

Conducting a Programme of Learning Improvement with 'Educationally Disadvantaged' Students in Engineering*

A. F. CLIFF

Student Learning Research Group, School of Education, University of Cape Town, Rondebosch 7700, South Africa

Within the research framework of an individual-difference model of student learning, this study describes a programme of learning improvement conducted as a normal part of an undergraduate engineering degree course. In all, three intervention programme workshops are presented and discussed. In each case, the emphasis is on students reaching their own conclusions as to the lessons gleaned from the workshops. A range of students' qualitatively different contrasting perceptions and conceptions of each are presented, and implications of these highlighted. In addition, the study focuses on the value of such workshops for learning improvement in everyday academic contexts in higher education.

A STUDENT LEARNING MODEL FOR HIGHER EDUCATION

RESEARCH into student learning in higher education has consistently pointed to the recognition of the manifestation of qualitative individual differences in the manner in which students engage typical everyday academic tasks [1]. Thus, for example, research studies have pointed to students' qualitatively different levels of intellectual development [2], approaches to learning [3], conceptions of learning [4, 5], motivations and strategies for learning [6] and perceptions of the contexts of learning of which they are a part [7, 8].

At the most stark level, it has been possible to identify a distinction between subgroups of students who adopt a 'deep' approach to learning, which suggests that they seek to interact vigorously with academic course content [9], and pay attention to authors' underlying arguments [10]; and students who adopt a 'surface' approach, which implies a minimalist, sterile engagement with course content and an emphasis on reproducing this content for assessment purposes [11].

Not only has it become apparent that students' approaches to learning engagements might manifest such qualitative distinctions, but also that their perceptions of the academic context of which they are an integral part might show similar such distinctions [7]. Thus, some subgroups of students appear to manifest 'deep' holistic perceptions of their context of learning. These are typically seen in their stated preferences for meaningful interaction with key elements of their academic context, such as the

academic staff, textbooks, forms of assessment and classrooms. Other students appear to have 'surface' perceptions of their learning contexts, typically manifested in these students' stated lack of clarity about the meaning and educational purposes of various forms of assessment, or by their inability to make meaningful contact with academic staff.

The concept of 'study orchestration' [12]—a term used to capture the coalescence of study approaches and contextual perceptions at an individual level—provided researchers into student learning with the opportunity of depicting students' contextualized study approaches as a function of their nuanced, qualitatively distinctive perceptions of learning context.

In essence, 'study orchestration' refers to individual students adopting an approach to their studies which is influenced by their perceptions of the learning context in which they find themselves. Studies of students' approaches to learning have described a meaning orchestration as one in which a student articulates a desire to understand deeply and to read widely and critically. Coupled with these approaches appears to be a deep, holistic understanding of the context in which specific learning occurs. This is evidenced by an understanding of the respective function and purposes of contextual variables such as assessment methods, tutorial processes and lectures.

A reproducing orchestration has been characterized by students adopting a surface approach to course content, coupled with an emphasis on memorizing and reproducing this content in examinations, and a sterile engagement with course process.

Empirical manifestations of study orchestration have been confirmed in a wide range of studies [12-17].

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What has also become apparent from research studies into student learning is that these qualitatively distinctive approaches to, and perceptions of, learning contexts might have qualitatively different outcomes for learning for students at the individual level. This has been shown to be especially so for students who come from 'educationally disadvantaged' backgrounds [13-15, 18], but also for students from 'traditional' academic backgrounds [11]. These and other studies have shown clearly that (engineering) students with disintegrated orchestrations are in danger of performing poorly, failing or failing to perceive the academic demands being placed upon them in higher education. In the context of these studies, the term 'disintegrated orchestration' refers to an orchestration which is theoretically uninterpretable within the individual-difference model of student learning used to determine it [19].

