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AUTHOR Seopa, Mampone A.; Laugksch, Rudiger C.; Aldridge, Jill M.; Fraser, Barry J.

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ABSTRACT

As part of an effort to monitor the transformation of classrooms within Limpopo Province, South Africa, an instrument was developed to assess students' perceptions of their learning environments. The developed questionnaire, the Outcomes-Based Learning Environment Questionnaire (OBLEQ), was designed to measure the impact of the Curriculum 2005 initiative on the learning environment of science outcomes. This exploratory study involved the collection of data from 2,638 learners in 50 classes in 50 schools. These data were analyzed to determine the validity and reliability of the OBLEQ . The factor structure of the OBLEQ indicated that students respond to the Investigation and Involvement scales in similar ways, so that these two scales have been combined to yield a total of six scales. The internal consistency reliability estimate for each of the six scales was comparable with those found in studies of similar instruments. There were statistically significant associations between student attitudes and all six scales of the OBLEQ at the individual level and for four scales at the class level. Findings also suggest that students would generally prefer a more favorable learning environment than the one they perceive to exist, a finding that replicates findings of research in Western primary and secondary schools. The questionnaire appears promising for showing the capability and success of educators in Limpopo Province in implementing outcomes-based education. An appendix contains a sample from the questionnaire. (Contains 35 references.) (SLD)

Development of an Instrument to Monitor the Success of Outcomes-Based Learning Environments in Science Classrooms in South Africa

MAMPONE A. SEOPA & RÜDIGER C. LAUGKSCH
University of Cape Town, South Africa

JILL M. ALDRIDGE & BARRY J. FRASER
Curtin University of Technology, Australia

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INTRODUCTION

In 1994, South Africa saw a significant breakthrough towards a non-racial and democratic social order. This breakthrough required social changes to ensure that the country could cater for its people irrespective of colour, creed, age or race. Such a challenge necessitated a restructuring of the curriculum, which resulted in *Curriculum 2005* (C2005; Department of Education, 1996). The vehicle by which this new curriculum is delivered is *outcomes-based education* (OBE; Department of Education 1997a, 1997b). This new approach to teaching and learning requires radical changes in the learning environment and in the levels of responsibility given to teachers in South Africa. A staggered implementation of C2005 began in 1998 and, to date, the new curriculum has been implemented in all primary grades, with the first implementation in the secondary phase having taken place in Grade 8 in 2001.

The present study was carried out in the Limpopo Province, one of the poorest provinces in South Africa. In this province, there is an acute shortage of classrooms and schools are generally under-resourced. The majority of schools have no electricity and few schools have running water. Teachers are often poorly qualified and, as a result, many struggle with subject matter content. The present study aimed to monitor the transformation of classrooms within this province towards the new education goals of South Africa. To assist teachers, teacher educators and researchers to monitor and guide changes towards the desired outcome-based classroom learning environments, it was appropriate to develop and validate an instrument that can be used to assess students' perceptions of their learning environments.

OBJECTIVES

1) To develop and validate a questionnaire for monitoring outcomes-based classroom learning environments in South Africa.
2) To investigate whether outcomes-based learning environments promote:
    a. attitudes;
    b. academic achievement; and
    c. equity.
3) To describe the learning environment of science classes in the Limpopo Province.
4) To investigate whether differences exist between girls and boys in terms of:
    a. the learning environments that they perceive and would prefer;
    b. attitude to science classes; and
    c. achievement.

BACKGROUND TO THE STUDY

The influence of the learning environment on the process of education has received a great deal of attention from educational researchers during the last three decades (Fraser, 1994, 1998, 2002). Over the past 30 years, several approaches have been used in conducting research in the field of learning environments. In 1974, Moos developed the *Classroom Environment Scale* (CES), which was used to assess the environment in school settings. Trickett and Moos (1974) used the CES to establish relationships between student satisfaction, their moods and their perceptions of their classroom environment.

Of particular interest are those past studies that have made use of the *What is Happening in this Class?* (WIHIC) questionnaire in Singapore (Fraser & Chionh, 2000), Brunei (Riah &

Fraser, 1998), Indonesia (Margianti, Fraser & Aldridge, 2002), Taiwan (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999) and Canada (Raaflaub & Fraser, 2002; Zandvliet & Fraser, 1999). The findings of these studies have replicated those of past research, reporting associations between the learning environment and students' outcomes. These studies provide suggestions to educators regarding classroom environment dimensions that could be changed in order to improve student outcomes.

Previous studies have investigated differences between students' perceptions of their preferred and actual learning environment (Fraser, 1998). Such research has involved the use of a 'preferred' form of instruments (which measures students' or teachers' perceptions of the learning environment that they would ideally like) and an 'actual' form (which measures students' and teachers' perceptions of the actual classroom environment). The wording of the items in these two instruments is similar. These studies also have revealed that students and teachers are likely to prefer a more positive environment than the one actually present in the classroom (Fisher & Fraser, 1983; Fraser & McRobbie, 1995; Wubbels, Brekelmans & Hoomayers, 1991).

