

**QUANTIFIED ASSESSMENT TO ENHANCE  
STUDENT LEARNING IN THE SCIENCES AT  
UWC**

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A project is submitted in partial fulfilment of the requirements for the degree of M.Sc. in the Faculty of Science, University of the Western Cape.

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## KEYWORDS

Assessment Experience Questionnaire (AEQ)

Quantifying assessment

Undergraduate education

Science students

Enhance student learning

Student effort

Assignments and learning

Quantity of feedback

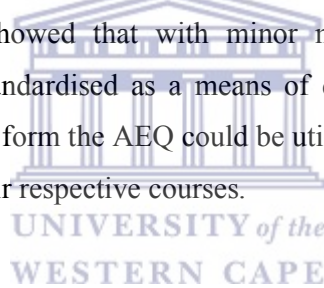
Quality of feedback

Use of feedback



# ABSTRACT

This project discusses whether the British prototype questionnaire called the Assessment Experience Questionnaire (AEQ) could be standardised as a quantifier of assessment and be used at a multicultural institute such as the University of the Western Cape (UWC). This questionnaire was created in the United Kingdom to assist lecturers in evaluating and developing their assessment systems. At UWC, the questionnaire was administered to ten different subgroups namely: Statistics (first, second and third-year students) (STA1, 2, 3); Computer Science (first, second and third-year students) (COS1, 2, 3); Physics (second and third-year students) (PHY2, 3); Chemistry (second-year-students) (CHEM2) and Biology (first-year-students). Data analyses were conducted on subgroups, year groups and on the combined UWC group. The UWC results were similar to that found in the UK, and showed that with minor modifications the prototype questionnaire could be standardised as a means of quantifying assessment at a tertiary level. In its current form the AEQ could be utilised by lecturers as a means to assess themselves in their respective courses.



# DECLARATION

I declare that *Quantified Assessment to Enhance Student Learning in the Sciences at UWC* is my own work, that it has not been submitted for any degree or examination in any other university, and that all sources I have used or quoted have been indicated and acknowledged by complete references.

Ronell Lombard

November 2005

Signed: .....



## LIST OF ABBREVIATIONS

AAS	Appropriate Assessment Scale
AEQ	Assessment Experience Questionnaire
AWS	Appropriate Workload Scale
CEQ	Course Experience Questionnaire
CGSS	Clear Goals and Standards Scale
FAST	Formative Assessment in Science Teaching
FC	Foundation Coalition
FCI	Force Concept Inventory
GSS	Graduate Skills Scale
GSSA	Graduate Careers Council of Australia
GTS	Good Teaching Scale
MUSEQ	Macquarie University Student Experience Questionnaire
NSSE	National Survey of Student Engagement
OSCEQ	Oxford Student Course Experience Questionnaire
OSI	Overall Satisfaction Index
RTOP	Reformed Teaching Observation Protocol
SAS	Statistical Analysis System
SCEQ	Student Course Experience Questionnaire
UK	United Kingdom
UMD	University of Massachusetts Dartmouth
UWC	University of the Western Cape

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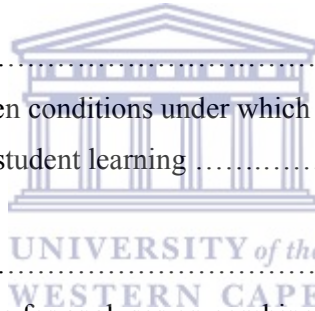
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# CHAPTER 1

## Introduction

When looking at various research articles on student learning and the impact of assessment thereon, it is evident that assessment is one of the key instruments which educators can utilize to evaluate their teaching techniques. Through assessment educators are able to establish the student's perception as to how they are experiencing the course. Information that could be gathered is the students' understandability of the course material taught and whether the feedback given to the students is at a level comprehensible to students from different cultural groups. Kaur (2003) mentioned that "*assessment is one of the most powerful levers teachers have to influence the way students respond to courses and behave as learners*" which was initially noted by (Gibbs & Lucas, 1997).

For this reason this study will be investigating assessment in the Science faculty at the University of the Western Cape (UWC). The following aspects of assessment are covered in the questionnaire: study efforts, assignments, exams and quality, quantity and use of feedback. The quantifier of assessment in this study will be a questionnaire called the Assessment Experience Questionnaire (AEQ) (Gibbs & Simpson, 2003). It is a prototype questionnaire developed in the United Kingdom in 2003 and its purpose was to measure assessment techniques and help UK lectures to evaluate and develop their assessment systems. The objective of this project is to determine whether the AEQ can be standardized as an instrument to quantify assessment. Furthermore, to see whether the AEQ will identify areas where student teaching and learning needs improvement to enhance student learning in the Sciences at tertiary levels, at an multicultural institute such as UWC.

The AEQ consists of 6 scales, each containing six questionnaire items addressing different aspects of assessment. These 6 scales measuring the student experience of assessment are:

1. Amount and distribution of student effort
2. Assignment and learning
3. Quantity and timing of feedback
4. Quality of feedback
5. Use of feedback
6. The examination and learning

In the literature review that follows a summary of the educational institutes at which the AEQ had been administered as well as their findings will be reported. In addition the different measures of assessment which other educational institutes are employing around the world will be mentioned.



## CHAPTER 2

### Literature Review

Firstly the literature on the Assessment Experience Questionnaire is explored to establish whom or which institutes have been evaluating the British prototype questionnaire.

As mentioned in Chapter 1, the first study was performed in the UK and administered to overall 2000 students at the Open University and Sheffield Hallam University (Gibbs et al., 2003; Brown et al., 2003; Glover, 2003). The findings showed that if two sections (1 and 2) of the AEQ be adapted the AEQ could be a successful assessment tool.

Joughin (2005) from the Hong Kong Institute of Education is currently evaluating the prototype questionnaire. In December 2005 he will run a workshop namely “*How does your assessment support learning? The Assessment Experience Questionnaire*”. Participants will be asked to consider the validity of the AEQ itself and its use to the Hong Kong Institute of Education.

At the end of 2003 a pilot study was launched at UWC in the Science Faculty and piloted on six different subgroups, in which 467 students completed the questionnaire. Data analyses indicated that with refinement to three sections namely 1, 2 and 4, the AEQ could possibly be standardized to be utilized as a measure of assessment at a tertiary level (Blignaut et al., 2005).

In the following section the literature written globally on methods of quantifying assessment will be explored.

The Course Experience Questionnaire (CEQ) (see Appendix A3) has a similar format to AEQ consisting of six scales. It is an annual government-mandated survey given to all students at Australian Universities that are graduates from undergraduate courses. The core scales of the CEQ are “Good Teaching Scale

(GTS)”, “Graduate Skills Scale (GSS)” and “Overall Satisfaction Index (OSI)”. The further three scales are selected by the university itself, from a range provided by the Graduate Careers Council of Australia (GCCA) (Gabb, 2004). The adapted version of the CEQ for use at Oxford was called Student Course Experience Questionnaire (SCEQ) which contained the scales “Appropriate Workload Scale (AWS)”, “Clear Goals and Standards Scale (CGSS)” and “Appropriate Assessment Scale (AAS)” in addition to the three core scales. A pilot study of the SCEQ was conducted in the academic years 2000-2001 and the findings were that students found the teaching intellectually stimulating, were overall satisfied with the quality of the course, found the tutorial system effective and indicated concern about the workload. Further analysis revealed suitable internal reliability of scores for all scales (Ashwin & Trigwell, 2001-2002).

Gregory et al. (1995) discusses using a Student Experience Questionnaire (SEQ) at the University of Hertfordshire in an attempt to enrich the value of the student educational experience. There are five SEQ elements namely “Good Teaching”, “Clear Goals and Standards”, “Appropriate Workload”, “Appropriate Assessment” and “Student Independence”, and the scoring scale ranges from one to five. The findings showed remarkable consistency in 1993 and 1994 for the average element scores. Similar to the 1993 survey when it was reported that apparent high student workload needed to be investigated, in the 1994 survey the lowest average scores were “Appropriate Workload” and “Student Independence” which indicated that these two elements needed investigation for improvement purposes.

The Macquarie University Student Experience Questionnaire (MUSEQ) has the same scales as the SEQ. It was distributed to continuing undergraduate students in April 2002 to establish the students’ perception of their university experience in teaching and learning and student support services. In scale 1, the results indicated that teaching staff encouraged students to produce their best work and that the educators were exceptional at explaining and making the courses taught interesting to the students. However the quality of feedback needed improvement

as students felt that the educator did not spend enough time on feedback and that the feedback received did not assist the students' future learning plan. In scale 2, students strongly indicated that educators made it clear from the start what they expected from students. However, students felt it hard to determine what was expected from them in the course. Scale 3 reflected the increase of pressure on students to balance work and study. In scale 4, 80% of the students broadly agreed that assessment tested their understanding and not mere facts. Scale 5 established whether the student developed further knowledge and skills as a result of the course. Students indicated that the course strongly developed their skills in most of the areas indicated in scale 5 except for areas such as oral presentations, analytical skills and teamwork, where students felt less confident. The sixth and last scale, measured the students' overall satisfaction with the quality of the course. Eighty-eight percent of the students indicated that they were satisfied with the overall quality of the course (Loxton, 2002). A questionnaire similar to this questionnaire is the Oxford Student Course Experience Questionnaire (OSCEQ).

Zeilik (1998) stated that when using conceptual diagnostic tests which are usually pre- and post tests, one is able to quantify the pre/post gains by calculating the gain index.

The Foundation Coalition (2001) discussed how the Arizona State University which is part of the Foundation Coalition (FC), used assessment and evaluation data to explore the relationship between learning and the aims and objectives of teaching and more importantly facilitating curricular decision-making. Firstly, the Physics pre- and post diagnostic tests, Force Concept Inventory (FCI), were used to measure student comprehension. Secondly, the Reformed Teaching Observation Protocol (RTOP) was used to measure the degree of improvement in the classroom. Data analysis indicated that if an improved curriculum was implemented then student performance on the diagnostic tests would surpass results of previous years in the FC and the RTOP scores indicated significant changes had occurred in Physics teaching.

The University of Massachusetts Dartmouth (UMD) evaluated its pilot FC freshman engineering programs using a web-based student survey which measured different subject areas. The findings showed that 83% of FC students continue studying at UMD compared to students in traditional engineering programs. At UMD there were more teamwork experiences, increased use of technology; enhanced incorporation of course material and greater student retention for the students returning to UMD for their sophomore year. Student performance measures indicated that FC students outperformed comparison groups when it came to successful completion of credits earned during the first semester. (The Foundation Coalition, 2001).

Carlson (2002) discusses the results of using the National Survey of Student Engagement (NSSE) at Saint Xavier University. In 2000 the findings were that students felt academically challenged as the quality of learning was at a high standard, however the area of active joint learning and student-faculty relations were at a low level. In 2001 the findings were still the same for the above mentioned areas however in addition, the student perceptions of learning improved but students were not reporting knowledge gained in utilising computer technology and a low level of electronic communication between students and educators were reported.

With all this literature and more, the FAST project's assumption is right on the mark as it says that *"assessment has a profound impact on how much effort students put into learning, which topics they learn and which they overlook, and the quality of their engagement with learning tasks they are set"* (Brown et al., 2003).

With this said, in the next three chapters the project explores the impact assessment had on student learning at UWC in the Science faculty. The first step of the exploration will be the methodology used to develop the AEQ.