Thus, the question of designing a learning improvement programme acquires a deep, practical significance in the context of the intervention described further on, in terms of the challenge being about such a programme assisting 'educationally disadvantaged' students in particular to adopt 'deep' approaches and perceptions in such a way that they are able to derive rich, meaningful benefit from their contextualized learning engagements. It was this author's contention that assisting these students to achieve a qualitative shift in approaches and perceptions represented a fundamental starting point to their realizing their academic potential in a university context.

In addition, it must be noted that there is nothing to suggest that this kind of learning improvement programme cannot be conducted with other groups of students in other academic contexts. In fact, it is precisely to pose this kind of challenge to any practitioners interested in learning improvement that this study is presented.

AIMS OF THIS PAPER

The aims of this paper are:

1. To describe a programme of learning improvement which was firmly rooted in a student learning research perspective in higher education, a perspective which formed the background to the conduct of the workshops presented in the discussion of this study;
2. To outline the context and content of three workshop presentations which were designed to facilitate discussion, between this author and the Academic Support Programme for Engineering in Cape Town (ASPECT) students, on key aspects of students' everyday academic engagements.
3. To describe the content of the workshop presentations, and present findings and conclusions based on these contents. Implications for learning and teaching in this and other learning contexts are also discussed.

THE ACADEMIC CONTEXT OF THIS STUDY

These workshops formed part of a course in technical communication offered to first-year ASPECT students, who primarily came from DET and DEC secondary school backgrounds. The DET and DEC are two state Departments of Education in South Africa. Many matriculants from DET and DEC schools have been underprepared within the school system to meet the demands of conventional university study. This is due to a variety of factors such as underresourced schools and underqualified teaching staff. In the context of this discussion, underpreparedness typically means that these students are likely to battle to cope with tertiary workloads and levels to a greater extent than their counterparts from historically well-resourced schools. As a result of this underpreparedness, these students are enrolled in an Academic Support Programme.

In essence, first-year ASPECT students who register for an engineering degree programme at the University of Cape Town are enrolled on a reduced curriculum which gives them the opportunity to complete the first two academic years of their engineering degree in three chronological years. At the conclusion of their third actual year of study, provided these ASPECT students have fulfilled the requirements for the first two academic years of their particular degree 'stream', they are able to move into the 'mainstream' degree programme in order to complete their undergraduate courses of study. ASPECT students are provided with full financial support during their years of academic study at the University of Cape Town, and they are also provided with academic tutorial and other support (over and above that provided to 'mainstream' students), the formal contact time of which is progressively reduced over the first two academic years of study. A detailed description of the curriculum model which has been adopted for use in ASPECT has been outlined elsewhere [20, 21], and is not repeated here.

One of the credit-bearing degree courses followed by ASPECT students in their first academic year of study is a course entitled Technical Communication. An objective of this course is to provide students with key written, oral and graphic presentation skills required for the successful completion of engineering drawing and project work, such as those skills required for the writing of reports on site work, and so on. As such, the course is divided into two parts: engineering drawing and professional communication. It is the latter part of the course which formed the context of the intervention programme implemented by this author.

The two staff members (this author and one other) who teach the professional communication component of the course, have, since the beginning of 1992, adopted a five-module structure. The course thus covers the following focuses: orientation to university life; pure language skills; applied

language skills; learning and study approaches; lifeskills and personal development. It was in the context of the learning and study approaches module that the intervention described in the following section on methodology was implemented. It is important to emphasize that these workshops were presented in the context of a normal focus on learning improvement within this course, a focus which could also form part of other 'mainstream' academic contexts.

METHODOLOGY FOR THE LEARNING IMPROVEMENT PROGRAMME

Description of the three workshops, together with this author's aims, which were not explicitly imparted to the students, follows. The primary reason for this author having not given his view of the aims of the workshops was to allow students to reach conclusions about the meaning and significance of the workshop sessions relatively free of authority figure influence. It was thus hoped that students would not simply feed back what they thought the author wanted to hear.