Past research has examined gender differences in students' perceptions of the learning environment in a bid to understand why, in the past, boys have outperformed girls in science and technological courses (Bellar & Gafni, 1996; Kahle & Meece, 1994). Past studies revealed that boys differ from girls in their perceptions of classroom environments (Fisher & Rickards, 1996; Tock, 1995). However, an exception to this pattern is Tamir and Caridin's (1993) finding of no sex differences in Israeli Arabic students' perceptions of the classroom environment.

Past studies of learning environments provide numerous research traditions and research methods that are relevant to the study presented in this paper. Our study draws on valid, economical and widely-applicable assessment instruments available in the field of learning environments, but it also extends past research by modifying existing scales to make them more suitable for assessing outcomes-based classroom environments and validating the new instrument for use in South Africa.

RESEARCH METHODS

Development of the New Instrument

A major contribution to the study is the development and validation of a widely-applicable and distinctive questionnaire for assessing learners' perceptions of their actual and preferred classroom learning environments in outcomes-based learning settings. The development and validation of the questionnaire involved a number of steps:

1. Department of Education policy documents and the national and international literature on outcomes-based education (OBE) were examined in order to identify dimensions central to the educational philosophy of OBE and C2005.
2. Interviews with science curriculum advisors in the Limpopo Province and with grade 8 science teachers were conducted to ensure that the scales are salient to the actual school context (Fraser, 1994).
3. It was ensured that the dimensions are consistent with Moos' (1974) scheme for classifying the dimensions of any human environment. These three dimensions are: Relationship dimensions (which measure the degree of people's involvement in the environment and the assistance given to each other); Personal Development dimensions (which measures the kind and strength of the personal relationships in the environment);

System Maintenance and System Change dimensions (which measure the degree of orderliness, control and responsiveness to change in the environment).

4. Relevant dimensions and items for the actual form were adopted and adapted from widely-used general classroom environment questionnaire such as the *What is Happening in this Class*? (WIHIC) questionnaire (Aldridge & Fraser, 2000) and the *Constructivist Learning Environment Survey* (Aldridge, Fraser, Taylor, & Chen, 2000; Taylor, Fraser & Fisher, 1997).
5. A parallel preferred form was developed to accompany the actual form, to enable the researchers to collect data pertaining to students' perceptions of the environment that they would prefer.
6. As English is the second language for the vast majority of students in the Limpopo Province, the items and instructions were translated into North Sotho (or Sepedi)—the local vernacular—using back-translation as recommended by Brislin (1970). Finally, the instrument was field tested with four classes of Grade 8 science students in four schools, subsamples of which were subsequently interviewed about the clarity and readability of the items and the item response format.

The new instrument, the *Outcomes-Based Learning Environment Questionnaire* (OBLEQ), consists of seven scales with eight items per scale. The OBLEQ includes scales from existing instruments that are considered relevant to the philosophy of outcomes-based education being adopted by South Africa, as well as a newly-developed scale entitled. Responsibility for Own Learning. Table 1 provides a description of each scale and its relevance to outcomes-based education according to *Curriculum 2005* (Department of Education, 1997a).

Although English is the medium for education in the Limpopo Province, it is the second language for the majority of students. It was considered important, therefore, to provide students with both the English and a North Sotho equivalent for each item. The OBLEQ was translated into North Sotho using a rigorous process of translation and back-translation to ensure accuracy (as recommended by Brislin, 1970). This process involved a South African researcher, whose first language was North Sotho in translating the questionnaire. Next, a staff member from the University of the North, fluent in English and North Sotho, then back-translated the items into English. The two English versions were then compared for accuracy. During a process that was repeated a number of times, changes were made to the North Sotho version to ensure an accurate translation of the original OBLEQ.

This questionnaire pioneered the idea of including both the English and North Sotho version of each item on the same questionnaire. The medium of instruction in South African high schools is English but, for many students in the Limpopo province, English is their second language. To assist students to complete the OBLEQ accurately, it was considered desirable to provide students with an English and North Sotho version of each item. Beneath each English item, in a slightly smaller font, the North Sotho translation is given as illustrated below:

I discuss ideas in class.
Ke ahlaahla dikgopolo ka mphatong.

This arrangement is provided also for the instructions and response scale. A copy of the OBLEQ used in the present study is in Appendix A.

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Table 1. Description and Origin of Each OBLEQ Scale and Its Relevance to Outcomes-Based Education in South Africa

Scale	Origin of Scale	Description	Relevance to Outcomes-Based Education (e.g., Department of Education, 1997a)
		The extent to which ...	*OBE advocates the following on the part of learners:*
Involvement	WIHIC	students have attentive interest, participate in discussions, do additional work and enjoy the class.	Learners are to be active participants in the learning process.
Investigation	WIHIC	emphasis is placed on the skills and processes of inquiry and their use in problem solving and investigation.	Instruction should be learner-centred. Learners must do things while the teacher acts only as the facilitator of learning.
Cooperation	WIHIC	students cooperate rather than compete with one another on learning tasks.	Learners should collaborate in learning rather than compete. They should co-operate and work together as a group.
Equity	WIHIC	students are treated equally and fairly by the teacher.	All learners are to be treated in the same way. Excellence is for every child not just a few.
Differentiation	ICEQ	teachers cater for students differently on the basis of ability, rates of learning and interests.	All learners can learn and succeed but not at the same time and same pace. Learners demonstrate achievement of outcomes over time and according to their own abilities.
Personal Relevance	CLES	teachers relate science to students out-of-school experiences.	Learning must be meaningful to the learners; this is possible if it is seen to be relevant to their everyday life experiences.
Responsibility for Own Learning	Developed for this study	learners perceive themselves as being in charge of their learning process, motivated by constant feedback and affirmation.	Accountability for performance rests with learners.