## CHAPTER 3

### Methodology

#### 3.1 Origin of the AEQ

When Gibbs et al. (2003) reviewed student assessment literature they uncovered eleven conditions (see Appendix C1) upon which assessment supported student learning. Questionnaire items were discovered and generated from information collected from pilot interviews conducted with science students and published accounts of student's perception and experience on assessment. This resulted in the formulation of the prototype questionnaire AEQ (see Appendix A1). The rationale behind the questionnaire was to quantify the extent to which students identify the '11 conditions' been met in specific courses they were undertaking.

The AEQ consists of 6 scales, each containing six questionnaire items addressing the 11 conditions. The 6 scales measuring the student experience of assessment are:

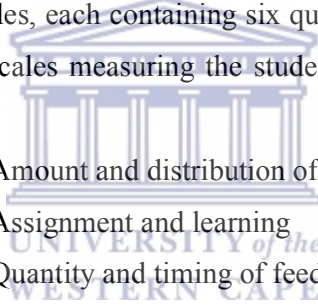
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1. Amount and distribution of student effort
  2. Assignment and learning
  3. Quantity and timing of feedback
  4. Quality of feedback
  5. Use of feedback
  6. The examination and learning

Table 1 gives an explanation of the score for each section. The response choices for this questionnaire were "Strongly Agree", "Agree", "Don't Know", "Disagree" and "Strongly Disagree".

For each item (question) a score ranging from 1 to 5 is allocated depended on the students' response. The highest score obtainable per section is a sum of 30 whereas the full questionnaire, combining all sections can sum up to a maximum score of 180. The direction of scoring the questions is not always the same. For



example, the response "Strongly Agree" would score 5 if the question was posed in a positive context and 1 if it was a response to a negatively posed question.

**Table 1. Description of the sections of the AEQ questionnaire**

No	Section Name	Explanation of score measured
1	Amount and distribution of study effort	A high score implies that the magnitude of studying done by the students each week is the same despite an assignment being due or not, as they deem it necessary if they wish to do well in the course. A low score implies that students study a greater magnitude or only study during weeks in which assessment take place, and feel with this study method they can still do well.
2	Assignments and learning	A high score indicates that the students feel that the assignments are clear and stimulating, and require understanding to complete. A low score would imply that students feel that the assignments are not comprehensible and challenging, and feel that they can complete and do well in assignments without understanding the task.
3	Quantity and timing of feedback	A high score indicates that the students feel that they get a sufficient amount of feedback fast enough. A low score indicates that feedback is inadequate and comes too late to be beneficial.
4	Quality of feedback	A high score shows that students find the feedback useful and constructive as it improves their understanding, and makes it possible for students to do better the next time. A low score indicates that students felt that the feedback was not understandable or constructive as it did not indicate where students need to improve but only how well they are doing in relation with others.
5	What you do with the feedback	A high score indicates that students found the feedback useful as it aided them when they were doing revision on work covered earlier, which helped to prevent them from making the same past mistakes again. A low score implies that the students did not utilize the feedback for revision as the feedback was either not useful or the students were only interested in reading the marks.
6	The examination and learning	A high score indicates that the students felt that exam preparation had a positive influence on their learning experience. A low score implied that the student's perception of exam preparation was primarily a case of memorizing the work. They also felt that understanding the work was not obligatory to do well in the exam as the majority of information studied will be forgotten after the exam.

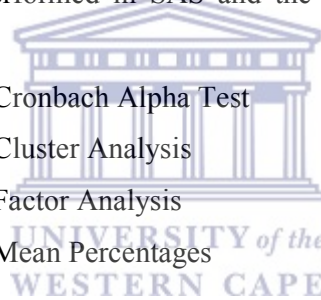
### 3.2 Pilot study at UWC

This study using the prototype AEQ was conducted at the end of the first semester of 2005. The original prototype questionnaire was adapted for use at UWC (see Appendix A2). Instead of having a score 1, 2, 3, 4 and 5 allocated to the responses, alphabetic letters A, B, C, D and E respectively were allocated to the

responses. This was done to make the questionnaire less confusing for the students and not to have them be misled by the scoring allocation. The questionnaire was administered to students in five different science courses, 10 different subgroups namely Statistics (first, second and third-year students) (STA1, 2, 3); Computer Science (first, second and third-year students) (COS1, 2, 3); Physics (second and third-year students) (PHY2, 3); Chemistry (second-year-students) (CHEM2) and Biology (first-year-students). Before analyzing the gathered data, the results were manipulated to the original format of the AEQ, using SAS (Buchecker & Dunlap, 2001) code (see Appendix D1) to replace the alphabetic letters with the correct scores in the correct scoring direction. Thereafter the data gathered was analyzed firstly by individual subgroups, then by year groups and lastly altogether as a combined UWC group.

All data analyses were performed in SAS and the analysis tests used were as follows:

- Cronbach Alpha Test
- Cluster Analysis
- Factor Analysis
- Mean Percentages



All analyses on the UWC data was then compared to the UK pilot study results. The results of the analyses will be discussed in the next chapter.

## CHAPTER 4

### Results

#### 4.1 Cronbach Alpha Test

Student's responses to the questionnaire were tested for consistency using the Cronbach Alpha test. Cronbach Alpha values more than or equal to 0.57 implied internal reliability of both the scales and questionnaire items, however note that the more correct value of consistency is 0.6 (Dawson & Trapp, 2001; Reynaldo & Santos, 1999). The results are tabulated (see Table 2) and compared to the pilot study in the UK (Gibbs et al., 2003; Brown et al., 2003; Glover, 2003).

**Table 2. Cronbach Alpha's for the different year groups**

No	Section	Year Groups Cronbach Alpha values				
		UK	UWC	First Years	Second Years	Third Years
	<b>Number of Students</b>	1579§	546	372	108	66
1	Amount and distribution of student effort	0.44§	-0.01 (0.14)*	0.04	-0.01	-0.23
2	Assignments and learning	0.48§	0.32 (0.36)#	0.30	0.23	0.48
3	Quantity and timing of feedback	0.87§	0.60	0.52	0.62	0.72
4	Quality of feedback	0.77§	0.46 (0.57)€	0.42	0.51	0.49
5	Use of feedback	0.74§	0.71	0.70	0.72	0.75
6	Examination and learning	0.57§	0.46 (0.48)£	0.41	0.48	0.61

- \* Removal of item 1 from section 1
- # Removal of item 11 from section 2
- € Removal of item 19 from section 4
- £ Removal of item 31 from section 6
- § From (Gibbs & Simpson, 2003)

In the individual subgroups (see Appendix B1) the test results were too small; with the first scale having some negative values. It was therefore decided to combine the data into year groups (see Table 2) which yielded better results however the negative values were still present in the first scale. In some of the scales, e.g. in section 6 the third year results showed consistency whereas the

other two groups did not. It was therefore decided to focus the analyses on the combined UWC group because it produced the best Cronbach Alpha values of the three groups and the sample size was also increased. The UK results also included a range of students over various years and were therefore more comparable with the UWC group.

In Table 2 it can be seen that only the items in sections 3 and 5 showed internal reliability whereas in the UK study there was consistency in sections 3, 4, 5 and 6. To improve the Cronbach Alpha values for sections 1, 2, 4 and 6 refer back to the SAS Cronbach Alpha test output (see Appendix D2) to see which items in each section, if removed would increase the Cronbach Alpha value. The only section that showed real improvement (see Table 2) was section 4 which increased from 0.46 to 0.57 when item 19 was removed. Item 19 reads “*The feedback mainly tells me how well I am doing in relation to others*”. In the 2003 UWC pilot study section 4’s Cronbach Alpha value was also low and increased when item 19 was removed (Blignaut et al., 2005).

#### **4.2 Cluster Analysis**

Cluster analysis is a method used for combining observations into clusters whereby all clustered groups are uniform with regard to certain characteristics but should differ from each other with respect to the same characteristics (Sharma, 1996). The key objective for doing the cluster analysis was to improve the Cronbach Alpha values which were not internally reliable. Cluster analysis was performed on all 36 items thereafter analysis was conducted on sections 1 and 2 only as they had the lowest values but more importantly these sections follow each other, allowing for a cluster analysis on 12 items. When examining the initial output of the cluster analysis (see Appendix D3), the focus point was to observe the manner in which these 12 items cluster and find the items that repeatedly cluster together. The output indicated that there were three combinations that repetitively clustered namely items 1, 2, 7 and 8, items 3, 5 and 9, and items 4, 6 and 12. The combination containing the most items (1, 2, 7 & 8) was then selected

and clustered each time with 2 of the remaining items which included items of the other 2 combinations.

Twenty-eight combinations of six items each were generated and Cronbach Alpha tests were conducted on them (see Appendix B2.1). It was found that in most combinations, that if item 2 is removed, the Cronbach Alpha value increased. The combination with the highest Cronbach Alpha value when item 2 was removed was the combination of items 1, 4, 7, 8 and 10. I then took this combination and clustered it each time with one of the remaining items excluding item 2. Six combinations were generated, on which the Cronbach Alpha test was conducted (see Appendix B2.2) and it was found that the combination with the highest Cronbach Alpha value was the combination of items 1, 4, 7, 8, 9 and 10 with a value of 0.44 and the second combination (see Appendix B2.3) of items were 2, 3, 5, 6, 11 and 12 with a Cronbach Alpha value of 0.32. The values for the two sections improved however they were not significant as they were less than 0.57 implying that there was not internal reliability.

### **4.3 Factor Analysis**

Factor analysis is a common expression for a group of statistical techniques that are interested in reducing a data set in terms of a smaller number of latent dimensions (Sharma, 1996). The Factor Analysis namely Principal Component Analysis with Varimax rotation (Wuensch, 2004) was performed on data of the 546 students and six factors were retained (see Appendix D4). The six factors did not correspond in a simple manner with the sections of the AEQ. This lack of association confirmed the low Cronbach Alpha values observed in some of the scales.

In the factor loading table (see Appendix B3) it can be seen that the 36 items are presented under the six sections of the AEQ and only factor loadings greater than 0.4 are included. The table indicates that students do distinguish between the three aspects of feedback namely the quantity and timing, quality and the use of feedback:

- with extent to which feedback given is sufficient and comes quick enough (factor 4, items in section 3)
- with extent to which the feedback is of good quality (factor 1, items in section 4)
- with extent to which feedback is only been read if it's a mark (factor 2, items in section 5).

Students did not distinguish between the different aspects of examination, like whether exam preparations meant verbatim studying or continuous studying in order to do well in the exam. However, there was a broadly positive response to the positive influence of exam preparation on the learning experience (factor 5, items in section 6).

The students' response to the quality and use of feedback emerged as the significant aspect of students' response to assessment, explaining 42% of the variance. In the UK study the same student response emerged as the most important aspect accounting for 41% of the variance, indicating that the two studies had similar results for the factor analysis.

#### **4.4 Mean and Percentages**

Lastly the mean values per subgroup (see Appendix B4) and per year group (see Table 3) for each section of the AEQ questionnaire was compared. These percentages will highlight areas of student learning and teaching that require improvement and may also serve as an indicator, in establishing how the aspects covered in each section contribute to the learning process. Sixty-five percent was used as a cut-off point, which meant the percentages in each section averaging less than 65% implied that the lecturer needed to re-evaluate their assessment methods to enhance student learning.