Awareness of learning context workshop

This workshop was modelled on the structure of previously conducted workshops designed and implemented in the context of studies aimed at altering students' qualitative levels of perception of their learning contexts [17, 22–24]. Fundamental to these previously reported studies was the notion that raising students' levels of awareness of their perceived learning contexts could be instrumental in bringing about qualitative improvement in these perceptions.

First-year ASPECT students ($n=65$) were divided into groups of five or six, and were asked to discuss among themselves their perceptions of different lecturer approaches, forms of assessments and so on. Subgroups then recorded their perceptions on sheets of paper, which were then attached to pinboards around the tutorial room in which these groups normally met for Technical Communication. Open discussion then followed, during which this author highlighted students' self-reported contrasting perceptions of learning contexts and encouraged students to reflect on how their perceptions might not be similar to their lecturers, for example. The possible implications of these mismatches in perceptions were also discussed.

It was hoped that, by students focusing on the multifunctional nature of these elements of their learning contexts, they would come to qualitatively 'deep' perceptions (if they did not already possess such) which would assist them to 'see' beyond the merely functional attributes of these learning context elements.

Different forms of understanding workshop

The design of this workshop was modelled on a previously reported research study [25]. Secondary

school students read a parable of Franz Kafka's, entitled 'Before the Law', several times. After each occasion, students were asked to recall the details of the story and state how they had understood what the story was about. A limited range of qualitatively different ways of understanding the parable were found. The authors of the study also found that some students made use of what these authors termed 'reflective variation' on repeated readings of the parable: students came to qualitatively different and/or more elaborated understandings of the meanings of the parable. The use of reflective variation also seemed to be highly correlated with more advanced understandings of the literary text.

The workshop offered to ASPECT students was aimed at assisting students to become aware that different learners might have different understandings of the meaning and/or underlying argument of a particular text which they had read. A subsidiary aim of this workshop was to encourage students to make use of individual reflection and discussion with other students in their approaches to academic texts with a view to their adopting 'deep' understandings of the content and structure of their reading of undergraduate academic texts, notes, worksheets and so on.

ASPECT students ($n=65$) were requested to read the parable on three separate occasions, individually recall its detail and its underlying meaning by answering questions on paper, and then (after the third reading) asked to discuss their understandings of its underlying meaning with one another in the context of a normal tutorial in Technical Communication. Initially, small-group discussions took place, with the students being organized in the same groups as had been the case for the first workshop. A general class discussion followed the group discussions, during which this author attempted to focus on lessons learned about understanding after repeated reading of a text.

Self-paced co-operative project work

The theoretical rationale for the development and implementation of this workshop idea found its focus in theory and research work on the theme of co-operative learning [26, 27]. Many variations on the theme of co-operative learning have been reported in the research literature, but, in essence, co-operative learning involves groups of students working on tasks in a manner that is largely directed by themselves and where these students are not competing with one another in terms of motivation, task definition and/or (assessment) rewards.

This author's workshop was designed to enable students to conceive an idea for a board game that could be played by final-year school students, which would give the players of these games insights into some of the key academic choices and pressures facing first-year engineering students on entry to, and during the first academic year of, study. ASPECT students were required to develop an idea for a project, discuss its merits and demerits with each other, refine it, and create a finished

product. The aim of this series of workshops was to leave students to regulate and pace their own group and individual work in terms of idea generation, group cohesion, goal-setting, meeting deadlines and so on. It was hoped that ASPECT students would derive benefit from working collaboratively on this project and from having been given deliberately ill-defined instructions as to what the task requirements were.

FINDINGS FROM THE WORKSHOPS

Written feedback of a qualitative nature was obtained from 45 ASPECT students as to the perceived value or otherwise of the learning improvement workshops conducted.

This feedback was obtained as part of a comprehensive, open-ended evaluation of the Technical Communication coursework of the second semester as a whole. Coursework evaluations of this kind are conducted as a normal part of academic work, across a wide range of disciplines and within specific contexts. Students were encouraged to give comments which were an accurate reflection of their experiences of their workshops and not necessarily comments which would 'please' this author. It must be emphasized again at this point that this author had not explicitly articulated his aims for the particular workshops to the students.

