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ABSTRACT

In any teaching situation, it is always possible to identify those students who generally seem to have a positive attitude towards what they are doing, and those who seem less positive. Students' attitudes seem to feature prominently in many teachers' and lecturers' concerns about the effectiveness of their teaching. Students' attitudes are an important factor in determining their success. This paper reports on aspects of a study which sought to gather information on students' attitudes toward the study of chemistry. The specific aims were: (1) to develop an instrument to assess first year students' attitudes toward the study of chemistry; (2) to use the instrument to gather baseline data on two cohorts of students (mainstream chemistry students and students on a two-year access program); and (3) to identify possible areas for intervention and remedial action. Many of the students involved in the study were first generation university students in a transforming university environment. They were often second language speakers of English, coming from a background of disadvantaged schooling with little laboratory experience. Other students were from a more advantaged environment and typically were second or third generation university students. The study found a definite relationship between students' views and their performance. There were few low performing students with high global means on the testing instrument and no high performing students with low global means. (Contains 16 references.) (Author/CCM)

Freshman South African Student's Views on the Study of Chemistry

by
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Freshman South African Students' Views on the Study of Chemistry

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Introduction and background to the study

In any teaching situation, it is always possible to identify those students who generally seem to have a positive attitude to what they are doing, and those who seem to be less positive. Students' attitudes seem to feature prominently in many teachers' and lecturers' concerns about the effectiveness of their teaching. There are a number of reasons for this. Levels of job satisfaction are likely to be influenced by students' affective responses as well as their performance in test and examinations. The motivation for revision of the teaching of individual topics and of whole courses is likely to have as much to do with increasing students' level of engagement with the subject as it is to do with the development of conceptual understanding.

This paper reports on aspects of a study which sought to gather information on students' attitudes to the study of chemistry. The study was undertaken because it was felt that students' attitudes are an important factor in determining their success or otherwise at university. Gaining a deeper understanding of factors which might help shape attitudes would be helpful to both staff and students in informing decisions made about the structure of teaching sessions and advice given to students on various aspects of their study.

The specific aims of the study were as follows:

- to develop an instrument to assess first year students' attitudes to the study of chemistry
- to use the instrument to gather baseline data on two cohorts of students (mainstream chemistry students and students on a two-year access programme)
- to identify possible areas for intervention and remedial action.

In this paper we focus on some aspects of the development of the instrument for assessing attitudes, as well as some selected findings from the study. Many of the students involved in this study are first generation university students in a transforming university environment. They are often second language speakers of English, coming from a background of disadvantaged schooling with little laboratory experience. Other students in the study were from a more advantaged environment and were typically second or third generation university students.

Planning the study

The research team undertaking the study was very conscious of the lack of consensus over the methods which might be employed to gain valid measures of attitudes, and that a prominent characteristic of much of the literature is discussion of potential problems associated with the measurement of attitudes. Thus a central aspect of the study was a detailed consideration of the methodology and techniques to be adopted.

Problems associated with the measurement of attitudes have been well-documented within science education and beyond by, for example, Gardner, 1975; Munby, 1983; Schibeci, 1984; Shrigley and Koballa, 1992, Crawley and Koballa, 1994; Gardner, 1996; Oppenheim, 1992; Ramsden, 1997). Such problems include: a lack of precision over definitions of key terms, poor design of instruments and of individual response items within instruments, failure to address matters of reliability and validity appropriately, inappropriate analysis and

interpretation of data, lack of standardisation of instruments, failure to draw on ideas from psychological theory; failure to formulate the research with reference to theory on the construction of data collection tools.

A number of strategies were adopted in the study to attempt to overcome or minimise these problems. Firstly, the methodology adopted drew on that employed in an earlier large scale study, the Views on Science-Technology-Society (VOSTS) study (Aikenhead and Ryan, 1989, 1992). Secondly, a fairly narrow focus, students' attitudes to the study of science, was selected for the study. Thirdly, data were validated by getting staff involved in the teaching of the students who completed the instrument to comment on their views of the students' attitude.