WIHIC – What is Happening in this Class? Questionnaire
ICEQ – Individualised Classroom Environment Questionnaire
CLES – Constructivist Learning Environment Survey

To give the students confidence and to encourage them to complete the questionnaire, scales pertaining to issues with which the students were likely to be more familiar (e.g., Involvement) were sequenced earlier than less familiar—and thus potentially more difficult—scales such as Responsibility for Own Learning. The response format consisted of a five-point frequency scale of Always, Often, Sometimes, Seldom and Never. The actual and preferred versions of the OBLEQ were placed next to one another on a single form of the questionnaire so that it was more economical to administer and easier to complete by grade 8 students. Each item, then, required a response on the same line to 'How it is' and 'How I want it' (see Appendix A).

Development of the Attitude Scale

An attitude scale, based on the *Test of Science-Related Attitudes* (TOSRA; Fraser, 1981), was developed to assess students' attitudes towards their science classes. The scale consists of eight items pertaining to students' attitudes to science lessons, some of which are reverse-scored. Students responded to these items using the same response format as the OBLEQ. The same procedure of translation and back translation used in the development of the OBLEQ was also used to generate a North Sotho and English equivalent for each item of the attitude scale. The attitude scale used in the present study is also in Appendix A (see Items 41 to 48).

Development of the Achievement Test

Also, a science test was developed specifically for use in this study to examine students' understanding of scientific investigations, as stipulated in Learning Outcome 1 for grade 8 in the Revised National Curriculum Statement for the Natural Sciences (Department of Education, 2002). The test was selected, adapted and modified from a pilot test of possible common assessment tasks for grade 8 science (Department of Education, n.d.) (Appendix B). It measures the extent to which learners can identify a testable question, factors important to the investigation, ways to make investigations 'fair', and whether they can communicate findings.

Sample

The exploratory nature of the present study lent itself to the large-scale collection of quantitative data. The new instrument (*Outcomes-Based Learning Environment Questionnaire*; OBLEQ), the attitude scale derived from the *Test of Science-Related Attitudes* (TOSRA, Fraser 1981) and the achievement test were administered to the students of 50 grade 8 science classes (see Appendix A for a copy of the OBLEQ used in the present study).

The sample included 2638 grade 8 science learners from 50 classes in 50 schools in the central region of the Limpopo Province, South Africa. For logistical reasons, schools were selected from within a 50-kilometre radius from Polokwane, the provincial capital. Of the 50 schools, 37 were rural, nine were township and four were urban schools. These schools were selected to represent the range of schools located in this part of South Africa.

FINDINGS

An important contribution of the present study was the development and validation of a questionnaire to monitor students' perceptions of the learning environment as a teacher moves towards a more outcomes-based teaching style in classrooms in South Africa.

Reliability and Validity of the OBLEQ

A major objective of the present study was to develop and validate a questionnaire for monitoring outcomes-based classroom learning environments in South Africa. The data collected from 2638 learners in 50 schools were used to examine the reliability and validity of the OBLEQ. As a first step, the data were used to perform a principal component factor analysis followed by varimax rotation (reported in Table 2). Factor loadings of less than 0.30 have been omitted in Table 2. Item 21, from the Cooperation scale, Items 33 and 37 from the Differentiation scale, and Items 54 and 56 from the Personal Relevance scale were considered problematic and were omitted from all further analyses. During factor analysis, the Investigation and Involvement scales came together, suggesting that learners regarded Involvement and Investigation in similar ways. All other items had a factor loading of at least 0.30 on their own scale and no other scale with the exception of Items 34 and 35 of the

Differentiation scale that did not have a loading of at least 0.30 on their own or any other scale.

Table 2. Factor Loadings for a Modified Version of Actual Form of the OBLEQ in South Africa

Item No	Factor Loading					
	Involvement/ Investigation	Cooperation	Equity	Differentiation	Personal Relevance	Responsibility for Learning
1	0.31					
2	0.40					
3	0.31					
4	0.40					
5	0.39					
6	0.39					
7	0.40					
8	0.47					
9	0.45					
10	0.48					
11	0.45					
12	0.44					
13	0.38					
14	0.38					
15	0.33					
16	0.39					
17		0.48				
18		0.40				
19		0.32				
20		0.42				
22		0.42				
23		0.41				
24		0.32				
25			0.41			
26			0.40			
27			0.41			
28			0.53			
29			0.53			
30			0.48			
31			0.42			
32			0.45			
34				–		
35				–		
36				0.58		
38				0.49		
39				0.59		
40				0.63		
49					0.56	
50					0.40	
51					0.52	
52					0.54	
53					0.53	
55					0.39	
57						0.38
58						0.46
59						0.59
60						0.48
61						0.46
62						0.40
63						0.45
64						0.37
% Variance	9.64	6.34	3.25	3.54	4.16	5.39
Eigenvalue	21.03	5.36	2.45	3.08	3.16	4.99

Factor loadings smaller than 0.30 have been omitted.
The sample consisted of 2638 students in 50 classes in South Africa.