**Table 3. Mean & percentages (in brackets) for the different year groups**

Nr	Section	Year Groups Cronbach Alpha values			
		UWC	First Years	Second Years	Third Years
	<b>Number of Students</b>	546	372	108	66
1	Amount and distribution of student effort	18.74 (62.5%)	18.48 (61.6%)	19.38 (64.6%)	19.17 (63.9%)
2	Assignments and learning	20.20 (67.3%)	20.06 (66.9%)	20.60 (68.7%)	20.36 (67.9%)
3	Quantity and timing of feedback	17.78 (59.3%)	17.95 (59.8%)	16.56 (55.2%)	18.86 (62.9%)
4	Quality of feedback	18.88 (62.9%)	18.75 (62.5%)	18.93 (63.1%)	19.48 (64.9%)
5	Use of feedback	20.79 (69.3%)	20.48 (68.3%)	21.46 (71.5%)	21.41 (71.4%)
6	Examination and learning	20.32 (67.7%)	19.97 (66.6%)	21.32 (71.1%)	20.72 (69.1%)

The percentages in Table 3 (see UWC subgroup) indicate three sections (number 1, 3 and 4) have an average percentage less than 65, which meant that the lecturers' intervention was required.

Section 1 might be revealing that the student workload was too much. Students may have been swamped with tests/assignments for different courses all running in the same week, therefore lectures should review their tests/assignment schedule and distribute tests/assignments more evenly so as to prevent students from being overloaded in the same weeks (Table 3 no 1). Section 3 indicates that feedback was not fast and sufficient enough; therefore feedback should be expeditiously provided by lectures and should sufficiently support future follow-up learning (Table 3 no 3).

Section 4 implies the quality of feedback needs improvement, so lecturers should ensure that feedback given to the student should be of a high quality, informative and useful to the student (Table 3 no 4).

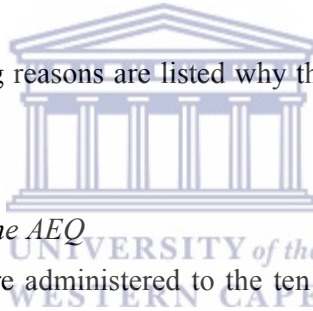
## CHAPTER 5

### Discussion and Conclusion

Assessment performed in class at a university provides the lecturer and faculty with information and insight that they could use to their advantage to enrich the quality of learning and make teaching more effective.

The AEQ was design with this in mind, with the purpose of gaining insight to bring to light areas of student learning and teaching that need enhancement. Lecturers are then able to adjust their teaching technique if intervention is required. Student learning strategies and study habits are improved as a result of enhanced teaching and feedback quality, ensuring the production of more successful students.

For the study the following reasons are listed why the results may not have been that favourable.



#### 1. *Administering the AEQ*

The questionnaires were administered to the ten subgroups at the end of the first semester when students may possibly have been preoccupied with assignments, projects and preparation for the forthcoming exams. So when the AEQ was answered by the students it might have been hastily completed without student focus or comprehension of the questions posed in the questionnaire. So if responses were not well thought-out, it would not present the students' true experience of the course and this would result in the data not being accurate, resulting in inaccurate results and conclusions.

A possible solution would be to administer the AEQ at the beginning of the second semester when students have returned from vacation and can recall with clarity their learning experience of the first semester. This would possibly provide more thorough and accurate answers.



### 2. *Lecturers administering the AEQ*

Only four out of the ten lecturers who administered the questionnaire in their classes were really interested in the results. If only lecturers that are interested or involved in the study administer the AEQ better quality data will be collected as lecturers would urge students to take time to complete the questionnaire truthfully, as these lecturers hope to benefit from the results yielded from the questionnaire. Interested lectures would be more likely to emphasize the importance of honesty when answering the questionnaire and would be quick to aid students when clarity is needed. With quality support available to students when completing the AEQ, questions in the AEQ are less likely to be misinterpreted and responses would therefore be more accurate.

### 3. *Language usage in the AEQ*

As the Assessment Experience Questionnaire was developed in the UK where the majority of the population speak English as a first and only language, the comprehensibility of AEQ questions was bound to arise as a possible problem at UWC, a university with students from ethnically and linguistically diverse backgrounds. To facilitate students with the comprehension of the AEQ the same solution as proposed for reason 2 would apply, having the questionnaires administered by lecturers/educators that are interest in the study as they would be more likely to offer assistance to students without hesitation.

In conclusion, the results of the data analyses indicated that with minor modifications to sections 1, 2, 4 and 6 the British prototype questionnaire could be standardized as an evaluation instrument for assessment. This questionnaire could ascertain the impact assessment has on the learning process. In its current form the AEQ can be used by lecturers/educators to quantify the assessment for their courses as Swedish lecturers are currently using the AEQ as a means of assessing themselves in their respective courses.

## BIBLIOGRAPHY

- Ashwin P. & Trigwell K. (2001-2002). Report 3: Oxford Learning Context project: Report to EPSC. [Online]. Available <http://www.learning.ox.ac.uk.iaul/pdf/EPSCReport.pdf> (sited October 2005).
- Buchecker M. & Dunlap D. (2001). *SAS Programming II : Manipulating Data with the DATA Step Course Notes*. SAS Institute Inc. Cary. NC 27513. USA.
- Blignaut R.J., Venter I.M. & Holtman L. (2005). Assessment and Student Learning. *Proceedings of MIPRO 2005, Computers in Education*. Opatija, Croatia.
- Brown E., Gibbs G. & Glover C. (2003). Evaluation tools for investigating the impact of assessment regimes on student learning. *BEE-j*. Volume 2. [Online]. Available <http://www.bioscience.heacademy.ac.uk/journal/vol2/beej-2-5.pdf> (sited August 2005).
- Carlson K. (2002). Using Student Engagement Results at Saint Xavier University. [Online]. Available [http://www.indiana.edu/~nsse/html/data\\_uses\\_sxu.htm](http://www.indiana.edu/~nsse/html/data_uses_sxu.htm) (sited October 2005).
- Dawson B. & Trapp R.G. (2001). *Basic & Clinical Biostatistics*. 3<sup>rd</sup> Edition. McGraw-Hill. USA. 312.
- Gabb R. (2004). The CEQ, SES and SET questionnaires. [Online]. Available <http://ceds.vu.edu.ac/set/pdf/CEQ%20ses%second> (sited September 2005).
- Gibbs G. & Lucas L. (1997). Coursework assessment, class size and student performance 1998-94. *Journal of Further and Higher Education*. 21 (2): 183-195.
- Gibbs G. & Simpson C. (2003). Measuring the response of students to assessment: the Assessment Experience Questionnaire. 11th Improving Student Learning Symposium. [Online]. Available <http://www.open.ac.uk/science/fdtl/documents/isl-2003-AEQ.pdf> (sited August 2005).
- Gibbs G., Simpson C. & Macdonald R. (2003). Improving student learning through changing assessment – a conceptual and practical framework, *EARLI Conference*. Padova.

Glover C. (2003). Report of broad themes of the Sheffield Hallam University AEQ responses. *Formative Assessment in Science Teaching Project*. [Online]. Available [http://www.open.ac.uk/science/fdtl/documents/shu\\_aeq\\_broadthemes.pdf](http://www.open.ac.uk/science/fdtl/documents/shu_aeq_broadthemes.pdf) (sited October 2005).

Gregory R.D., Harland G. & Thorley L. (1995). Using a student experience questionnaire for improving teaching and learning. University of Hertfordshire. UK [Online]. Available <http://www.city.londonmet.ac.uk/deliberations/ocsd-pubs/islass-gre> (sited October 2005).

Joughin G. (2005). [Online]. Available <http://www.ied.edu.hk/lttc/staff/stfwshop.htm> (sited September 2005).

Kaur S. (2003). Using Student Journals for Evaluating Course Experience. *UltiBASE Articles*. November 2003 Edition. [Online]. Available <http://ultibase.rmit.edu.au/Articles/nov03/kaur2.htm> (sited October 2005).

Loxton J. (2002). Macquarie University Student Experience Questionnaire (MUSEQ). [Online]. Available <http://www.mq.edu.au/dvc-academic/MUSEQ-U2002.pdf> (sited October 2005).

Reynaldo J. & Santos A. (1999). Cronbach's Alpha: A Tool for Assessing the Reliability of Scales. *Journal of Extension* 37(2). [Online]. Available <http://www.joe.org/joe/1999april/tt3.html> (sited July 2005).

Sharma S. (1996). *Applied Multivariate Techniques*. John Wiley & Sons, Inc. New York.

The Foundation Coalition. (2001). [Online]. Available <http://www.foundationcoalition.org> (sited October 2005).

Wuensch K.L. (2004). Factor Analysis. [Online]. Available <http://core.ecu/psyc/wuenschk/StatsLesson.htm> (sited July 2005).

Zeilik M. (1998). Classroom Assessment Techniques Conceptual Diagnostic Tests. *Field-tested Learning Assessment Guide*. [Online]. Available <http://www.flaguide.org/cat/diagnostic/diagnostic7.php> (sited September 2005).

# APPENDIX A

## CONTENTS

A1.	The original British AEQ prototype questionnaire .....	A-2
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## A1. THE ORIGINAL BRITISH AEQ PROTOTYPE QUESTIONNAIRE

	strongly disagree	disagree	?	agree	strongly agree
Please answer every item by giving your immediate response. Circle the appropriate code number to show your response to assessment.					
<b>1 Amount and distribution of study effort</b>					
I do the same amount of study each week, regardless of whether an assignment is due or not.	1	2	3	4	5
I can be quite selective about what I study and learn and still do well.	5	4	3	2	1
I only study things that are going to be covered in the assignments.	5	4	3	2	1
I have to study regularly if I want to do well on the course.	1	2	3	4	5
On this course, it is possible to do quite well without studying much.	5	4	3	2	1
In weeks when the assignments are due I put in many more hours.	5	4	3	2	1
<b>2 Assignments and learning</b>					
Tackling the assignments really makes me think.	1	2	3	4	5
I learn more from doing the assignments than from studying the course material.	1	2	3	4	5
In completing the assignments you can get away with not understanding and still get high marks.	5	4	3	2	1
The assignments give very clear instructions about what you are expected to do.	1	2	3	4	5
When I tackle an assignment it is not at all clear what would count as a successful answer.	5	4	3	2	1
The assignments are not very challenging.	5	4	3	2	1
<b>3 Quantity and timing of feedback</b>					
On this course I get plenty of feedback on how I am doing.	1	2	3	4	5
The feedback comes back very quickly.	1	2	3	4	5
There is hardly any feedback on my assignments when I get them back.	5	4	3	2	1
When I get things wrong or misunderstand them I don't receive much guidance in what to do about it.	5	4	3	2	1
I would learn more if I received more feedback.	5	4	3	2	1
Whatever feedback I get comes too late to be useful.	5	4	3	2	1

	strongly disagree	disagree	?	agree	strongly agree
<b>4 Quality of feedback</b>					
The feedback mainly tells me how well I am doing in relation to others.	5	4	3	2	1
The feedback helps me to understand things better.	1	2	3	4	5
The feedback shows me how to do better next time.	1	2	3	4	5
Once I have read the feedback I understand why I got the mark I did.	1	2	3	4	5
I don't understand some of the feedback.	5	4	3	2	1
I can seldom see from the feedback what I need to do to improve.	5	4	3	2	1
<b>5 What you do with the feedback</b>					
I read the feedback carefully and try to understand what the feedback is saying.	1	2	3	4	5
I use the feedback to go back over what I have done in the assignment.	1	2	3	4	5
The feedback does not help me with any subsequent assignments.	5	4	3	2	1
The feedback prompts me to go back over material covered earlier in the course.	1	2	3	4	5
I do not use the feedback for revising.	5	4	3	2	1
I tend to only read the marks.	5	4	3	2	1
<b>6 The examination and learning (only to be completed if there is an exam)</b>					
Preparing for the exam was mainly a matter of memorizing.	5	4	3	2	1
Doing the exam brought things together for me.	1	2	3	4	5
I learnt new things while preparing for the exam.	1	2	3	4	5
I understand things better as a result of the exam.	1	2	3	4	5
I'll probably forget most of it after the exam.	5	4	3	2	1
In the exam you can get away with not understanding and still get good marks.	5	4	3	2	1
Comments you would like to make about the way the assessment affected your learning on the course					

## A2. THE AEQ ADMINISTERED AT UWC



### University of the Western Cape Assessment questionnaire (2005)

*Dear Student,*

*Participants are assured of confidentiality should you be willing to participate in the research study. A coding system will be used to protect your identity. The results of this study will be used as input to assess the assessment practices of various departments in the Science Faculty.*

***Use the pink answer sheet for the answers.***

*Fill in your student number and circle the appropriate numbers in the rows below the student number.*

*Select only one option per question.*

*Please read the instructions on the pink form.*

*Feel free to add comments at the end of the questionnaire.*

**Assessment Experience Questionnaire (AEQ)**  
**Authors Graham Gibbs and Claire Simpson - Open University, England.**

Please answer every item quickly by giving your immediate response.