The original *Views on Science-Technology-Society* (VOSTS) study was undertaken in Canada to document upper high school students' views on science-technology-society topics. Of particular interest to the research team involved in the study here was the methodology employed in the VOSTS study. In essence, this involved the empirical development of a multiple-choice item pool based on views expressed by the students. The methodology was very much in keeping with that recommended by Oppenheim (1992), where the design of an attitude inventory should be a two-step process. The first step should involve using interviews to establish the nature and origins of the attitudes in the are in questions, and the second step should be to obtain expressions of such attitudes from the respondents in a form which might make them suitable for use as statements in an attitude scale.

Since its original inception the instrument has been widely used in a number of contexts (see, for example, Schoneweg et al., 1995); Vázquez and Manassero, 1997; Zoller et al., 1990). Items have also been added to the pool (see, for example, Rubba and Harkness (1993).

The original report of the VOSTS study (Aiken head and Ryan, 1989) focussed on the development of the instrument, with only limited analysis of the data taking place. Subsequent discussion in the literature has also focused on techniques for analysing the data gathered (see, for example, Rubba et al., 1996; Vázquez-Alonso and Manassero-Mas, 1999). This latter aspect was also of interest to the research team, as a detailed analysis of the data was seen as essential in order to identify areas for possible intervention and remedial action.

The final shape of the study involved three main phases over a period of two years. Phases 1 and 2 lasted approximately eighteen months and involved the development of the research instrument to gather students' responses to the study of chemistry in a number of relevant strands. Phase 3 involved the collection and analysis of the data.

The development of the research instrument

The development and validation of the research instrument took place in ten steps, as summarised in Table 1.

Table 1: Steps in the development and validation of the research instrument

Step	*Procedure*
1	Identify strands to be explored
2	Compose approximately 10-12 statement pairs within each strand
3	Gather free responses to each statement pair from approximately 25-30 students
4	Categorise free responses
5	Develop fixed-response items based on categories of free responses
6	Validate response in items
7	Produce and use trial fixed-response version of instrument
8	Modify instrument where necessary
9	Produce revised version of instrument

More detail on these steps is provided below:

Step1: Identification of strands to be explored

The first step in the design of the instrument was to identify the strands to be explored in order to obtain a measure of students' attitudes to the study of science. These strands were identified through a combination of student interviews and discussion by the research team.

Six strands were finally identified, as summarised in Table 2.

Table 2: The six strands used in the study

Strand	*Focus*
1	Views on lectures
2	Views on tutorials
3	Views on practical work
4	Views on aspects of language of instruction
5	Views on strategies for study
6	Views on being on an access course leading to a science degree

Strands 1 and 2 were originally combined into one strand: students' views on formal teaching situations, but the difference in responses made by students in Step 3 indicated the necessity of separating out views on lectures and tutorials.

Strand 6 was added as discussions with students revealed that there were differences in responses between students following the mainstream chemistry course and students following the two year access course, known as the College of Science (COS). COS programme leads on to the second year of the science degree and the students enrolled on this course tend to be from disadvantaged backgrounds and second language speakers of English.

One issue which had to be addressed at an early stage was that of terminology. Given the difficulties associated with the term, the original VOSTS study deliberately adopted the term 'view' rather than 'attitude', though the study is frequently cited in reviews of attitudes to science. In this study, it was decided to use the term 'view' to describe the picture of students gathered through responses in individual strands. The term 'attitude' to describe the overall picture gained from responses in all strands. This was felt to be reasonable, as the literature describes attitudes as comprising responses in a number of individual constructs, and such 'constructs' would be comparable to the strands identified in the study.

Step 2: Composition of statement pairs

The student interviews undertaken in Step 1 had indicated a number of dimensions to explore within each strand. These were developed by the research team into 'statement pairs'. Firstly, a statement was composed which represented a particular viewpoint, for example: *I like it when the lecturer gives us small tasks to do or discuss in lectures.* Secondly, a statement was composed which represented the opposite point of view, or 'opposite statement', for example: *I do not like it when the lecturer gives us small tasks to do or discuss in lectures.* These two statements became 'statement pair'. The purpose of developing pairs of statements was to gather as wide a range of responses as possible, and to compare responses made to the original statement and the opposite statement.

Step 3: Gathering of free responses

A representative sample of students was then presented with a selection of either the statements or opposite statements and invited to give a free response. Table 3 shows an example of a free response item.