The following were comments from ASPECT students which are considered by this author to represent discrete categories of qualitatively different perceptions of what these students said they had learned at the workshops. In each case, the emphasis is the author's as these portions of the comment appear to illustrate contrasting perceptions most powerfully. The number in brackets after the comment indicates the number of respondents whose comments were categorized by this author as being in this conceptual category.

Workshop 1

The first comment might be said to fit with one of the aims of this author, i.e. it suggests that, for some students, the session indeed assisted in raising their levels of awareness of key elements of their academic environment.

'I became to realize how simple factors such as uses of lecture rooms, reference book, receiving of lectures can affect a student academically.' (n = 16)

The second comment, however, suggests that a disturbing number of students never got beyond the level of chatting about academic contexts, and that there was no perceived utilitarian value in the session.

'To me it was like just a discussion on what happens during lectures and what students do or are most likely to do. It was not useful in any way. Maybe next year it will be.' (n = 19)

The third comment seems to suggest that these students intend at least to integrate points raised in the workshop in future learning experiences.

'This session helped me in trying to improve my approach to learning.'

Workshop 2

Comments on the value of this workshop contained some powerful contrasts in terms of being typical of the intellectual positions described in Perry's model of intellectual development [2]. The first two comments seem to be good examples of the relativistic position as described by Perry, i.e. that of understanding being related to perception and knowledge not necessarily being inviolate or uncontested. The second of these two comments, however, seems to suggest a student who was grappling with dualistic notions of understanding, being uncomfortable with this ambivalence and wanting to have it settled somehow.

'This made me to see that there are as many interpretations of a concept as the number of people who have come across it!'

and

'... it is useful to read something twice. But I don't think we dealt with the problem that also arises out of that. Mainly that of coming up with two perceptions that contradict each other.' (n = 13)

The third comment suggests the strong mediating influence of perceived course requirements (as well as the lecturer being perceived as the source of all truth) on some students. For this subset of students, studying applied mathematics is clearly not the same as reading (and interpreting) a literary parable.

'I did not understand its purpose to us as students because in a course like Applied Maths one is expected to know a section of work as the lecturer expects it, not what you think.' (n = 20)

The fourth comment is typical of the subset of students who perceived some kind of value to the workshop in terms of its usefulness in their everyday academic contexts.

'It helped because understanding is part of our everyday life as student.' (n = 12)

Workshop 3

The first two student comments in this section suggest that a subgroup of students gleaned some of the accepted principles of good co-operative learning such as listening to others, synthesizing individual ideas in the group and reaching consensus.

'... one must always accept other ideas [and] not always want to force his own ideas without listening to others'

and

'It's all about coming with *different ideas and putting them together.*' (n = 28)

The third comment, however, is indicative of a common problem encountered within a course such as Technical Communication where class activities do not carry as much examination-weighted credibility as other core courses such as Applied Mechanics.

'... but the problem was the *timing, designing/playing games when u [sic] should be studying* for your exams is not a good thing.' (n = 6)

The final comment cited here is worrisome in the sense that some students seem unable to make connections about design principles employed in making the board game and similar principles encountered in an engineering drawing class.

'There is no coordination or the relationship *between engineering and designing/making of the board games.* It's just a waste of time.' (n = 11)

CONCLUSIONS BASED ON STUDENT FEEDBACK

So what can be concluded on the basis of the above student comments, which, as emphasized in the section on methodology, could be regarded as representative of the range of qualitatively discrete perceptions?

Firstly, it is worth noting the distinctive qualitative differences in students' reported perceptions of the value to them of the various workshops. Previous studies of the manifestation of large qualitative differences in individual perceptions among similar groups of students have already highlighted this phenomenon [16, 17]. The manifestation of these differences led this author to the inescapable conclusion that what it was intended by this author that students should learn from these workshops, was, in some cases, at considerable variance with what students said they had learned.