Table: **A** Strongly disagree  
**B** Disagree  
**C** Don't know  
**D** Agree  
**E** Strongly agree

#### ***Amount and distribution of study effort***

- |    |   |           |
|----|---|-----------|
| 1. | I do the same amount of study each week, regardless of whether an assignment is due or not. | A B C D E |
| 2. | I can be quite selective about what I study and learn and still do well.                    | A B C D E |
| 3. | I only study things that are going to be covered in the assignments.                        | A B C D E |
| 4. | I have to study regularly if I want to do well on the course.                               | A B C D E |
| 5. | On this course, it is possible to do quite well without studying much.                      | A B C D E |
| 6. | In weeks when the assignments are due I put in many more hours.                             | A B C D E |

***Assignments and learning***

- |     |   |           |
|-----|---|-----------|
| 7.  | Tackling the assignments really makes me think.   | A B C D E |
| 8.  | I learn more from doing the assignments than from studying the course material.                 | A B C D E |
| 9.  | In completing the assignments you can get away with not understanding and still get high marks. | A B C D E |
| 10. | The assignments give very clear instructions about what you are expected to do.                 | A B C D E |
| 11. | When I tackle an assignment it is not still clear what would count as a successful answer.      | A B C D E |
| 12. | The assignments are not very challenging.   | A B C D E |

***Quantity and timing feedback***

- |     |   |           |
|-----|---|-----------|
| 13. | On this course I get plenty of feedback on how I am doing.  | A B C D E |
| 14. | The feedback comes back very quickly.   | A B C D E |
| 15. | There is hardly any feedback on my assignments when I get it back.                                  | A B C D E |
| 16. | When I get things wrong or misunderstand them I don't receive much guidance in what to do about it. | A B C D E |
| 17. | I would learn more if I receive more feedback.  | A B C D E |
| 18. | Whatever feedback I get comes too late to be useful.  | A B C D E |

***Quality of feedback***

- |     |   |           |
|-----|---|-----------|
| 19. | The feedback mainly tells me how well I am doing in relation to others. | A B C D E |
| 20. | The feedback helps me to understand things better.                      | A B C D E |
| 21. | The feedback shows me how to do better next time.                       | A B C D E |
| 22. | Once I have read the feedback I understand why I got the mark I did.    | A B C D E |
| 23. | I don't understand some of the feedback.                                | A B C D E |
| 24. | I can seldom see from the feedback what I need to do to improve.        | A B C D E |

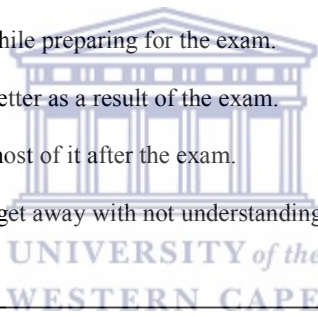


***What you do with the feedback***

- |     |  |           |
|-----|--|-----------|
| 25. | I read the feedback carefully and try to understand what the feedback is saying. | A B C D E |
| 26. | I use the feedback to go back over what I have done in the assignment.           | A B C D E |
| 27. | The feedback does not help me with any subsequent assignments.                   | A B C D E |
| 28. | The feedback prompts me to go back over material covered earlier in the course.  | A B C D E |
| 29. | I do not use the feedback for revising.  | A B C D E |
| 30. | I tend to only read the marks.   | A B C D E |

***The examination and learning (only to be completed if there is an exam/test)***

- |     |   |           |
|-----|---|-----------|
| 31. | Preparing for the exam was mainly a matter of memorizing.                     | A B C D E |
| 32. | Doing the exam brought things together for me.                                | A B C D E |
| 33. | I learnt new things while preparing for the exam.                             | A B C D E |
| 34. | I understand things better as a result of the exam.                           | A B C D E |
| 35. | I'll probably forget most of it after the exam.                               | A B C D E |
| 36. | In the exam you can get away with not understanding and still get good marks. | A B C D E |



Comments you would like to make about the way the assessment affected your learning on the course

*Thank you for your cooperation. Proffs. R nette Blignaut and Isabel Venter, Dr Lorna Holtman*

### **A3. THE COURSE EXPERIENCE QUESTIONNAIRE (CEQ) SCALES**

#### ***Good Teaching Scale (six items)***

The teaching staff of this course motivated me to do my best work

The staff put a lot of time into commenting on my work

The staff made a real effort to understand difficulties I might be having with my work

The teaching staff normally gave me helpful feedback on how I was going

My lecturers were extremely good at explaining things

The teaching staff worked hard to make their subjects interesting

#### ***Generic Skills Scale (six items)***

The course developed my problem-solving skills

The course sharpened my analytic skills

The course helped me develop my ability to work as a team member

As a result of my course, I feel confident about tackling unfamiliar problems

The course improved my skills in written communication

My course helped me to develop the ability to plan my own work

#### ***Clear Goals and Standards Scale (four items)***

It was always easy to know the standard of work expected

I usually had a clear idea of where I was going and what was expected of me in this course

It was often hard to discover what was expected of me in this course

The staff made it clear right from the start what they expected from students

#### ***Graduate Qualities Scale (six items)***

University stimulated my enthusiasm for further learning

The course provided me with a broad overview of my field of knowledge

My university experience encouraged me to value perspectives other than my own

I learned to apply principles from this course to new situations

The course developed my confidence to investigate new ideas

I consider what I learned valuable for my future

#### ***Learning Resources Scale (five items)***

The library resources were appropriate for my needs

Where it was used, the information technology in teaching and learning was effective

It was made clear what resources were available to help me learn

The study materials were clear and concise

Course materials were relevant and up to date

#### ***Overall Satisfaction Item***

Overall, I was satisfied with the quality of this course

# APPENDIX B

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B1.	The Cronbach Alpha's for the different subgroups .....	B-2
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**B1. THE CRONBACH ALPHA'S FOR THE DIFFERENT SUBGROUPS**

No	Section	Individual Groups Cronbach Alpha values											
		UK	UWC	BCB1	CHEM2	STA1	STA2	STA3	COS1	COS2	COS3	PHY2	PHY3
	<b>Number of Students</b>	1579	546	50	15	179	67	50	143	12	10	14	6
1	Amount and distribution of student effort	0.44	-0.01	0.36	-1.14	0.06	0.03	-0.19	-0.24	0.03	-0.18	0.361	-0.355
2	Assignments and learning	0.48	0.32	0.08	0.35	0.36	0.19	0.41	0.30	-0.20	0.57	0.360	0.730
3	Quantity and timing of feedback	0.87	0.60	0.51	0.50	0.57	0.62	0.66	0.48	0.53	0.93	0.356	0.529
4	Quality of feedback	0.77	0.46	0.61	0.05	0.42	0.52	0.53	0.34	0.73	0.06	-0.083	0.619
5	Use of feedback	0.74	0.71	0.78	0.85	0.68	0.63	0.72	0.68	0.76	0.86	0.539	.
6	Examination and learning	0.57	0.46	0.37	0.51	0.30	0.51	0.67	0.48	0.33	-0.24	0.313	-0.126

## B2. THE CLUSTER GROUPINGS FOR SECTION 1 & 2

### B2.1 28 combinations containing the cluster of items 1, 2, 7 and 8

Combination	Cronbach Alpha Value	Remove	Value
item1 item2 item3 item4 item7 item8	0.13	item2	0.32
item1 item2 item3 item5 item7 item8	0.10	item2	0.23
item1 item2 item3 item6 item7 item8	-0.15	item6	0.03
item1 item2 item3 item9 item7 item8	0.16	item2	0.29
item1 item2 item3 item10 item7 item8	0.09	item2	0.28
item1 item2 item3 item11 item7 item8	0.02	item2	0.16
item1 item2 item3 item12 item7 item8	0.09	item2	0.24
item1 item2 item4 item5 item7 item8	0.20	item2	0.39
item1 item2 item4 item6 item7 item8	-0.16	item6	0.17
item1 item2 item4 item9 item7 item8	0.22	item2	0.41
*item1 item2 item4 item10 item7 item8	0.23	item2	0.46
item1 item2 item4 item11 item7 item8	0.07	Item2	0.29
item1 item2 item4 item12 item7 item8	0.21	item2	0.42
item1 item2 item5 item6 item7 item8	-0.13	item6	0.06
item1 item2 item5 item9 item7 item8	0.19	item2	0.32
item1 item2 item5 item10 item7 item8	0.11	item2	0.31
item1 item2 item5 item11 item7 item8	0.02	item2	0.16
item1 item2 item5 item12 item7 item8	0.17	item2	0.32
item1 item2 item6 item9 item7 item8	-0.09	item6	0.14
item1 item2 item6 item10 item7 item8	-0.07	item2	0.15
item1 item2 item6 item11 item7 item8	-0.22	item6	-0.02
item1 item2 item6 item12 item7 item8	-0.13	item6	0.11
item1 item2 item9 item10 item7 item8	0.19	item2	0.38
item1 item2 item9 item11 item7 item8	0.09	item2	0.25
item1 item2 item9 item12 item7 item8	0.21	item2	0.37
item1 item2 item10 item11 item7 item8	0.09	item2	0.30
item1 item2 item10 item12 item7 item8	0.16	item2	0.37
item1 item2 item11 item12 item7 item8	0.05	item2	0.23

\* This combination has the highest Cronbach Alpha value if item 2 is removed

### B2.2 6 combinations containing the cluster of items 1, 4, 7, 8 and 10 with item 2 removed

Combination	Cronbach Alpha Value
items1 items3 items4 items10 items7 items8	0.35
items1 items4 items5 items10 items7 items8	0.41
items1 items4 items6 items10 items7 items8	0.20
*items1 items4 items9 items10 items7 items8	0.44
items1 items4 items11 items10 items7 items8	0.35
items1 items4 items12 items10 items7 items8	0.43