Table 3: A sample free-response item

10.	I like it when the lecturer gives us small tasks to do in lectures.
	I AGREE / DISAGREE with this statement because ....
	....

Between 25 and 30 responses from both main stream and COS students were gathered for each statement pair.

Steps 4 and 5: Categorisation of free responses and development of fixed-response items

The free responses gathered for each statement pair were then clustered. A response was framed to express the overall view of each of the clustered responses. This process was undertaken by the research team, and involved each member of the team being responsible for the preliminary identification of clusters of the free responses in one or two of the strands. In order to validate the clusters, another team member then carried out an independent clustering of the free responses. The two methods of clustering were then compared, and differences discussed, with adjustments to clusters being made where necessary. The responses which were framed in this way formed the basis of the options to go into the fixed response items.

Two versions of each fixed response item were developed. To construct each of these 'items' one of the statements from the statement pair was selected. The opposite statement was then used in the second version, together with the options developed in the clustering process.

The phrasing of the responses in the fixed response items was as close as possible to the words used by students in their free responses. At this stage, some statements were eliminated as they resulted in the collection of duplicate information.

The items finally developed normally contained between four and six possible responses, with a balance between 'agree' and 'disagree' responses. Students were asked to select *the single response which best fitted their point of view*. The option of asking students to select as many of the responses as they wished was discussed, but rejected on the grounds that the categories

of responses had emerged from the views expressed by the students, and that categories of responses included all the differing views which had been expressed. Additionally, each item ended with an 'X' option, which students were invited to complete if they felt none of the response options in the item adequately reflected their view. This was to enable the research team to gather any additional views which might not have emerged from the original free responses.

Table 4 shows an example of a fixed-response item.

Table 4: An example fixed-response item

I like it when the lecturer gives us small tasks to do in lectures.	
A.	I AGREE with this statement because it improves my understanding.
B.	I AGREE with this statement because it improves my concentration.
C.	I AGREE with this statement because I learn better in a group.
D.	I DISAGREE with this statement because discussions are for tutorials.
E.	I DISAGREE with this statement because it increases the noise and wastes time.
F.	I DISAGREE with this statement because in a big class some students do not participate.
G.	None of the above statements reflects my view, which is ......

The resulting instrument consisted of two different questionnaires for each strand, with a balance of positive and negative versions of the fixed response items in each.

Step 6: Validation of items

Limited student interviews were undertaken to validate the fixed responses. These involved asking students who had not provided the free responses to respond verbally to selected statements, and then asking them to select the fixed response which most closely represented their view. Any anomalies were discussed with the students, and the outcomes of the discussion used to make minor modifications to the selection of fixed responses.

Steps 7-9: Production and use of trial fixed-response instrument and the revised version of the instrument

The trial fixed-response instrument was used to gather preliminary data from approximately 200 students, with students providing responses to one or two strands. These responses were used by the research team to scrutinise and refine the instrument in terms of the number of items it contained and the structure of the items. This scrutiny resulted in the selection of either the positive or negative version of the item and a small number of items being removed or combined due to the similarity in responses selected, as well as minor modifications to the language used in the items to improve their clarity. Normally the version of the statement chosen was the positive one, as negative statements had occasionally proved more difficult for students to formulate their responses if they found themselves disagreeing with a statement which already contained the phrase, "I do not agree ...."

The revised version of the instrument comprised 43 items in Strands 1 – 5, with an additional 8 items in Strand 6.

This revised instrument was used with 223 students on the point of completing their first year of study, 135 in the COS programme, and 88 in the mainstream chemistry programme. (The cohort of students involved in the development of the instrument were now in their second year, thus data were collected from students new to the instrument.) Given the length of the instrument and the reading demands it might place on students, it was decided to issue students with the items relating to particular strands on different occasions over a period of about a week. The majority of students provided responses to four or five of the strands. Roughly 25% of each group (30 students on the bridging programme and 24 students on the mainstream programme) provided responses to all the strands.

