highly desirable forms of study behaviour on entry to their first year arguably possess more academic potential because the intention, motivation, perceptions and supporting intellectual processes required for understanding are harmoniously integrated in the best possible manner. The problem is that such desirable forms of study behaviour are a necessary, but not sufficient, condition for conceptual understanding to occur or be manifested in terms of academic achievement. In the case of disadvantaged students, in particular, there is considerable uncertainty about what these sufficient conditions might be.

THE RESPONSE OF THE PROGRAMME

The Programme has responded dynamically to the conclusions of its research programme and, as a consequence, it has also effectively highlighted the need for further related research to be undertaken in the regular curriculum. In terms of its own response, a number of intervention activities were implemented in 1991 that were aimed specifically at first year engineering students considered to be at risk in terms of entry study behaviour. The initial targeting of this student subgroup was informed by the conclusions of a number of studies undertaken that indicate that such students are, in fact, at a multiple disadvantage; they come from a disadvantaged school background, with manifestations of contextualised study behaviour that are conceptually very disturbing, even to the extent of being conceptually incoherent. The origins of these behaviours are unclear but their manifestations

certainly appear with equal clarity in terms of studying school subjects (for example, science). Interestingly, there is some evidence to suggest that study behaviour manifestations of the type referred to, are associated in more general terms with student failure in engineering—both in South Africa and in the United Kingdom [14], [16].

In attempting to respond to the needs of a specific subgroup of its own students in a conceptually high risk category, a number of new features were experimentally integrated into the Programme. The role of a study counsellor was introduced and, at the beginning of the academic year, every single student in the Programme was interviewed and, thereafter, every individual student potentially at risk was regularly interviewed and encouraged, in a very supportive manner, to talk about how learning was being approached as if such a conversation was a normal part of undergraduate teaching. The initial focus of this engagement was an individual's study history as manifested in the contextualised and retrospective study behaviour associated with studying science in the final year of high school.

This focus shifted early in the academic year to current study behaviour in applied mathematics. Having initially engaged students in a reflective verification of their school study behaviour, and in the light of evidence to suggest a stable pattern of such behaviour, every at risk student was presented with a printed copy of their study orchestration profile. (All of the remaining students were also presented with their profiles in order to avoid at risk students forming any perceptions of being singled out. At no time were any students ever told that they might be at risk.)

Every student in the Programme was presented with a profile that mirrored, in symbolic form, their own recent, self-reported study behaviour [14]. These profiles established the basis for the various intervention strategies that followed and which were directed specifically at the at risk subgroup in two different ways.

At one level all the students were presented with an example of an above average profile and an explanation of what it meant in conceptual terms. They were then asked to evaluate their own profiles against the example and indicate, confidentially, whether they were concerned or not, or would like to discuss their evaluation further with the study counsellor. In terms of ongoing interviews, students at risk were particularly encouraged to explore further the meaning and the implications of their own profiles, thereby creating for the study counsellor an individual framework for rendering assistance. A further related activity involved verbal presentations by senior students (who had also been in the Programme in their first year) on how they had managed the problems of the first year and to what they ascribed their success. In conceptual terms the activities at this level were based on the work of Biggs [17], Vermunt and Van Rijswijk [18], and that of Van Overwalle and De Metsenaere [19]. The prime intention was to establish a foundation on which each individual was encouraged to build an awareness of their own learning behaviour and a perception that they could control it. Elements of important concepts such as locus of control, meta-learning, self-regulated learning and attributional retraining were thus integrated into the Programme.

At another level there was an activity based on the work of Parsons and Meyer [20] that sought to alter learning behaviour by operating on student perceptions of the context of that behaviour. The intention here was to assist students at risk to develop deeper and more holistic perceptions of their learning environment. This involved a sharing of perceptions between the students and the teaching staff about what constituted the most important elements of the discipline-specific context of teaching and learning, and what the attributes of, and functional relationships between, these elements were. In this way students were made more aware of their teachers' conceptions of learning, their attitudes and values, their epistemologies and many other previously underdeveloped perceptions that are associated with deep approaches to learning.