Table 2 reports the percentage of variance and the eigenvalue for each scale. The percentage of variance varies from 3.25 to 9.64 for different scales, with the total variance accounted for being 32.32%. The value of the eigenvalue varies from 2.45 to 21.03 for the different scales.

For this revised instrument, three further indices of scale reliability and validity were generated for the actual and preferred versions of the instrument. The Cronbach alpha reliability coefficient was used as an index of scale internal consistency of the actual and preferred versions. A discriminant validity index (namely, the mean correlation of a scale with the other five scales) was used as evidence that each scale in the actual and preferred versions the OBLEQ measures a separate dimension that is distinct from the other scales within the questionnaire. Analysis of variance (ANOVA) results were used as evidence of the ability of the actual form of each scale to differentiate between the perceptions of students in different classrooms.

Table 3. Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (Mean Correlation With Other Scales) and Ability to Differentiate Between Classrooms (ANOVA Results) for Two Units of Analysis for the Modified Version of the OBLEQ

Scale	Unit of Analysis	No. of Items	Alpha Reliability		Mean Correlation with other Scales		ANOVA Eta²
			Actual	Preferred	Actual	Preferred	Actual
Involvement/ Investigation	Individual	16	0.79	0.84	0.30	0.43	0.12**
	Class Mean		0.93	0.97	0.33	0.57	
Cooperation	Individual	7	0.67	0.76	0.30	0.43	0.12**
	Class Mean		0.91	0.95	0.42	0.63	
Equity	Individual	8	0.73	0.81	0.30	0.42	0.13**
	Class Mean		0.94	0.98	0.35	0.59	
Differentiation	Individual	7	0.62	0.66	0.12	0.18	0.13**
	Class Mean		0.85	0.67	0.13	0.01	
Personal Relevance	Individual	6	0.69	0.74	0.23	0.34	0.10**
	Class Mean		0.86	0.91	0.14	0.57	
Responsibility for Learning	Individual	8	0.73	0.79	0.31	0.40	0.08**
	Class Mean		0.90	0.97	0.37	0.47	

** $p<0.01$

The sample consisted of 2638 students in 50 classes in South Africa.

The eta² statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.

Table 3 shows that the internal consistency reliability (Cronbach alpha coefficient) for the actual version of the OBLEQ ranges from 0.62 to 0.79 with the individual as unit of analysis, and from 0.85 to 0.94 using the class mean as unit of analysis. For the preferred version of the OBLEQ, the internal consistency reliability of scales ranges from 0.66 to 0.84 for the individual as the unit of analysis, and from 0.67 to 0.98 for the class mean as the unit of analysis. These results indicate that the internal consistency for both the actual and preferred versions of the OBLEQ is satisfactory.

For the actual version of the OBLEQ, the discriminant validity (mean correlation of a scale with other scales) ranges from 0.12 to 0.31 with the individual as the unit of analysis and

between 0.13 and 0.42 with the class mean as the unit of analysis (see Table 3). For the preferred version of the OBLEQ, the discriminant validity ranges from between 0.18 and 0.43 for the individual as the unit of analysis and between 0.01 and 0.63 for the class mean as the unit of analysis. These results, reported in Table 3, suggest that scales in the actual version of the OBLEQ assess distinct constructs, although there is a degree of overlap. The results for the preferred version of the OBLEQ suggest that raw scores assess somewhat overlapping aspects of learning environment (see Table 3). However, the factor analysis results (Table 2) attest to the independence of factor scores on the actual form of the OBLEQ.

An analysis of variance (ANOVA) with class membership as the independent variable was used to determine whether the actual for each OBLEQ scale was able to distinguish between the perceptions of students in different classes. The results reported in Table 3 indicate that each OBLEQ scale differentiated significantly ($p<0.01$) between classes.

Overall results suggest that the *Outcomes-Based Learning Environment Questionnaire* is valid and reliable for use in high school science classes in South Africa and therefore can be used with confidence by teachers and researchers in the future.

Reliability of Attitude Scale

Data collected from 2638 learners in 50 schools were analysed to examine the reliability of the attitude scale. The internal consistency reliability (Cronbach alpha coefficient) for the attitude scale is 0.63 with the individual as the unit of analysis and 0.92 with class mean as the unit of analysis.

Associations between Outcomes-Based Learning Environments, Attitudes, Achievement and Equity

The second objective of the present study was to investigate whether outcomes-based learning environments promote attitudes, achievement and equity. To assess students' attitudes to science a scale, the *Test of Science-Related Attitudes* (Fraser, 1981) was modified. To assess academic achievement, a test was adapted and modified from pilot versions of common assessment tasks for OBE developed by the Department of Education. This new approach to teaching and learning has as one of its objectives that education should be accessible to all learners regardless of race and/or sex. This then requires teachers to treat all learners equally, and equity is thus both a salient characteristic of, as well as an outcome to be achieved through, outcomes-based education. For these reasons, the Equity scale from the OBLEQ was used as a dependent variable for some analyses.