All the response data were entered onto a spreadsheet, together with selected additional data. This additional data included a rating by the tutor of each student, and the student's final mark in the end-of-year examination. The tutor rating was obtained in order to provide a measure of the validity of the instrument in assessing students' attitudes to science. Tutors were asked to rate each student on a seven-point scale, where 7 represented a student with a very positive overall attitude and 1 represented a student with a very negative overall attitude to the study of chemistry in the view of the tutor. The examination mark was obtained in order to provide a measure of the correlation between attitude and academic performance.

Analysis and discussion

The biggest challenge facing the research team was how to analyse and make sense of the data gathered. The VOSTS study, from which the methodology had been drawn, simply presented the data as a bar chart for each item, showing the percentage of students selecting each of the responses within the item.

Much of the discussion of possible analysis techniques for VOSTS items (see, for example, Rubba et al., 1996; Vázquez-Alonso and Manassero-Mas, 1999), focuses on increasingly detailed aspects of quantitative analysis of the data and the efficacy of different scoring systems for responses to items. The research team felt that, whilst some quantitative analysis was both necessary and desirable, much of the strength of the instrument lies in its potential to provide an 'in-depth' picture of students' attitude, a picture which would run the risk of being lost in purely quantitative analysis of the data. Thus a decision was taken to limit the amount of quantitative analysis and to look for ways in which the data might lend itself to more qualitative analysis.

Quantitative analysis

Any examination of the possibilities for quantitative analysis of data such as that gathered in the study inevitably leads to discussion of options for scoring responses to items. Rubba et al. (1996) proposed the following scoring system for VOSTS items:

R = Realistic (the response expresses an appropriate view)
HM = Has Merit (whilst not realistic, the response expresses a number of legitimate points)
N = Naïve (the response expresses a view which is inappropriate or not legitimate)

R responses are then allocated 3 points, HM responses 2 points and N responses 1 point, and points are added up to give a global mark.

Clearly such a scoring system has limitations, of which the most significant is that very

different response patterns may give rise to the same global score. None-the-less, the technique of assigning a numerical value to responses appeared useful in that a global score would give some very broad measure of attitude as measured by the instrument.

The categories of Realistic/Has Merit/Naïve did not appear to lend themselves particularly well to the styles of response made by students in the instrument developed for this study. Therefore a technique similar to that used in developing 'Thurstone' (see, for example, Oppenheim, 1992 for details of the procedure) scales in attitude inventories was adopted. This involved the following steps:

1. A five person panel, comprising the research team plus one additional member independently scored each response on a seven point scale, where 7 = most positive view with respect to the statement and 1 = least positive view with respect to the statement.

2. Scores from each panel member were compared.

3. Median scores were calculated for each item. In the majority of cases, there were differences in the panel members' scores of no more than 1.

4. Where there was a greater spread in the scores, these responses were discussed in detail. In the majority of these discussions, the outcome was agreement over the score which should be given to the response. In the very limited number of cases where the panel could not reach agreement, it was decided to leave the response in as it had emerged from original free-response data, but not to assign a score to it for the purposes of analysis.

Table 5 gives an example of the scores allocated to one of the items in the instrument. Notice that the whole range of 1-7 is not always used for each question.

Table 5: An example of the scores allocated to one of the items in the instrument

S1 IT IS EASY TO HAND IN ASSIGNMENTS ON TIME		
A.	I AGREE because once I start I usually enjoy it and have no trouble finishing.	6
B.	I AGREE because assignments are based on what we have already studied.	5
C.	.I DISAGREE because I struggle to manage my time and leave things to the end.	3
D.	.I DISAGREE because this is only true for assignments I am interested in.	3

Once scores had been allocated to responses, it was possible to calculate mean scores for each student within each strand, and to calculate a mean score for each item and a global mean for the instrument as a whole for those students who had completed all the strands. In the discussion that follows we examine the examples of how items were answered by students, as well as what we learnt from the mean scores for individual students.

<u>Student views on selected items</u>

Data will be presented on student views in four of the strands to highlight some of the differences between the two groups of students in the study, viz. students on the access course and students in the main stream.