\* This combination had the highest Cronbach Alpha value

### B2.3 The second combination containing items 2, 3, 5, 6, 11 and 12

Combination	Cronbach Alpha Value
items2 items3 items5 items6 items11 items12	0.32

### B3. THE FACTOR LOADINGS

Items	Factors					
	1	2	3	4	5	6
<b>Section 1 Amount and distribution of study effort</b>						
Q1						+0.49
Q2						
Q3						
Q4						
Q5						
Q6						
<b>Section 2 Assignments and learning</b>						
Q7						
Q8						
Q9		+0.44				
Q10						
Q11						
Q12						
<b>Section 3 Quantity and timing of feedback</b>						
Q13				+0.66		
Q14				+0.72		
Q15						
Q16			+0.44			
Q17			+0.46			
Q18						
<b>Section 4 Quality of feedback</b>						
Q19						
Q20	+0.67					
Q21	+0.72					
Q22	+0.61					
Q23			+0.43			
Q24						
<b>Section 5 Use of feedback</b>						
Q25						
Q26						
Q27		+0.41				
Q28						
Q29		+0.54				
Q30		+0.57				
<b>Section 6 Examination and learning</b>						
Q31						
Q32					+0.63	
Q33					+0.52	
Q34					+0.69	
Q35		+0.46				
Q36		+0.45				
<b>% Variance</b>	<b>21%</b>	<b>21%</b>	<b>17%</b>	<b>15%</b>	<b>14%</b>	<b>11%</b>

**B4 THE MEAN AND PERCENTAGES (BRACKETS) FOR DIFFERENT SUBGROUPS**

No	Section	Mean and percentage (in brackets) per sub-group										
		UWC	BCB1	CHEM2	STA1	STA2	STA3	COS1	COS2	COS3	PHY2	PHY3
	<b>Number of Students</b>	546	50	15	179	67	50	143	12	10	14	6
1	Amount and distribution of student effort	18.74 (62.5%)	19.62 (65.4%)	18.60 (62.0%)	18.09 (60.3%)	19.43 (64.8%)	19.18 (63.9%)	18.57 (61.9%)	19.17 (63.9%)	18.80 (62.7%)	20.14 (67.1%)	19.67 (65.6%)
2	Assignments and learning	20.20 (67.3%)	19.96 (66.5%)	19.40 (64.7%)	20.47 (68.2%)	20.24 (67.5%)	20.32 (67.7%)	19.58 (65.3%)	21.83 (72.8%)	20.00 (66.7%)	22.57 (75.2%)	21.33 (71.1%)
3	Quantity and timing of feedback	17.78 (59.3%)	18.18 (60.6%)	19.67 (65.6%)	17.82 (59.4%)	15.33 (51.1%)	18.76 (62.5%)	18.03 (60.1%)	17.17 (57.2%)	18.00 (60%)	18.50 (61.7%)	21.17 (70.6%)
4	Quality of feedback	18.88 (62.9%)	18.54 (61.8%)	20.87 (69.6%)	18.52 (61.7%)	17.88 (59.6%)	19.60 (65.3%)	19.13 (63.8%)	20.83 (69.4%)	18.40 (61.3%)	20.21 (67.4%)	20.33 (67.8%)
5	Use of feedback	20.79 (69.3%)	20.74 (69.1%)	23.87 (79.6%)	20.06 (66.9%)	20.29 (67.6%)	21.36 (71.2%)	20.94 (69.8%)	24.08 (80.3%)	20.50 (68.3%)	22.07 (73.6%)	23.33 (77.8%)
6	Examination and learning	20.32 (67.7%)	21.06 (70.2%)	21.77 (72.6%)	19.66 (65.5%)	20.95 (69.8%)	21.14 (70.5%)	19.97 (66.6%)	22.67 (75.6%)	20.30 (67.7%)	21.46 (71.5%)	18.00 (60%)

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**APPENDIX C**  
**CONTENTS**

C1. The eleven conditions ..... C-2





## **C1. THE 11 CONDITIONS UNDER WHICH ASSESSMENT SUPPORTS STUDENT LEARNING**

### ***Quantity and distribution of student effort***

- Condition 1 Assessed tasks capture sufficient study time and effort
- Condition 2 These tasks distribute student effort evenly across topics and weeks

### ***Quality and level of student effort***

- Condition 3 These tasks engage students in productive learning activity
- Condition 4 Assessment communicates clear and high expectations to students

### ***Quantity and timing of feedback***

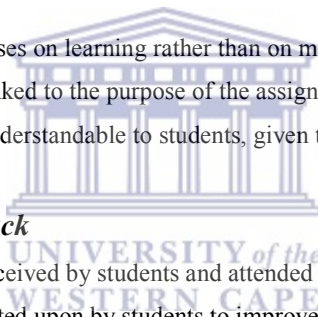
- Condition 5 Sufficient feedback is provided, both often enough and in enough detail
- Condition 6 The feedback is provided quickly enough to be useful to students

### ***Quality of feedback***

- Condition 7 Feedback focuses on learning rather than on marks or students themselves
- Condition 8 Feedback is linked to the purpose of the assignment and to criteria
- Condition 9 Feedback is understandable to students, given their sophistication

### ***Student response to feedback***

- Condition 10 Feedback is received by students and attended to
- Condition 11 Feedback is acted upon by students to improve their work or their learning



# APPENDIX D

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## D1. SAS CODE FOR ANALYSES ON COMBINED DATA SET

### 1.1 Reading in the data from the 10 subgroups

```
data work.BCB_1 ;
infile 'bcb 1.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.CHEM_2 ;
infile 'chem 2.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.STA_1 ;
infile 'sta 1.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.STA_2 ;
infile 'sta 2.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.STA_3 ;
infile 'sta 3.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.COS_1 ;
infile 'cos 1.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.COS_2 ;
infile 'cos 2.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.COS_3 ;
infile 'cos 3.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
data work.PHY_2;
infile 'phy 2.csv' dlm=' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;
```

```

data work.PHY_3 ;
infile ' phy 3.csv' dlim= ' ';
input course $ q1 $ q2 $ q3 $ q4 $ q5 $ q6 $ q7 $ q8 $ q9 $ q10 $ q11 $ q12 $ q13 $ q14 $ q15 $
q16 $ q17 $ q18 $ q19 $ q20 $ q21 $ q22 $ q23 $ q24 $ q25 $ q26 $ q27 $ q28 $ q29 $ q30 $ q31
$ q32 $ q33 $ q34 $ q35 $ q36 $ ;
run;

```

### 1.2 Combining the ten subgroup data sets into a combined UWC group data set & changing the alphabetic letters back to number scores in the correct scoring direction

```

data work.UWC;
set work.BCB_1 work.CHEM_2 work.STA_1 work.STA_2 work.STA_3 work.COS_1
work.COS_2 work.COS_3 work.PHY_2 work.PHY_3 ;
array option{36} q1- q36;
array options{36};
do i = 1, 4, 7, 8, 10,13, 14, 20,21, 22, 25,26, 28,32,33,34;
    if option {i} = 'A' then options {i} = 1;
    else if option {i} = 'B' then options {i} = 2;
    else if option {i} = 'C' then options {i} = 3;
    else if option {i} = 'D' then options {i} = 4;
    else if option {i} = 'E' then options {i} = 5;
    else if option {i} = " " then options {i} = . ;
    end;
do i = 2,3,5,6,9,11,12,15 to 19, 23,24,27,29,30,31,35,36;
    if option {i} = 'A' then options {i} = 5;
    else if option {i} = 'B' then options {i} = 4;
    else if option {i} = 'C' then options {i} = 3;
    else if option {i} = 'D' then options {i} = 2;
    else if option {i} = 'E' then options {i} = 1;
    else if option {i} = " " then options {i} = . ;
end;

scale1=sum(options1,options2,options3,options4,options5,options6);
scale2=sum(options7,options8,options9,options10,options11,options12);
scale3=sum(options13,options14,options15,options16,options17,options18);
scale4=sum(options19,options20,options21,options22,options23,options24);
scale5=sum(options25,options26,options27,options28,options29,options30);
scale6=sum(options31,options32,options33,options34,options35,options36);
run;

```

### 1.3 Cronbach Alpha Test

```

proc corr data=UWC alpha nomiss ;
var options1 options2 options3 options4 options5 options6 ;
title 'UWC Combine Year Group- Cronbach alpha Amount and distribution of study effort ';
run;
proc corr data=work.UWC alpha nomiss ;
var options7 options8 options9 options10 options11 options12;
title 'UWC- Cronbach alpha for Assignments and learning ';
run;
proc corr data=work.UWC alpha nomiss ;
var options13 options14 options15 options16 options17 options18;
title 'UWC Combine Year Group- Cronbach alpha for Quantity and timing feedback ';
run;
proc corr data=work.UWC alpha nomiss ;
var options19 options20 options21 options22 options23 options24;
title 'UWC Combine Year Group- Cronbach alpha for Quality of feedback '; run;

```

```

proc corr data=work.UWC alpha nomiss ;
var options25 options26 options27 options28 options29 options30;
title 'UWC Combine Year Group- Cronbach alpha for Use of feedback ';
run;
proc corr data=work.UWC alpha nomiss ;
var options31 options32 options33 options34 options35 options36;
title 'UWC Combine Year Group- Cronbach alpha for Examination and learning ';
run;

```

#### 1.4 Cluster Analysis

```

proc Varclus ;
var options1 options2 options3 options4 options5 options6
options7 options8 options9 options10 options11 options12
options13 options14 options15 options16 options17 options18
options19 options20 options21 options22 options23 options24
options25 options26 options27 options28 options29 options30
options31 options32 options33 options34 options35 options36;
run;

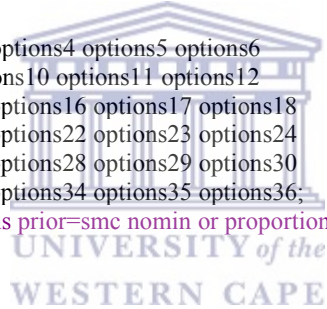
```

#### Factor Analysis

```

proc factor method=prininit priors=smc reorder res rotate=varimax
corr scree fuzz=.4 ;
var options1 options2 options3 options4 options5 options6
options7 options8 options9 options10 options11 options12
options13 options14 options15 options16 options17 options18
options19 options20 options21 options22 options23 options24
options25 options26 options27 options28 options29 options30
options31 options32 options33 options34 options35 options36;
title 'Factor Analysis with options prior=smc nomin or proportions';
run;

```



## D2. THE CRONBACH ALPHA TEST SAS OUTPUT

### *Cronbach Alpha for Amount and Distribution of study effort*

#### Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.033317
Standardized	-.008787

#### Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options1	-.142668	0.173064	-.145631	0.143535
options2	0.016609	0.024013	-.001793	-.008971
options3	0.127872	-.113555	0.120480	-.155069
options4	-.059923	0.098709	-.077780	0.074086
options5	0.184980	-.211085	0.181838	-.234502
options6	-.052474	0.092306	-.061774	0.057064

### *Cronbach Alpha for Assignments and Learning*

#### Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.316949
Standardized	0.317804

#### Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options7	0.229923	0.221697	0.223846	0.218548
options8	0.146481	0.275411	0.158415	0.267650
options9	0.175715	0.251287	0.178690	0.252681
options10	0.109553	0.300171	0.113143	0.300290
options11	0.028350	0.355014	0.021546	0.363105
options12	0.171259	0.257263	0.165388	0.262527