SOME OBSERVATIONS ON THE INTERVENTION ACTIVITIES

A full evaluation of both the quantitative and the qualitative aspects of the intervention activities will be reported elsewhere in due course. In terms of what has already been reported [21], the activities described have impacted significantly on the Programme and the context within which it is perceived to operate by its intended beneficiaries. This impact is reflected in two important groups of people: the selected students who were targeted as the prime beneficiaries of the project and academic staff, including some not associated with the Programme.

The students involved in the pilot project have validated the most important basic assumption on which the viability of all the intervention activities is based; namely, that it is possible to engage students themselves with manifestations of their learning behaviour in a naturalistic setting and in a manner that is perceived by them to be supportive and useful. The possibility therefore exists for students to derive benefit, and develop intellectually from what is offered through their own involvement in what is seen as a perfectly normal and integral part of their first year learning experience.

Based on mid-year examination results and an evaluation of the various intervention activities (including an evaluation emanating from the experiences of the students themselves) there is cautious optimism concerning the short-term success of the project; it would appear that approximately half of the targeted at risk students in the intervention programme, have derived expected benefits related to their study behaviour and their

academic performance. The first stage of the pilot project, furthermore, appears to have also benefited some individuals outside the targeted subgroup. It may, therefore, be beneficial to extend the intervention activities to all first year students in the Programme on a voluntary basis or at least integrate some of them into the regular undergraduate programme to which they are also exposed.

The academic staff in the Programme have been exposed to a number of powerful concepts and conclusions emanating from contemporary research on student learning, and have witnessed how these can be implemented to impact directly on educational practice in a manner that is predictably consistent with the underlying theory. The resultant manifestation and interpretation of student learning has thus had a marked and clearly observable positive influence on a number of other previously sceptical academic support practitioners who have witnessed the dynamics of the project.

Some other academic practitioners outside the Programme have been encouraged to become involved in evaluating the quality of student learning in their own courses. In one notable instance, an intervention was attempted in one of the largest first year courses in the university involving over six hundred students.

THE REGULAR PROGRAMME

It has become apparent from the research experience of the Programme that there are also untested assumptions concerning student learning in the regular engineering programme. In 1992, a research project was launched at the University of Cape Town to investigate specific aspects of student learning in the general undergraduate student population. Apart from illuminating the longitudinal study behaviour of engineering students there are three broader areas of concern that will be addressed.

The first of these relates to the incidence of differential entry study behaviour among first year students—specifically the incidence, and the consequences, of at risk behaviour among 'traditional' students. The extent of this phenomenon needs to be established and the need for responses to it evaluated. It is probable that most of these students are likely to require considerable assistance in their first and subsequent years and this clearly has very important consequences for undergraduate teaching.

A second concern relates to students who do not appear to be at risk on entry but who perform very poorly in their first year. The reasons for this distressing phenomenon are not known, but it is likely that it will require a response quite different from that of the first concern above.

The third concern relates to academic support students who apparently benefit from the Programme, and who do quite well academically to begin with, only to fail when exposed to the full demands of the regular curriculum.

There is thus a tangible commitment to investigating the quality of student learning in engineering. Concerns about student failure and unrealised human potential are not new in higher education, but they have not previously been expressed or addressed within the student learning perspective described in this paper. The challenges presented by educational research of this nature are quite daunting but the rewards are rich.