Simple correlation and multiple regression analyses were conducted to examine whether associations exist between students' perception of learning environment and the outcomes of students' attitude towards their science classes, equity and student achievement score. Simple correlation analysis was used to provide information about the bivariate relationship between each attitude measure and each individual environment scale. Multiple regression analysis was used to describe the joint relationship between each attitude measure and the whole set of six environment scales. Using the standardised regression coefficients (β), the environment scales which contributed uniquely and significantly to the explanation of the variance in each dependent varaible were identified. For example, the standardised regression coefficients identify the specific environment scales that make a significant contribution to explaining the variance in the attitudinal outcomes when the other environment scales are mutually controlled.

Associations with Student Attitudes

For student attitudes, when using the individual as the unit of analysis, the results of the simple correlation analyses indicate a statistically significant ($p<0.01$) association between students' attitudes towards their science classes and all six learning environment scales. With the class mean as the unit of analysis, four of the six learning environment scales were statistically significantly related to attitudes ($p<0.01$), namely, Cooperation, Equity, Differentiation and Responsibility for Own Learning. All statistically significant associations are positive with the exception of the Differentiation scale, which is negatively associated to students' attitudes.

Table 4. Simple Correlation and Multiple Regression Analyses for Associations Between Dimensions of the OBLEQ and Student Attitudes, Equity and Achievement

Scale	Unit of Analysis	Student Attitudes		Equity		Achievement	
		r	*β*	*r*	*β*	*r*	*β*
Involvement/ Investigation	Individual	0.19**	-0.01	0.42**	0.19**	-0.02	-0.07**
	Class Mean	0.25	-0.06	0.60**	0.17	-0.27	-0.26
Cooperation	Individual	0.30**	0.14**	0.47**	0.30**	0.05*	0.06*
	Class Mean	0.60**	0.29*	0.83**	0.40**	0.01	0.50
Equity	Individual	0.40**	0.27**	–	–	0.05*	0.06*
	Class Mean	0.75**	-0.01	–	–	-0.13	-0.22
Differentiation	Individual	-0.25**	-0.29**	-0.02	-0.11**	0.02	0.02
	Class Mean	-0.81**	-0.79**	-0.51**	-0.39**	0.14	-0.09
Personal Relevance	Individual	0.12**	0.08**	0.20**	0.06**	0.08**	0.09**
	Class Mean	-0.02	0.20**	0.09	0.15	0.41**	0.40*
Responsibility For Own Learning	Individual	0.24**	0.11**	0.40**	0.23**	-0.02	-0.06**
	Class Mean	0.53**	0.18*	0.74**	0.28**	-0.21	-0.28
Multiple Correlation (R)	Individual		0.51**		0.57**		0.12**
	Class Mean		0.94**		0.93**		0.56**

* $p<0.05$
** $p<0.01$

The sample consisted of 2638 students in 50 classes in 50 schools in South Africa.

The multiple correlation between students' perceptions of the learning environment and students' attitude is 0.51 with the individual as the unit of analysis and 0.94 with the class mean as the unit of analysis. At both levels, the multiple correlation is statistically significant ($p<0.01$). Inspection of the significant standardised regression coefficients in Table 4 shows that, with the individual as the unit of analysis, five of the six scales were significant ($p<0.01$) independent predictors of student attitudes, namely, Cooperation, Equity, Differentiation, Personal Relevance and Responsibility for Own Learning. At the class mean level of analysis, four of the six scales were significant ($p<0.05$) independent predictors of student attitudes (Cooperation, Differentiation, Personal Relevance and Responsibility for Own Learning). With the exception of Differentiation, all environment scales had a positive relationship with student attitudes. These results suggest that the learning environment created by teachers in their science classes could have an effect on their attitudes towards that subject. Therefore, teachers wishing to improve the learning environment should consider providing more

Cooperation, Equity, Personal Relevance and Responsibility for Own Learning and less Differentiation.

Associations with Students' Perceptions of Equity

Table 4 indicates that, with the individual as the unit of analysis, a positive and statistically significant simple correlation ($p<0.01$) exists for four of the five scales (except Differentiation). With the class mean as the unit of analysis, a statistically significant association ($p<0.01$) exists for all scales except Personal relevance; these associations are positive for all scales except Differentiation.

The multiple correlation between students' perceptions of the learning environment and Equity is 0.57 at the individual level and 0.93 at the class mean level of analysis, and is statistically significant ($p<0.01$) for both. The standardized regression coefficients (β) indicate that, with the individual as the unit of analysis, all five of the learning environment scales uniquely accounts for a significant ($p<0.01$) amounts of variance in Equity beyond that attributable to other environment scales. At the class mean level of analysis, three of the five learning environment scales (Cooperation, Differentiation and Responsibility for Own Learning) independently account for a significant ($p<0.01$) proportion of variance in Equity. At both the individual and class levels of analyses, significant associations are positive for all scales except for the Differentiation scale.

Associations with Achievement Scores

Finally, analyses were conducted to explore associations between the six dimensions of the learning environment and student achievement. The results of the simple correlation analysis indicate that, with the individual as the unit of analyses, a statistically significant ($p<0.05$) relationship exists between achievement and three of the six environment scales (Cooperation, Equity and Personal Relevance). At the student level of analysis, only the correlation between achievement and Personal Relevance is statistically significant. An examination of the signs of the simple correlations for student achievement shows that all associations are positive.