***Cronbach Alpha for Quantity and Timing feedback***

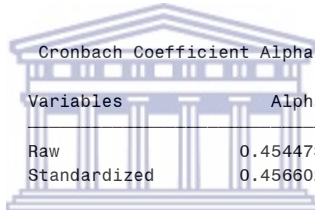
Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.590514
Standardized	0.590485

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options13	0.377354	0.522338	0.370821	0.526078
options14	0.329580	0.544063	0.324775	0.545961
options15	0.361367	0.530374	0.362383	0.529761
options16	0.280086	0.565883	0.288058	0.561443
options17	0.203608	0.592739	0.205521	0.595063
options18	0.408862	0.512394	0.407902	0.509681

***Cronbach Alpha for Quality of feedback***



Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.454473
Standardized	0.456602

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options19	-.078735	0.564831	-.082198	0.569427
options20	0.346181	0.340792	0.347182	0.339695
options21	0.376408	0.315137	0.385740	0.315747
options22	0.398439	0.306819	0.402916	0.304891
options23	0.204306	0.420576	0.201624	0.424959
options24	0.157625	0.448293	0.155928	0.450106

***Cronbach Alpha for Use of feedback***

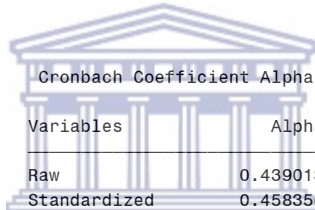
Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.711793
Standardized	0.712083

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options25	0.375049	0.692716	0.380480	0.692409
options26	0.512221	0.654646	0.519827	0.649228
options27	0.382849	0.691438	0.373266	0.694563
options28	0.371654	0.693396	0.380585	0.692377
options29	0.547159	0.638133	0.537373	0.643575
options30	0.483738	0.660751	0.476462	0.662991

***Cronbach Alpha for Examination and Learning***



Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.439013
Standardized	0.458356

Cronbach Coefficient Alpha with Deleted Variable

Deleted Variable	Raw Variables		Standardized Variables	
	Correlation with Total	Alpha	Correlation with Total	Alpha
options31	0.133389	0.448024	0.107486	0.478059
options32	0.306921	0.347635	0.343128	0.344842
options33	0.224481	0.391142	0.257522	0.395608
options34	0.239707	0.381935	0.286151	0.378940
options35	0.186759	0.411806	0.158222	0.451081
options36	0.227670	0.387002	0.217050	0.418652



### D3. THE CLUSTER ANALYSIS SAS OUTPUT

#### 2 Clusters formed by splitting the 1 Cluster

1 Cluster contained all 36 items.

Cluster summary for 2 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	21	21	4.173744	0.1987	1.7050
2	15	15	3.054508	0.2036	1.4691

Total variation explained = 7.228252 Proportion = 0.2008

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options1	0.0941	0.0070	0.9123
	options2	0.0352	0.0000	0.9648
	options4	0.1407	0.0046	0.8633
	options6	0.1646	0.0003	0.8357
	options7	0.2463	0.0047	0.7572
	options8	0.0851	0.0036	0.9182
	options10	0.0981	0.0063	0.9077
	options12	0.0393	0.0207	0.9810
	options13	0.1425	0.0116	0.8675
	options14	0.0738	0.0040	0.9299
	options17	0.0812	0.0052	0.9236
	options19	0.1256	0.0055	0.8792
	options20	0.4714	0.0960	0.5848
	options21	0.4363	0.0757	0.6099
	options22	0.3220	0.0746	0.7326
	options25	0.2803	0.0202	0.7345
options26	0.3172	0.0501	0.7188	
options28	0.3106	0.0349	0.7143	
options32	0.2149	0.0107	0.7936	
options33	0.2794	0.0110	0.7286	
options34	0.2152	0.0033	0.7874	
Cluster 2	options3	0.1209	0.0039	0.8826
	options5	0.0957	0.0001	0.9044
	options9	0.1858	0.0047	0.8181
	options11	0.0712	0.0113	0.9394
	options15	0.1740	0.0308	0.8522
	options16	0.1768	0.0000	0.8232
	options18	0.2095	0.0221	0.8083
	options23	0.1587	0.0037	0.8444
	options24	0.0884	0.0160	0.9263
	options27	0.3643	0.0785	0.6899
	options29	0.3977	0.1465	0.7057
	options30	0.3844	0.0911	0.6773
options31	0.1243	0.0065	0.8814	
options35	0.2616	0.0000	0.7384	
options36	0.2411	0.0357	0.7870	

### 3 Clusters formed by splitting Cluster 1 in the 2 Cluster

Cluster summary for 3 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	17	17	3.881461	0.2283	1.4727
2	15	15	3.054508	0.2036	1.4691
3	4	4	1.763534	0.4409	0.9332

Oblique Principal Component Cluster Analysis

Total variation explained = 8.699504 Proportion = 0.2417

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options1	0.0916	0.0070	0.9148
	options2	0.0353	0.0007	0.9654
	options4	0.1534	0.0096	0.8548
	options6	0.1795	0.0102	0.8289
	options7	0.2401	0.0413	0.7926
	options8	0.0823	0.0100	0.9269
	options12	0.0516	0.0207	0.9684
	options17	0.1027	0.0052	0.9019
	options20	0.4582	0.0960	0.5993
	options21	0.4288	0.0757	0.6180
	options22	0.3346	0.0746	0.7191
	options25	0.2929	0.0220	0.7231
	options26	0.3221	0.0501	0.7136
	options28	0.3112	0.0429	0.7196
Cluster 2	options3	0.1209	0.0077	0.8859
	options5	0.0957	0.0110	0.9144
	options9	0.1858	0.0053	0.8186
	options11	0.0712	0.0129	0.9410
	options15	0.1740	0.0654	0.8838
	options16	0.1768	0.0040	0.8266
	options18	0.2095	0.0663	0.8466
	options23	0.1587	0.0041	0.8447
	options24	0.0884	0.0120	0.9227
	options27	0.3643	0.0829	0.6932
	options29	0.3977	0.1578	0.7152
	options30	0.3844	0.1020	0.6855
	options31	0.1243	0.0080	0.8827
	options35	0.2616	0.0059	0.7428
options36	0.2411	0.0414	0.7916	
Cluster 3	options10	0.2285	0.0477	0.8101
	options13	0.6387	0.0590	0.3839
	options14	0.6915	0.0176	0.3140
	options19	0.2048	0.0650	0.8505

*4 Clusters formed by splitting Cluster 1 in the 3 Cluster*

Cluster summary for 4 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	10	10	3.06144	0.3061	1.2926
2	15	15	3.054508	0.2036	1.4691
3	4	4	1.763534	0.4409	0.9332
4	7	7	2.210853	0.3158	1.1870

Total variation explained = 10.09034 Proportion = 0.2803

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options1	0.1526	0.0070	0.8534
	options2	0.0433	0.0087	0.9650
	options7	0.2232	0.0946	0.8579
	options8	0.0910	0.0222	0.9296
	options20	0.5343	0.1162	0.5270
	options21	0.5729	0.0757	0.4621
	options22	0.4074	0.0746	0.6404
	options25	0.3140	0.0870	0.7514
	options26	0.3650	0.0824	0.6921
	options28	0.3578	0.0797	0.6978
Cluster 2	options3	0.1209	0.0071	0.8853
	options5	0.0957	0.0110	0.9144
	options9	0.1858	0.0063	0.8194
	options11	0.0712	0.0126	0.9407
	options15	0.1740	0.0654	0.8838
	options16	0.1768	0.0171	0.8375
	options18	0.2095	0.0663	0.8466
	options23	0.1587	0.0196	0.8581
	options24	0.0884	0.0147	0.9252
	options27	0.3643	0.0946	0.7022
	options29	0.3977	0.1680	0.7239
	options30	0.3844	0.1147	0.6954
	options31	0.1243	0.0105	0.8849
	options35	0.2616	0.0059	0.7428
options36	0.2411	0.0317	0.7838	
Cluster 3	options10	0.2285	0.0542	0.8157
	options13	0.6387	0.0718	0.3892
	options14	0.6915	0.0188	0.3144
	options19	0.2048	0.0837	0.8679
Cluster 4	options4	0.2319	0.0560	0.8137
	options6	0.2688	0.0676	0.7842
	options12	0.0833	0.0207	0.9361
	options17	0.1776	0.0341	0.8514
	options32	0.4193	0.0839	0.6339
	options33	0.5112	0.1088	0.5485
	options34	0.5187	0.0756	0.5207

5 Clusters formed by splitting Cluster 2 in the 4 Cluster

Cluster summary for 5 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	10	10	3.06144	0.3061	1.2926
2	9	9	2.586286	0.2874	1.0925
3	4	4	1.763534	0.4409	0.9332
4	7	7	2.210853	0.3158	1.1870
5	6	6	1.888534	0.3148	0.9861

Total variation explained = 11.51065 Proportion = 0.3197

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options1	0.1526	0.0169	0.8619
	options2	0.0433	0.0087	0.9650
	options7	0.2232	0.0946	0.8579
	options8	0.0910	0.0222	0.9296
	options20	0.5343	0.1162	0.5270
	options21	0.5729	0.0688	0.4586
	options22	0.4074	0.0740	0.6400
	options25	0.3140	0.0870	0.7514
	options26	0.3650	0.0824	0.6921
Cluster 2	options28	0.3578	0.0797	0.6978
	options3	0.1436	0.0163	0.8707
	options5	0.1157	0.0137	0.8966
	options9	0.2211	0.0230	0.7972
	options27	0.3582	0.0946	0.7089
	options29	0.4695	0.1680	0.6376
	options30	0.4709	0.1147	0.5976
	options31	0.1888	0.0105	0.8198
	options35	0.3230	0.0299	0.6978
Cluster 3	options36	0.2956	0.0317	0.7275
	options10	0.2285	0.0542	0.8157
	options13	0.6387	0.0718	0.3892
	options14	0.6915	0.0270	0.3170
Cluster 4	options19	0.2048	0.0837	0.8679
	options4	0.2319	0.0560	0.8137
	options6	0.2688	0.0676	0.7842
	options12	0.0833	0.0384	0.9533
	options17	0.1776	0.0858	0.8996
	options32	0.4193	0.0839	0.6339
	options33	0.5112	0.1088	0.5485
Cluster 5	options34	0.5187	0.0756	0.5207
	options11	0.1257	0.0198	0.8920
	options15	0.3646	0.0654	0.6799
	options16	0.3495	0.0455	0.6815
	options18	0.4114	0.0663	0.6305
	options23	0.4034	0.0316	0.6161
	options24	0.2339	0.0172	0.7795

6 Clusters formed by splitting Cluster 1 in the 5 Cluster

Cluster summary for 6 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	6	6	2.753207	0.4589	0.9982
2	9	9	2.586286	0.2874	1.0925
3	4	4	1.763534	0.4409	0.9332
4	7	7	2.210853	0.3158	1.1870
5	6	6	1.888534	0.3148	0.9861
6	4	4	1.547739	0.3869	0.9420