REFERENCES

1. Pouris, A., *The Hidden Crisis*, The Foundation for Research Development, CSIR, Pretoria (1989).
2. National Manpower Commission, *High-level and middle-level manpower in South Africa: recent developments*, RP98/1987, Republic of South Africa, Department of Manpower (1987).
3. Hartshorne, K., Look back in anger. African Matric Results 1988–1989, *Indicator SA*, **7**(2), 70–74 (1990).
4. Entwistle, N. J., Student Learning and Study Strategies, in B. R. Clark and G. Neave (Eds.), *The Encyclopedia of Higher Education*, Pergamon, Oxford (1992).
5. Ramsden, P., Context and strategy. Situational influences on learning. In R. R. Schmeck (Ed.), *Learning strategies and learning styles*, Plenum Press, New York (1988).
6. Meyer, J. H. F. and Dunne, T. T., Study approaches of nursing students: effects of an extended clinical context. *Medical Education*, **25**, 497–516 (1991).
7. Sass, A., Academic support in engineering at the University of Cape Town, *South African Journal of Higher Education*, **2**, 25–28 (1988).
8. Entwistle, N. and Ramsden, P., *Understanding Student Learning*, Croom Helm, London (1983).
9. Entwistle, N. J. and Meyer, J. H. F., Findings and implications from research on student learning, *South African Medical Journal*, **81**, 593–595 (1992).
10. Meyer, J. H. F. and Muller, M. W., Evaluating the Quality of Student Learning. I—an unfolding analysis of the association between perceptions of learning context and approaches to studying at an individual level, *Studies in Higher Education*, **15**, 131–154 (1990).
11. Meyer, J. H. F. and Watson, R., Evaluating the Quality of Student Learning. II—study orchestration and the curriculum, *Studies in Higher Education*, **16**, 251–275 (1991).
12. Meyer, J. H. F. and Muller, M. W., An unfolding analysis of the association between perceptions of learning context and approaches to studying, *South African Journal of Higher Education*, **4**, 46–58 (1990).
13. Meyer, J. H. F., Parsons, P. and Dunne, T. T., Study orchestration and learning outcome: Evidence of association over time among disadvantaged students, *Higher Education*, **20**, 245–269 (1990).

14. Meyer, J. H. F., Study orchestration: the manifestation, interpretation and consequences of contextualised approaches to studying, *Higher Education*, **22**, 297–316 (1991).
15. Meyer, J. H. F., Dunne, T. T. and Sass, A. R., Impressions of disadvantage. I—School versus university study orchestration and implications for academic support, *Higher Education*, **24**, 291–316 (1992).
16. Entwistle, N. J., Meyer, J. H. F. and Tait, H., Student Failure: disintegrated perceptions of study strategies and perceptions of the learning environment, *Higher Education*, **21**, 249–261 (1991).
17. Biggs, J. B., The role of metalearning in study process, *British Journal of Educational Psychology*, **55**, 185–212 (1985).
18. Vermunt, J. D. H. M. and Van Rijswijk, F. A. W. M., Analysis and development of students' skill in self-regulated learning, *Higher Education*, **17**, 647–682 (1988).
19. Van Overwalle, F. and De Metsenaere, M., The effects of attribution-based intervention and study strategy training on academic achievement in college freshmen, *British Journal of Educational Psychology*, **60**, 299–311 (1990).
20. Parsons, P. and Meyer, J. H. F., The academically 'at risk' student: a pilot intervention programme and its observed effects, *Higher Education*, **20**, 323–334 (1990).
21. Cliff, A., Qualitative differences in learning amongst disadvantaged students: implications for academic support, *Proceedings of the South African Academic Development Conference*, 5–7 December, University of Witwatersrand (1991).

Professor J. H. F. Meyer is the Director of the Teaching Methods Unit at the University of Cape Town. After obtaining his first degree in pure and applied mathematics, he obtained further qualifications in computer science and education. His research interest is in student learning, particularly in terms of conclusions that can inform educational practice. His recent published work has explored manifestations of contextualised study behaviour at an individual level. A focus of much of this work has been on the learning behaviour of first year engineering students from educationally disadvantaged backgrounds, who are admitted to special first year undergraduate programmes.

Associate Professor A. R. Sass is a registered Professional Engineer. He graduated from the University of Cape Town as a mechanical engineer in 1963 and after seven years in the commercial world he returned to the University of Cape Town and joined the staff in Mechanical Engineering in 1971. His main fields of interest include manufacturing processes and design, and in particular computer controlled machine tools. In 1982 he became involved with the bridging scheme for Black students who had been disadvantaged by poor schooling, sponsored by Shell South Africa. This interest continued and in 1988 he accepted the post of Co-ordinator of the Academic Support Programme for Engineering in Cape Town (ASPECT) in the Faculty of Engineering.