The multiple correlations (R) for achievement suggest that the association of students' achievement to the whole set of six environment scales is statistically significant ($p<0.01$) both for the individual and class mean level of analysis. The magnitude of the multiple correlation is 0.12 for the individual and 0.56 for the class mean as the unit of analysis. The standardised regression coefficient (β) is statistically significant ($p<0.05$) for five of the six learning environment scales with the individual as the unit of analysis (the exception being Differentiation), and for one scale (Personal Relevance) with the class mean as the unit of analysis. However, regression coefficients are negative for Involvement/Investigation and Responsibility for Own Learning.

Using the OBLEQ to Describe Science Classrooms in the Limpopo Province

The third aim of the present study was to use the dimensions of the OBLEQ in describing the typical science classroom environment in the Limpopo Province. The learning environment of science classes was analysed using descriptive statistics based on students' responses to the questionnaire. Because the number of items in each scale varied from six to 16, the average item mean (the scale mean divided by the number of items in the scale) was calculated and used as the basis for comparison between different scales. Table 5 reports the results in terms of average item means for the class as the unit of analysis for the learning environment scales of Involvement/Investigation, Cooperation, Equity, Differentiation, Personal Relevance and Responsibility for Own Learning.

Using the class mean as the unit of analysis, average item means for students' perceptions of the actual learning environment ranged from 2.63 to 3.63 for different scales. The average item means for the learning environment that students would prefer range from 3.03 to 4.01 for different scales. Figure 1 also shows that the level of each OBLEQ dimension perceived to be actually present is lower for every scale than students' preferred level.

Table 5. Average Item Mean, Average Item Standard Deviation and Difference between Actual and Preferred Perceptions on Each OBLEQ (Effect Size and MANOVA Results) for the Class Mean as the Unit of Analysis

Scale	Average Item Mean		Average Item Standard Deviation		Difference	
	Actual	Preferred	Actual	Preferred	Effect Size	*F*
Involvement/ Investigation	3.38	3.92	0.21	0.28	2.20	4.35**
Cooperation	3.62	4.00	0.26	0.34	1.27	3.68**
Equity	3.63	4.01	0.27	0.42	1.10	3.28**
Differentiation	2.62	3.04	0.32	0.23	1.53	3.42**
Personal Relevance	3.04	3.51	0.19	0.27	2.04	3.29**
Responsibility for Own Learning	3.31	3.80	0.23	0.35	1.69	4.29**

**$p<0.01$

The sample consisted of 2638 students in 50 classes in 50 schools.

The average item mean is the scale mean divided by the number of items in that scale.

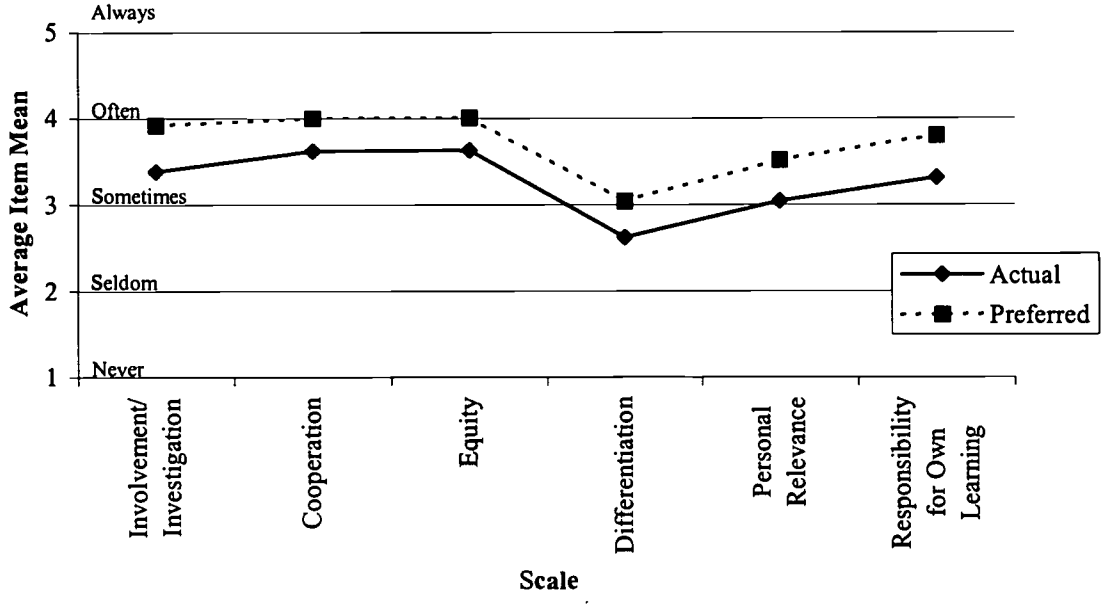

Figure 1. Differences in Students' Perceptions of Actual and Preferred Learning Environment for the OBLEQ

A one-way MANOVA was performed with the six OBLEQ scales as dependent variables and the form (actual or preferred) as the independent variable. The multivariate test yielded significant results ($p<0.01$) in terms of Wilks' lambda criterion, indicating that there were differences in the set of criterion variables as a whole. Therefore, the one-way ANOVA was interpreted for each of the six individual OBLEQ scales. The results of the F tests are shown in Table 5 along with descriptive statistics. In order to estimate the magnitudes of the differences (in addition to their statistical significance), effect sizes (magnitudes of the differences between countries expressed in standard deviation units) were calculated as recommended by Thompson (1998a, 1998b).