Secondly, in terms of the workshops having raised students' levels of awareness about the associations between elements of their perceived academic contexts and their approaches to study, the workshops would seem to have been partly successful. There was some evidence from student feedback of qualitatively 'deep' perceptions of learning context and approaches to study. This evidence has been supported in other studies of this kind with different samples of students [22, 23].

Whether these articulated perceptions were provided by these students because they thought that these were perceptions this author was expecting

to read, however, is difficult to determine on the basis of the qualitative feedback alone.

It seems reasonable to assume, however, that their feedback can be interpreted as a reflection of their accurate feelings, as (i) they had not been explicitly told what the aims of the workshops were, (ii) some students had said that aspects of the workshops had been useless to them—hardly a choice of feedback word that they would think this author wanted to hear, and (iii) they had been directly requested to give accurate and frank feedback in response to a series of workshops conducted as a normal part of their experience in the Technical Communication course.

Thirdly, it can be assumed from the qualitative feedback that some transfer of the perceptions gained in the workshops to the context of these students' everyday study engagement with engineering undergraduate degree subjects did occur. Of this and the two previous conclusions, more will be said in the final section of this paper.

IMPLICATIONS OF THE FINDINGS OF THIS STUDY

Student feedback on the benefits of the various workshops conducted seems to imply that it is possible to alter some students' self-reported learning approaches and perceptions of context. The manifestations of large individual differences in perceptions, however, make it exceedingly difficult to suggest that creating a climate within which 'meaning-full' learning might occur necessarily means that such learning will indeed take place.

How, for example, is it possible to cater for the learning needs of one student who says that the self-paced board game project taught him to pool his ideas with other students, and another student who says that there is absolutely no connection between designing the board games and engineering? And how does one accommodate the very important perceptions of students who say that in Applied Mathematics, for example, a student is expected to come up with what the lecturer thinks, not one's own interpretation? Or students whose concerns are that the timing of the board game project was not right, coming as it did just before examinations?

Should a lecturer/presenter make explicit his aims for a particular course or subsection of a course as has been suggested elsewhere [28]? Or does one then run the risk of students simply appropriating such aims and not realizing these for themselves?

It would seem that any attempt at study and learning improvement of the kind described in this paper would be better served within the specific content and context of the subject discipline. This idea has already been suggested in a number of research studies in student learning [18, 21]. It would also seem reasonable to suggest that any learning improvement programme which does not

take cognisance of crucial factors in a system of influences on students' academic experiences [29], such as assessment demands and lecturer and student approaches and perceptions, for example, runs a high risk of adopting too narrow a focus, and having concomitant limited success.

What the findings of this intervention programme suggest quite positively, however, is that raising students' awareness of the existence of a range of approaches and perceptions appears to be instrumental, at least in part, in their articulating qualitatively 'deep' views on study and learning. And this seems to be a reasonable starting point

for creating a set of conditions for the development of 'meaning-full' learning. Further research seems indicated in attempting to integrate the findings of this study into teaching and learning which occurs both within and outside of the context of academic support programmes such as the one described in this study.