Attitudes towards chemistry tutorials

Tutorial classes are held for both groups of students in chemistry. In the COS they take the form of small group classes (about 16-18 students) led by a tutor, while in the main stream,

the whole class (about 150) sits in groups of about 4-5, each tutor being responsible for about 5-6 groups. The average ratings for the two groups for the various items are shown in table 6 below:

Table 6: Average ratings of the two groups towards chemistry tutorials

Item	Description	Possible Range	MS Av. Rating	COS Av. Rating
T1	Chemistry tutorials are a good way of learning chemistry	2-6	5.5	5.7
T2	It is easy to concentrate in chemistry tutorials	3-6	4.8	5.6
T3	Preparing in advance for chemistry tutorials is important.	1-7	6.3	6.3
T4	I normally practice extra examples after chemistry tutorials	2-7	4.7	5.7
T5	Tutors should allow us to discuss our ideas in chemistry tutorials	1-6	5.4	5.8
T6	Interest in a chemistry topic depends on the tutor	3-6	5.6	5.4

These data were obtained from 31 Mainstream students and 120 College of Science students. In almost all items, the COS students' views on chemistry tutorials are more positive than those of their main stream counterparts. One of the largest differences in perceptions is on the importance of practising extra examples after tutorials. This is something which is emphasised in the tutorial sessions in the COS. The score of 6.3 on preparation reflects the emphasis given to this aspect on both the main stream and COS courses. The difference in item T2, on concentration is easily explained by the different modes of delivery of the tutorials in the two classes.

Attitudes to Lectures

The average ratings for the two groups for the various items are shown in table 7 below:

Table 7: Average ratings of the two groups towards lectures

Item	Description	Possible Range	MS Av. Rating	Cos Av Rating
Le1	Lectures are a good way of learning information in chemistry	2-6	5.7	5.5
Le2	It is easy to concentrate in chemistry lectures	3-6	4.9	5.2
Le3	It is easy to take notes in chemistry lectures	3-6	4.5	5.7
Le4	Everything said by the lecturer in chemistry lectures should be written down	4-5	4.9	4.9
Le5	It is important to read through and tidy up my notes after chemistry lectures	2-7	5.7	6
Le6	Lecturers should ask questions during chemistry lectures	2-6	5.8	5.3
Le7	Lecturers should give small tasks to be done in chemistry lectures	2-6	4.1	4.9
Le8	Interest in a chemistry topic is determined by the lecturer	4-6	5.5	5.6
Le9	Each chemistry lecture covers the correct number of ideas	3-5	4.9	4.7
Le10	For good understanding, all chemistry topics should be dealt with in lectures	4-6	5	4.7

These data were obtained from 32 Mainstream students and 61 College of Science students. Although the attitudes of the COS students are generally more positive than the mainstream students, it is clear that both groups are relatively negative about the content load in lectures. The rating panel felt that wishing to write everything down in a chemistry lecture represented a negative attitude and the relatively low ratings of the responses to item Le4 show that there is a tendency for students to think this is a good idea. Mainstream students also seem to have a more positive attitude towards questions being asked of them in lectures, while COS students are more positive about doing small tasks in the lecture. Of great interest is the difference in responses to item Le3. The COS makes a great effort to teach students to take notes in lectures

and make note taking easy - it is clear that mainstream students need some assistance in this direction as well.

Attitudes to Language
The average ratings for the two groups for the various items are shown in table 8 below:

Table 8: Average ratings of the two groups towards language

Item	Description	Possible Range	MS. Av. rating	COS Av. rating
La1	I am confident of my ability to speak English	3-7	6.4	5.2
La2	It is difficult writing in English	3-6	4.7	4.3
La3	Sometimes the language used in a question makes it difficult to understand exactly what is required to answer the question	2-6	3.8	4
La4	It is easy to understand the language used by lecturers	2-7	6.1	6.1
La5	Finishing a test is difficult because of language problems	3-5	4.3	4
La6	Being able to speak many languages helps one adjust to university	5-6	5.5	5.5
La8	It is easy to communicate in a mixed language group	2-6	4.8	5.3

These data were obtained from 32 Mainstream students and 105 College of Science students. This is one area where the views of the mainstream students are more positive than those of the COS students. The CoS contains a much higher percentage of second language speakers as evidenced by their reply to item 1. They also perceive more problems in areas such as test writing and writing in general. Interestingly, they are more positive about communication in mixed language groups. Also it is noteworthy that both groups perceive no language problems in lectures.