The results reported in Table 5 indicate a statistically significant difference ($p<0.01$) between actual and preferred scores for all six learning environment scales for the class mean as the unit of analysis. The effect size for each of the OBLEQ scales, reported in Table 5, ranges between approximately one and two standard deviations for the class mean as the unit of analysis. These results suggest that there are large differences between students' perceptions of the actual and preferred environment. As South African science classrooms—and certainly the vast majority of those in the Limpopo Province—are characterised by the 'chalk-and-talk' approach to teaching and learning science, it is only natural for students exposed to this kind of teaching to wish to experience pedagogically more meaningful involvement in the learning process of science that is relevant to their daily lives. It is thus not surprising to find that there are such large differences between students' actual and preferred perceptions.

Examining Gender Differences

The fourth aim of the present study was to examine gender differences in classroom environment perceptions, attitudes to science and achievement. To do this, data were analysed with a one-way MANOVA for repeated measures and using the within-class gender subgroup mean as the unit of analysis. Gender was the repeated measures factor and the OBLEQ, attitude and achievement scales formed the set of dependent variables. As males and females are not found in equal numbers in every class, the within-class gender mean was chosen as the unit of analysis to provide a matched pair of means—one within-class mean for males and one within-class mean for females. This reduces confounding in that, for each group of males within a particular classroom, there is a corresponding group of females in the same classroom. Because the multivariate test produced statistically significant results using Wilks' lambda criterion, the univariate ANOVA for repeated measures was interpreted for each individual scale to investigate whether males and females had different perceptions of their classrooms, different attitudes and different achievement scores.

Table 6 reports the average item mean and average item standard deviation for male and female students for each actual OBLEQ scale, each preferred OBLEQ scale, the attitude scale and student achievement. Also, the results for the ANOVAs and effect sizes are reported in Table 6. The means generated using male and female scores on each actual OBLEQ scale, attitude scale and achievement scale were used to draw the graphical profile provided in Figure 2.

Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL, April 2003

Table 6. Average Item Mean, Average Item Standard Deviation and Difference Between Males and Females (Effect Size and MANOVA for Repeated Measure) on the Actual and Preferred Versions of the OBLEQ, Attitudes and Achievement using the Within-Class Gender Mean as the Unit of Analysis

Scale		Average Item Mean		Average Item Standard Deviation		Difference	
		Male	Female	Male	Female	Effect Size	*F*
Involvement/ Investigation	Actual	3.37	3.35	0.30	0.29	0.07	0.82
	Preferred	3.96	3.89	0.29	0.30	0.24	1.52*
Cooperation	Actual	3.59	3.67	0.28	0.26	0.30	1.56*
	Preferred	3.98	4.05	0.36	0.35	0.20	1.33
Equity	Actual	3.61	3.65	0.29	0.27	0.14	1.20
	Preferred	3.99	4.04	0.43	0.44	0.11	1.26
Differentiation	Actual	2.65	2.61	0.33	0.36	0.12	1.10
	Preferred	3.03	3.04	0.29	0.24	0.04	0.62
Personal Relevance	Actual	3.10	3.05	0.25	0.29	0.19	1.14
	Preferred	3.55	3.52	0.33	0.34	0.09	0.81
Responsibility For Own Learning	Actual	3.27	3.33	0.26	0.27	0.23	1.36*
	Preferred	3.76	3.86	0.38	0.37	0.27	1.69
Attitude	Actual	3.58	3.61	0.33	0.34	0.09	0.86
Achievement	Actual	1.65	1.80	1.33	1.12	0.12	1.40

*$p<0.05$

The sample consisted of 50 matched pairs of within-class gender means.

The results reported in Table 6 suggest that male and female perceptions are statistically significantly ($p<0.05$) different for Cooperation and Responsibility for Own Learning. In both cases, females perceive a more positive classroom environment than do males. Generally, however, the results indicate that the magnitudes of the differences between male and female students' perceptions of the actual learning environment are small. The effect size for each actual scale of the OBLEQ (calculated to provide an estimation of the magnitude of the differences) ranged between approximately 0.07 and 0.30 standard deviations for different scales. The magnitudes of the differences between male and female students' perceptions of the preferred learning environment also are small and statistically nonsignificant for all scales except Involvement/Investigation. For this scale, the results indicate that boys would prefer statistically significantly ($p<0.05$) more Involvement/Investigation than girls. The effect size for each preferred scale of the OBLEQ ranged from approximately 0.04 to 0.27 standard deviations for different scales. Overall the results indicate that gender differences in students' actual and preferred perceptions, attitudes towards their science lessons and achievement are small and statistically nonsignificant. These similarities in student scores on the actual and preferred form of the OBLEQ, attitudes and achievement are reflected in Figure 2.