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REFERENCES

1. J. H. F. Meyer and A. R. Sass, Developing desirable approaches to learning among disadvantaged students. A paper prepared for the Anglo American Seminar on Engineering Bridging Courses, Johannesburg (1991).
2. W. G. Perry, *Forms of Intellectual and Ethical Development in the College Years: A Scheme*, Holt, Rinehart and Winston, New York (1970).
3. F. Marton and R. Säljö, Approaches to learning, in F. Marton, D. Hounsell and N. J. Entwistle (eds), *The Experience of Learning*, Scottish Academic Press, Edinburgh (1984).
4. R. Säljö, Qualitative differences in learning as a function of the learner's conception of the task, *Acta Universitatis Gothoburgensis*, Göteborg (1975).
5. F. Marton, G. Dall'Alba and E. Beaty, Conceptions of learning, *Int. J. Ed. Res.*, **19**, 277-300 (1993).
6. J. B. Biggs, The role of metalearning in study processes, *Br. J. Ed. Psychol.*, **55**, 185-212 (1985).
7. J. H. F. Meyer, Student perceptions of learning context and approaches to studying, *S. Afr. J. Higher Ed.*, **2**, 73-82 (1988).
8. P. Ramsden, Context and strategy: situational influences on learning, in R. R. Schmeck (ed.), *Learning Strategies and Learning Styles*, Plenum Press, New York (1988).
9. N. J. Entwistle, Student learning and study strategies, in B. R. Clark and G. Neave (eds), *The Encyclopaedia of Higher Education*, Pergamon Press, Oxford (1992).
10. F. Marton and R. Säljö, On qualitative differences in learning: I—outcome and process, *Br. J. Ed. Psychol.*, **46**, 4-11 (1976).
11. J. H. F. Meyer and A. R. Sass, The impact of the first year on the learning behaviour of engineering students, *Int. J. Engng Ed.*, **9**, 209-217 (1993).
12. J. H. F. Meyer, Study orchestration: the manifestation, interpretation and consequences of contextualised approaches to studying, *Higher Ed.*, **22**, 297-316 (1991).
13. J. H. F. Meyer and M. W. Muller, 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 Higher Ed.*, **15**, 131-154 (1990).
14. J. H. F. Meyer and M. W. Muller, An unfolding analysis of the association between perceptions of learning context and approaches to studying, *S. Afr. J. Higher Ed.*, **4**, 46-58 (1990).
15. J. H. F. Meyer, P. G. Parsons and T. T. Dunne, Study orchestration and learning outcome: evidence of association over time among disadvantaged students, *Higher Ed.*, **20**, 245-269 (1990).
16. A. F. Cliff, Qualitative differences in learning amongst disadvantaged students: implications for academic support. Paper presented at the Sixth Conference of the South African Association for Academic Development, Wits University, Johannesburg (1991).
17. A. F. Cliff, The 'educationally disadvantaged' student: factors impacting upon conceptions of learning and perceptions of learning contexts. Unpublished M.Ed. dissertation, University of Cape Town (1992).
18. J. H. F. Meyer, T. T. Dunne and A. R. Sass, Impressions of disadvantage. I—School versus university study orchestration and implications for academic support, *Higher Ed.*, **24**, 291-316 (1992).
19. N. J. Entwistle, J. H. F. Meyer and H. Tait, Student failure: disintegrated patterns of study strategies and perceptions of the learning environment, *Higher Ed.*, **21**, 249-261 (1991).
20. A. R. Sass, Academic support in engineering at the University of Cape Town, *S. Afr. J. Higher Ed.*, **2**, 25-28 (1988).
21. J. H. F. Meyer and A. R. Sass, Engineering students from educationally disadvantaged backgrounds: assumptions, research conclusions, and curriculum responses, *Int. J. Engng Ed.*, **8**, 328-335 (1992).
22. P. G. Parsons and J. H. F. Meyer, The academically 'at risk' student: a pilot intervention programme and its observed effects on learning outcome, *Higher Ed.*, **20**, 323-334 (1990).
23. P. G. Parsons, The student 'at risk': the successful integration of intervention into the regular teaching programme, *S. Afr. J. Higher Ed.*, **7**, 24-32 (1993).
24. J. H. F. Meyer, A. F. Cliff and T. T. Dunne, Impressions of disadvantage: II—Monitoring and assisting the student at risk, *Higher Ed.*, **27**, 95-117 (1994).
25. F. Marton, M. A. Carlsson and L. Halasz, Differences in understanding and the use of reflective variation in reading, *Br. J. Ed. Psychol.*, **62**, 116 (1992).
26. S. Sharan and Y. Sharan, *Small-group Teaching*, Educational Technology, Englewood Cliffs, NJ (1976).
27. R. E. Slavin, *Co-operative Learning*, Longman, New York (1983).