Total variation explained = 12.75015 Proportion = 0.3542

R-squared with

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options20	0.6158	0.1162	0.4347
	options21	0.6012	0.0836	0.4352
	options22	0.4635	0.0740	0.5794
	options25	0.3339	0.0870	0.7296
	options26	0.3683	0.0824	0.6884
	options28	0.3704	0.0797	0.6841
Cluster 2	options3	0.1436	0.0163	0.8707
	options5	0.1157	0.0137	0.8966
	options9	0.2211	0.0230	0.7972
	options27	0.3582	0.1030	0.7156
	options29	0.4695	0.1699	0.6391
	options30	0.4709	0.1119	0.5957
	options31	0.1888	0.0101	0.8195
	options35	0.3230	0.0299	0.6978
	options36	0.2956	0.0344	0.7296
Cluster 3	options10	0.2285	0.0476	0.8101
	options13	0.6387	0.0753	0.3907
	options14	0.6915	0.0270	0.3170
	options19	0.2048	0.0915	0.8753
Cluster 4	options4	0.2319	0.0489	0.8076
	options6	0.2688	0.0531	0.7722
	options12	0.0833	0.0384	0.9533
	options17	0.1776	0.0858	0.8996
	options32	0.4193	0.0752	0.6279
	options33	0.5112	0.1083	0.5482
Cluster 5	options34	0.5187	0.0769	0.5214
	options11	0.1257	0.0198	0.8920
	options15	0.3646	0.0654	0.6799
	options16	0.3495	0.0455	0.6815
	options18	0.4114	0.0663	0.6305
	options23	0.4034	0.0316	0.6161
Cluster 6	options24	0.2339	0.0216	0.7830
	options1	0.4872	0.0496	0.5396
	options2	0.2830	0.0096	0.7239
	options7	0.3930	0.0946	0.6704
	options8	0.3845	0.0245	0.6309

7 Clusters formed by splitting Cluster 4 in the 6 Cluster

Cluster summary for 7 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	6	6	2.753207	0.4589	0.9982
2	9	9	2.586286	0.2874	1.0925
3	4	4	1.763534	0.4409	0.9332
4	3	3	1.839327	0.6131	0.6395
5	6	6	1.888534	0.3148	0.9861
6	4	4	1.547739	0.3869	0.9420
7	4	4	1.509345	0.3773	0.9353

Total variation explained = 13.88797 Proportion = 0.3858

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options20	0.6158	0.0949	0.4244
	options21	0.6012	0.0836	0.4352
	options22	0.4635	0.0683	0.5759
	options25	0.3339	0.0638	0.7115
	options26	0.3683	0.0798	0.6865
	options28	0.3704	0.0653	0.6736
Cluster 2	options3	0.1436	0.0163	0.8707
	options5	0.1157	0.0137	0.8966
	options9	0.2211	0.0230	0.7972
	options27	0.3582	0.1030	0.7156
	options29	0.4695	0.1699	0.6391
	options30	0.4709	0.1119	0.5957
	options31	0.1888	0.0126	0.8216
	options35	0.3230	0.0299	0.6978
Cluster 3	options10	0.2285	0.0476	0.8101
	options13	0.6387	0.0753	0.3907
	options14	0.6915	0.0270	0.3170
	options19	0.2048	0.0915	0.8753
Cluster 4	options32	0.6056	0.0752	0.4265
	options33	0.5684	0.1083	0.4840
	options34	0.6653	0.0769	0.3625
Cluster 5	options11	0.1257	0.0198	0.8920
	options15	0.3646	0.0654	0.6799
	options16	0.3495	0.0464	0.6822
	options18	0.4114	0.0663	0.6305
	options23	0.4034	0.0361	0.6190
	options24	0.2339	0.0216	0.7830
Cluster 6	options1	0.4872	0.0496	0.5396
	options2	0.2830	0.0096	0.7239
	options7	0.3930	0.1105	0.6824
	options8	0.3845	0.0279	0.6331
Cluster 7	options4	0.4549	0.0489	0.5731
	options6	0.3645	0.0665	0.6807
	options12	0.2485	0.0384	0.7815
	options17	0.4414	0.0858	0.6110

8 Clusters formed by splitting Cluster 2 in the 7 Cluster

Cluster summary for 8 clusters

Cluster	Members	Cluster Variation	Variation Explained	Proportion Explained	Second Eigenvalue
1	6	6	2.753207	0.4589	0.9982
2	5	5	2.179442	0.4359	0.8202
3	4	4	1.763534	0.4409	0.9332
4	3	3	1.839327	0.6131	0.6395
5	6	6	1.888534	0.3148	0.9861
6	4	4	1.547739	0.3869	0.9420
7	4	4	1.509345	0.3773	0.9353
8	4	4	1.434043	0.3585	0.9151

Total variation explained = 14.91517 Proportion = 0.4143

R-squared with

Cluster	Variable	R-squared with		1-R**2 Ratio
		Own Cluster	Next Closest	
Cluster 1	options20	0.6158	0.1275	0.4403
	options21	0.6012	0.0990	0.4426
	options22	0.4635	0.0683	0.5759
	options25	0.3339	0.0638	0.7115
	options26	0.3683	0.0895	0.6938
	options28	0.3704	0.0653	0.6736
Cluster 2	options27	0.4456	0.1030	0.6180
	options29	0.5469	0.1699	0.5458
	options30	0.5388	0.1119	0.5193
	options35	0.3334	0.0689	0.7159
	options36	0.3146	0.0609	0.7298
Cluster 3	options10	0.2285	0.0476	0.8101
	options13	0.6387	0.0753	0.3907
	options14	0.6915	0.0270	0.3170
	options19	0.2048	0.0915	0.8753
Cluster 4	options32	0.6056	0.0752	0.4265
	options33	0.5684	0.1083	0.4840
	options34	0.6653	0.0769	0.3625
Cluster 5	options11	0.1257	0.0169	0.8893
	options15	0.3646	0.0654	0.6799
	options16	0.3495	0.0542	0.6878
	options18	0.4114	0.0663	0.6305
	options23	0.4034	0.0404	0.6217
Cluster 6	options24	0.2339	0.0216	0.7830
	options1	0.4872	0.0496	0.5396
	options2	0.2830	0.0187	0.7306
	options7	0.3930	0.1105	0.6824
Cluster 7	options8	0.3845	0.0279	0.6331
	options4	0.4549	0.0489	0.5731
	options6	0.3645	0.0665	0.6807
	options12	0.2485	0.0492	0.7903
Cluster 8	options17	0.4414	0.0858	0.6110
	options3	0.3896	0.0404	0.6361
	options5	0.3986	0.0272	0.6182
	options9	0.3410	0.0825	0.7183
	options31	0.3049	0.0690	0.7466

#### D4. THE FACTOR ANALYSIS SAS OUTPUT

Preliminary Eigenvalues: Total = 10.3237809 Average = 0.28677169

	Eigenvalue	Difference	Proportion	Cumulative
1	4.29533396	2.12278942	0.4161	0.4161
2	2.17254454	0.69840120	0.2104	0.6265
3	1.47414334	0.52331979	0.1428	0.7693
4	0.95082355	0.08324905	0.0921	0.8614
5	0.86757450	0.19870131	0.0840	0.9454
6	0.66887319	0.17276636	0.0648	1.0102
7	0.49610683	0.03097417	0.0481	1.0583
8	0.46513267	0.10766501	0.0451	1.1033
9	0.35746765	0.03908024	0.0346	1.1380
10	0.31838742	0.02994361	0.0308	1.1688
11	0.28844380	0.07723309	0.0279	1.1967
12	0.21121071	0.02390699	0.0205	1.2172
13	0.18730372	0.02577074	0.0181	1.2353
14	0.16153298	0.02239444	0.0156	1.2510
15	0.13913854	0.03177982	0.0135	1.2645
16	0.10735871	0.02803418	0.0104	1.2749
17	0.07932454	0.03098710	0.0077	1.2825
18	0.04833744	0.02068525	0.0047	1.2872
19	0.02765219	0.03635514	0.0027	1.2899
20	-.00870295	0.01419761	-0.0008	1.2891
21	-.02290056	0.01116939	-0.0022	1.2868
22	-.03406995	0.03290527	-0.0033	1.2835
23	-.06697522	0.01524236	-0.0065	1.2771
24	-.08221758	0.04158291	-0.0080	1.2691
25	-.12380049	0.01972847	-0.0120	1.2571
26	-.14352896	0.03247398	-0.0139	1.2432
27	-.17600294	0.00852880	-0.0170	1.2261
28	-.18453175	0.00795736	-0.0179	1.2083
29	-.19248910	0.02934572	-0.0186	1.1896
30	-.22183482	0.01674258	-0.0215	1.1681
31	-.23857740	0.01580231	-0.0231	1.1450
32	-.25437971	0.01833740	-0.0246	1.1204
33	-.27271711	0.01739583	-0.0264	1.0940
34	-.29011294	0.01919956	-0.0281	1.0659
35	-.30931250	0.06144289	-0.0300	1.0359
36	-.37075539		-0.0359	1.0000

6 factors will be retained by the PROPORTION criterion.





Iteration	Change	Communalities							
1	0.0818	0.25456	0.16521	0.14286	0.19582	0.18941	0.18596	0.28676	0.13309
		0.22940	0.15119	0.09898	0.20342	0.43954	0.45958	0.25048	0.27998
		0.28693	0.35745	0.25419	0.53923	0.54158	0.42233	0.25939	0.20337
		0.25737	0.32893	0.31374	0.25550	0.43546	0.44138	0.12972	0.38636
2	0.0359	0.39622	0.42679	0.28846	0.23862				
		0.25998	0.16575	0.13567	0.19154	0.19583	0.17601	0.28396	0.12674
		0.22671	0.14451	0.08787	0.20843	0.45610	0.48688	0.24767	0.27071
		0.28897	0.37341	0.25853	0.54789	0.56813	0.42432	0.24941	0.20076
3	0.0192	0.24773	0.31916	0.30826	0.25362	0.43713	0.45895	0.12560	0.41177
		0.40737	0.46274	0.28766	0.23520				
		0.26173	0.16532	0.13401	0.19078	0.19749	0.17374	0.28270	0.12517
		0.22449	0.14284	0.08613	0.20923	0.46256	0.50220	0.24497	0.26782
4	0.0109	0.28814	0.37854	0.25838	0.55030	0.58137	0.42437	0.24606	0.19894
		0.24548	0.31630	0.30586	0.25316	0.43709	0.46558	0.12470	0.42354
		0.40871	0.48198	0.28672	0.23425				
		0.26224	0.16490	0.13355	0.19073	0.19789	0.17316	0.28209	0.12465
5	0.0065	0.22314	0.14232	0.08566	0.20902	0.46485	0.51130	0.24334	0.26692
		0.28721	0.38006	0.25761	0.55065	0.58818	0.42408	0.24492	0.19794
		0.24485	0.31541	0.30482	0.25299	0.43687	0.46816	0.12443	0.42881
		0.40761	0.49287	0.28610	0.23397				
6	0.0040	0.26237	0.16464	0.13339	0.19079	0.19800	0.17299	0.28176	0.12443
		0.22240	0.14213	0.08546	0.20870	0.46544	0.51692	0.24245	0.26665
		0.28660	0.38042	0.25702	0.55045	0.59177	0.42384	0.24453	0.19743
		0.24464	0.31511	0.30436	0.25293	0.43673	0.46917	0.12432	0.43103
7	0.0026	0.40632	0.49937	0.28577	0.23389				
		0.26240	0.16449	0.13333	0.19085	0.19804	0.17293	0.28158	0.12432
		0.22200	0.14205	0.08536	0.20846	0.46539	0.52049	0.24195	0.26658
		0.28626	0.38043	0.25665	0.55018	0.59369	0.42371	0.24440	0.19716
8	0.0017	0.24456	0.31499	0.30414	0.25290	0.43666	0.46955	0.12426	0.43182
		0.40534	0.50339	0.28560	0.23387				
		0.26239	0.16440	0.13330	0.19089	0.19806	0.17289	0.28148	0.12426
		0.22178	0.14202	0.08580	0.20830	0.46514	0.52279	0.24168	0.26658
9	0.0011	0.28607	0.38036	0.25642	0.54996	0.59473	0.42365	0.24435	0.19702
		0.24453	0.31494	0.30403	0.25289	0.43662	0.46969	0.12423	0.43198
		0.40469	0.50596	0.28551	0.23386				
		0.26238	0.16435	0.13329	0.19091	0.19807	0.17288	0.28141	0.12423
10	0.0008	0.22165	0.14201	0.08527	0.20820	0.46487	0.52431	0.24151	0.26658
		0.28598	0.38029	0.25629	0.54981	0.59530	0.42363	0.24434	0.19694
		0.24452	0.31491	0.30397	0.25289	0.43661	0.46974	0.12421	0.43187
		0.40428	0.50765	0.28547	0.23386				
10	0.0008	0.26237	0.16432	0.13329	0.19093	0.19809	0.17287	0.28137	0.12421
		0.22157	0.14200	0.08525	0.20815	0.46464	0.52531	0.24141	0.26660
		0.28593	0.38023	0.25621	0.54972	0.59561	0.42364	0.24434	0.19689
		0.24451	0.31490	0.30393	0.25289	0.43660	0.46975	0.12419	0.43167
10	0.0008	0.40403	0.50877	0.28545	0.23387				
		0.26236	0.16430	0.13328	0.19094	0.19809	0.17286	0.28134	0.12419
		0.22152	0.14200	0.08524	0.20811	0.46445	0.52598	0.24135	0.26661
		0.28590	0.38019	0.25616	0.54966	0.59577	0.42365	0.24435	0.19686
10	0.0008	0.24451	0.31489	0.30391	0.25289	0.43660	0.46976	0.12418	0.43147
		0.40387	0.50953	0.28544	0.23387				