Attitudes to Practical work
The average ratings for the two groups for the various items are shown in table 9 below:

Table 9: Average ratings of the two groups towards practical work

Item	Description	Possible Range	MS Av. Rating	Cos Av. Rating
P1	Practical work is important in chemistry for helping understand theory	2-7	5.8	6.3
P4	Practical work makes chemistry more interesting	1-6	5.2	5.6
P7	Pre-laboratory discussions for chemistry practicals are important.	2-6	4.9	5.4
P9	Demonstrators are helpful in chemistry practical work	1-6	5.2	5.9
P11	Chemistry practicals are challenging	2-7	5.6	6.4
P12	Chemistry practicals are important	1-6	5.5	5.8

These data were obtained from 83 Mainstream students and 97 College of Science students. Here the attitudes of the COS students are again more positive than the mainstream students, particularly in key areas such as finding the practicals challenging. It should be mentioned that there are differences in the actual exercises that the students do in the laboratories. The difference in student views on teaching assistants (TA's) can be attributed to the fact that the COS TA's are handpicked while those serving the auxiliary class tend to be the lower end of the spectrum. This difference would also explain the importance attributed to pre laboratory discussions.

Quantitative analysis of mean scores per student on each strand

Five main findings relating to the methodology emerged from the quantitative analysis:

A. correlation of the global mean scores on the instrument with the tutor ratings suggested that the instrument provides a valid measure of students' attitudes to the study of chemistry (correlation coefficient = 0.34)
B. correlation of tutor ratings with exam marks suggested that tutors saw a strong link between academic prowess and positive attitude (correlation coefficient 0.56)
C. students who obtained lower global mean scores on the instrument almost invariably obtained lower examination marks
D. students who obtained higher global mean scores on the instrument generally obtained higher examination marks, but there was a small subset who had high global mean scores but lower examination results
E. The range of global mean scores was not as broad as had been anticipated, with global mean scores all lying in the range 4.6 – 5.7. It may be that adopting a procedure similar to that described by Vázquez-Alonso and Manassero-Mas, (1999), where the most positive response options are assigned scores such that they get a much higher weighting would increase the discrimination of the instrument.

In terms of the focus of the study, comparisons of the mean scores within the six strands also provided a general overview of students' responses. For example, as can be seen from tables 6-9 above, students views of practical work were much more positive than their views of lectures, and students on the bridging programme particularly valued their experiences in tutorials.

Qualitative analysis

One of the original aims of the study was to use its findings to identify possible areas for intervention and remedial action. The research team therefore decided to explore the possibilities of using the data to build up 'profiles' of particular subsets of students by looking for possible patterns in their responses. Initially, it had been planned to build up profiles for four similar groups of students on the access programme and on the mainstream programme. These were students in the following categories: (i) high global mean scores on the instrument and good examination results; (ii) high global mean scores but poor examination results; (iii) low global mean scores but high examination results; and (iv) low mean global scores and low examination results. However, examination of the data revealed only a very small number of students in category (ii), and no students in category (iii). Thus the final analysis was limited to producing 'profiles' for the following four groups:

A. Students on the access programme with high global mean scores and good examination results.
B. Students on the access programme with low global mean scores and poor examination results.
C. Students on the mainstream chemistry programme with high global mean scores and good examination results.
D. Students on the mainstream chemistry programme with high global mean scores and good examination results.

Additionally, two further groups of students were identified:

E. Historically disadvantaged students, for whom the access programme had originally been designed.

F. Mature students.

A six-step procedure was finally adopted for putting together the profiles. This is described below, using the students on the COS course as an example:

1. Students on the access course who had completed all the strands were identified and ranked in order of their global mean scores on the attitude inventory.

2. Approximately the top 20% and the bottom 20% in terms of their global mean scores were identified. For the access programme students these two groups contained seven and eight students respectively. These groups were termed the 'More positive' and 'Less positive' groups.

3. The data for these two groups were then examined to check that these students had corresponding high or low examination results to ensure they were representative students. This was normally the case.

4. The data for the group as a whole was examined to see of there were any students who had been given a particularly high or particularly low 'tutor rating', but had not fallen within the top or bottom 20% within the group. Here, there were some students whose 'tutor ratings' were higher than those in the top 20% group. Examination of the data revealed that pattern of responses of these students was such that they had a low than expected average score on one of the strands, almost always the strands relating to language or being a student on the access course. (These students might themselves make an interesting group to 'profile' but this was not pursued at this stage.)

5. Tally charts were used to produce a summary of the responses to each item for the students within each group. For example, the response pattern to a particular item for students in the 'more positive' group might be ACCAADCA, but CBBBCDBB for students in the 'less positive' group, suggesting that responses A and C were most frequent for the 'more positive' group, but that the 'less positive' group was most frequently characterised by response B.

6. The most frequently selected responses were then used to build up the 'profile' for students within each group.

Table 10 shows the profiles for the 'more positive' and the 'less positive' students on the access programme, with key differences grouped around each of the six strands.

Table 10: Profiles of students on the access programme

Strand	*positive students ...*	*less positive students ...*
Lectures	A. see lectures as a framework to build on B. record key points and try to listen C. add to notes after lectures	A. see lectures as covering all key areas B. try to write everything down C. do not have time to add to notes D. are less keen on being asked questions in lectures E. feel discussion tasks are for tutorials F. feel they learn more from practicals and tutorials
Tutorials	A. think preparation is important to help understanding (and avoid wasting time) B. do extra practice after tutorials C. are less influenced by tutor interest and enthusiasm	A. think preparation is important to avoid wasting time B. do not do extra practice due to pressure of work C. feel the tutor's interest and enthusiasm affects their motivation
Practicals	A. like to know what is happening, but like not knowing everything B. have faith in their own results, and do not think it matters of they are 'wrong' as long as they have understood C. Find practicals mentally challenging D. say practicals make them 'feel like a chemist'	A. like to know what is happening B. have faith in their own results, but think they should be changed if they are 'wrong' C. particularly value the support of demonstrators
Study	A. get assignments in on time B. use library resources and ask for help if necessary C. link assignments with previous work D. feel that effort leads to improved marks and increases confidence	A. struggle with time management and leave things to the last moment B. rely on lecture notes as they have problems locating books in the library C. try harder at things they enjoy
Language	A. went to an English-medium school B. generally understand written questions C. sometimes struggle with language in tests D. feel that English should be the medium of instruction, but that speaking more than one language is helpful in mixed language tutorial groups	A. most did not go to an English-medium school B. have difficulties understanding written questions C. often struggle with language in tests D. cite the social advantages of speaking more than one language E. appear to find it harder to interact in mixed language tutorial groups
COS	A. are happy with the pace of work B. report an increased need to rely on themselves rather than their teachers C. feel the workload is fair and the time has to be found to keep up	A. feel the pace of work is too fast B. feel there is a big gap between school and college in terms of level and/or workload C. find it hard to keep up with the workload

As this example shows, the detailed profiles do provide many insights into the characteristics of each group. In particular, those students in the less positive group are students who tend to see others as being responsible for their learning, appear to have problems with time management, experience language-related difficulties and feel there is a big gap between school and college. These therefore emerge as the areas where intervention would appear to be desirable. The profiles also point to a mechanism whereby the intervention might be most effectively made, as they reveal that even students in the 'less positive group' respond positively to the experiences they have in tutorials.

Conclusion

This paper has focussed on the application of a well-developed technique for gathering data on attitudes to a new situation, and presented a new technique for qualitative analysis of the data such that detailed 'profiles' of key groups of students can be built up. What also emerges from this study is that there is definitely a relationship between students' views and their performance. There were few low performing student with high global mean scores o n the instrument and no high performing students with low global means. It is not possible to claim a causal relationship either way, but the association of the characteristics allows planning of interventions which could take into account students' views. Possible action might include a review of student induction, revisiting the issue of study skills and diagnostic use of the instrument

In the case of Wits University it was possible for us to pick out important differences between the main stream and the College of Science and suggest strategies to address problems. Many of the differences found provided a validation for what we considered anecdotal truths about the learning of the students. This is not surprising as the responses themselves were based on authentic interview data and the phrasing of the options was as far as possible the words of the students.

It would not be difficult to adapt the instrument to other learning areas and other learning contexts, allowing faculty easy access to students' views and hence facilitation of learning.

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