Convergence criterion satisfied.

Eigenvalues of the Reduced Correlation Matrix: Total = 10.625478 Average = 0.29515217

	Eigenvalue	Difference	Proportion	Cumulative
1	4.31901611	2.14852111	0.4065	0.4065
2	2.17049500	0.65144207	0.2043	0.6108
3	1.51905292	0.51735713	0.1430	0.7537
4	1.00169579	0.09501423	0.0943	0.8480
5	0.90668157	0.19754063	0.0853	0.9333
6	0.70914094	0.23585149	0.0667	1.0001
7	0.47328945	0.00443185	0.0445	1.0446
8	0.46885760	0.11694142	0.0441	1.0887
9	0.35191618	0.06230033	0.0331	1.1218
10	0.28961585	0.01929464	0.0273	1.1491
11	0.27032121	0.06242564	0.0254	1.1745
12	0.20789557	0.02124779	0.0196	1.1941
13	0.18664777	0.01381565	0.0176	1.2117
14	0.17283212	0.03732760	0.0163	1.2279
15	0.13550452	0.01337362	0.0128	1.2407
16	0.12213090	0.02739069	0.0115	1.2522
17	0.09474021	0.02868082	0.0089	1.2611
18	0.06605938	0.03531480	0.0062	1.2673
19	0.03074458	0.02636668	0.0029	1.2702
20	0.00437791	0.02325689	0.0004	1.2706
21	-.01887898	0.01329858	-0.0018	1.2688
22	-.03217757	0.01938638	-0.0030	1.2658
23	-.05156394	0.02346977	-0.0049	1.2610
24	-.07503372	0.03202188	-0.0071	1.2539
25	-.10705560	0.01326174	-0.0101	1.2438
26	-.12031734	0.03809796	-0.0113	1.2325
27	-.15841530	0.02415937	-0.0149	1.2176
28	-.18257467	0.00750752	-0.0172	1.2004
29	-.19008219	0.02303713	-0.0179	1.1825
30	-.21311932	0.01508603	-0.0201	1.1625
31	-.22820535	0.00966431	-0.0215	1.1410
32	-.23786967	0.03486776	-0.0224	1.1186
33	-.27223742	0.00661200	-0.0256	1.0930
34	-.27884942	0.04946581	-0.0262	1.0667
35	-.32831523	0.05252665	-0.0309	1.0358
36	-.38084188		-0.0358	1.0000

Factor Pattern

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
options20	0.67371	-0.01015	0.09974	-0.05422	-0.14205	-0.25023
options21	0.64534	-0.02290	0.12990	-0.19515	-0.22893	-0.26725
options29	0.55044	0.25266	-0.22695	-0.10931	0.01292	0.07846
options22	0.54009	0.05641	0.10576	0.01592	-0.22833	-0.25533
options26	0.52941	-0.10861	-0.03543	-0.08087	0.07563	0.09649
options28	0.48912	-0.09599	0.02638	-0.04108	0.00297	-0.04524
options30	0.47980	0.29564	-0.25733	-0.14168	-0.00616	0.25654
options25	0.45676	-0.16200	-0.07049	-0.03418	0.01624	0.05690
options33	0.45106	-0.25126	-0.11458	0.34607	-0.06081	0.02627
options27	0.43324	0.30906	-0.09999	-0.08197	-0.02972	-0.05564
options32	0.40068	-0.18505	-0.05734	0.30870	-0.20487	0.31004
options7	0.39569	-0.26380	-0.01508	-0.10477	0.20858	0.02164
options36	0.31367	0.21845	-0.21850	0.03010	0.19217	-0.04670
options4	0.29284	-0.19834	-0.15311	0.08989	0.17917	-0.04707
options10	0.25627	-0.04726	0.23713	-0.04889	-0.04277	0.11680
options6	-0.29437	0.23242	0.00642	-0.13267	-0.06199	0.10342
options23	0.06458	0.43904	0.11505	0.01184	-0.17005	-0.07159
options16	0.13034	0.43315	0.17466	-0.03187	-0.14729	0.09370
options18	0.26504	0.41251	0.29489	0.22973	-0.00613	-0.00190
options35	0.15613	0.38107	-0.24073	-0.10434	0.02967	0.21478
options24	-0.03302	0.37562	-0.01942	0.05606	-0.13433	-0.18197
options17	-0.19330	0.34183	0.29001	0.01673	-0.10297	0.19158
options15	0.26876	0.29270	0.25516	-0.03473	0.12204	0.04726
options19	-0.23645	0.29048	-0.18326	0.26132	-0.11787	0.01006
options11	-0.02520	0.28200	-0.00287	-0.01079	0.04583	-0.05338
options3	0.15813	0.22610	-0.16102	0.16987	0.04499	-0.01857
options8	0.17904	-0.25467	-0.02913	-0.15768	0.03434	-0.01982
options14	0.23400	-0.00941	0.58799	0.14145	0.31091	0.09342
options13	0.33386	-0.00586	0.54005	0.06682	0.23027	0.06176
options31	0.17131	0.16939	-0.19433	-0.06517	0.15237	-0.03031
options5	0.09285	0.21437	-0.24328	0.16548	0.18257	-0.15368
options34	0.38081	-0.23521	-0.09505	0.44359	-0.27693	0.16338
options2	-0.13094	0.15102	0.04593	0.27062	0.17921	-0.12993
options1	0.26164	-0.12835	-0.02000	-0.35283	-0.06283	0.22045
options12	0.19979	-0.02366	-0.20418	0.11637	0.30540	-0.13832
options9	0.19004	0.27055	-0.12698	0.03941	0.29062	0.10033

Variance Explained by Each Factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
4.3190161	2.1704950	1.5190529	1.0016958	0.9066816	0.7091409

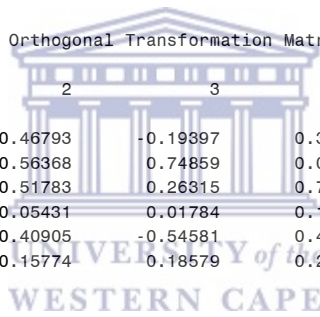
Final Commuality Estimates: Total = 10.626082

options1	options2	options3	options4	options5	options6
0.26235999	0.16429759	0.13328160	0.19093647	0.19809482	0.17285874
options7	options8	options9	options10	options11	options12
0.28134199	0.12419330	0.22151968	0.14200034	0.08523524	0.20811430
options13	options14	options15	options16	options17	options18
0.46445110	0.52598236	0.24135116	0.26660501	0.28590400	0.38018839
options19	options20	options21	options22	options23	options24
0.25615726	0.54966285	0.59577333	0.42364600	0.24434516	0.19685590
options25	options26	options27	options28	options29	options30
0.24451040	0.31489243	0.30391216	0.25288740	0.43660197	0.46975752
options31	options32	options33	options34	options35	options36
0.12418379	0.43147267	0.40387451	0.50952582	0.28543883	0.23386825

Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2	3	4	5	6
1	0.64988	0.46793	-0.19397	0.32270	0.39717	0.24329
2	0.01409	0.56368	0.74859	0.08139	-0.24225	-0.23744
3	0.13504	-0.51783	0.26315	0.79088	-0.13616	0.01834
4	-0.14941	-0.05431	0.01784	0.11520	0.66490	-0.72045
5	-0.36723	0.40905	-0.54581	0.45384	-0.37070	-0.23774
6	-0.63406	0.15774	0.18579	0.21100	0.43072	0.55545



Rotated Factor Pattern

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
options21	0.71929	.	.	.	.	.
options20	0.67008	.	.	.	.	.
options22	0.60944	.	.	.	.	.
options28	.	.	.	.	.	.
options26	.	.	.	.	.	.
options25	.	.	.	.	.	.
options30	.	0.57006	.	.	.	.
options29	.	0.54111	.	.	.	.
options35	.	0.46420	.	.	.	.
options36	.	0.45267	.	.	.	.
options9	.	0.43975	.	.	.	.
options27	.	0.41223	.	.	.	.
options31	.	.	.	.	.	.
options5	.	.	.	.	.	.
options3	.	.	.	.	.	.
options17	.	.	0.46179	.	.	.
options16	.	.	0.44216	.	.	.
options23	.	.	0.42613	.	.	.
options24	.	.	.	.	.	.
options19	.	.	.	.	.	.
options6	.	.	.	.	.	.
options11	.	.	.	.	.	.
options8	.	.	.	.	.	.
options12	.	.	.	.	.	.
options4	.	.	.	.	.	.
options7	.	.	.	.	.	.
options14	.	.	.	0.71688	.	.
options13	.	.	.	0.65960	.	.
options18	.	.	.	.	.	.
options15	.	.	.	.	.	.
options10	.	.	.	.	.	.
options34	.	.	.	.	0.68914	.
options32	.	.	.	.	0.62652	.
options33	.	.	.	.	0.51958	.
options1	.	.	.	.	.	0.48534
options2	.	.	.	.	.	.



Values less than 0.4 are not printed.

Variance Explained by Each Factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
2.2819936	2.2149698	1.7789037	1.6458828	1.5358457	1.1684867