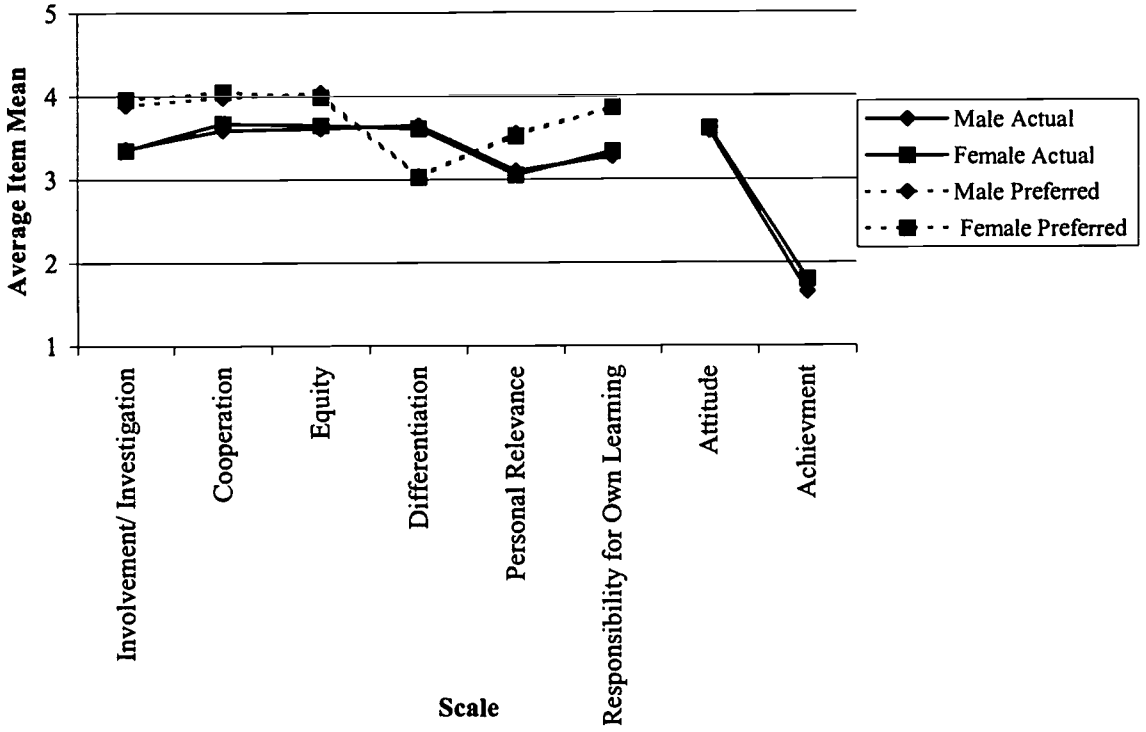

Figure 2. Differences between Male and Female Students' Scores on Actual and Preferred OBLEQ, Attitude and Achievement Scales

DISCUSSION AND CONCLUSIONS

With the exception of earlier isolated work on laboratory learning environments (Adams, 1996, 1997), this study on learning environments is the first major research of its kind in South Africa. It is thus likely to open up new avenues for research in South Africa, as well as to broaden the research base for establishing the success or otherwise of curriculum innovations in the country, in general, and in the Limpopo Province, in particular.

The development of a questionnaire—*Outcomes-Based Learning Environment Questionnaire* (OBLEQ)—to monitor the impact of *Curriculum 2005* on the learning environment of science classrooms is timely. This carefully-designed instrument, developed in this study, captures important aspects of the learning environment associated with outcomes-based education, and it provides teachers and researchers with an accessible means of monitoring changes within science classes.

This exploratory study involved the collection of data from a sample of 2638 learners in 50 classes in 50 schools. The data were analysed to determine the validity and reliability of the OBLEQ, in terms of its factor structure, internal consistency reliability, discriminant validity and ability to differentiate between classrooms. The factor structure for the actual form of the OBLEQ indicated that students respond to the Investigation and Involvement scales in similar ways. Therefore, these two scales were combined to form one scale. For all six scales (Investigation/Involvement, Cooperation, Equity, Differentiation, Personal Relevance and Responsibility for Own Learning), nearly all items have a factor loading of at least 0.30 on their *a priori* scale and no other scale.

The internal consistency reliability estimate (Cronbach alpha coefficient) for each of the six scales for both the actual and preferred forms of the OBLEQ, using both the individual and the class mean as the unit of analysis, was comparable with past studies (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Aldridge, Fraser, Taylor & Chen, 2000; Fraser & Chionh; 2000, Kim, Fisher & Fraser, 1999; Lee & Fraser, 2002). The results of one-way ANOVAs indicate that the actual form of each scale was able to differentiate between the environments of different classes. Overall, the validation provides support for the confident future use of the OBLEQ in high school science classes in South Africa.

Simple correlation and multiple regression analyses were conducted to examine whether associations exist between students' perceptions of the learning environment and the outcomes of student attitudes, equity and student achievement. Simple correlation analyses indicated that there were statistically significantly associations between student attitudes and all six scales of the OBLEQ at the individual level and four scales at the class level. The multiple correlation was statistically significant at both the individual and class mean levels of analysis. Standardised regression coefficients indicate that Cooperation, Equity (at the student level only), Differentiation, Personal Relevance and Responsibility for Own Learning were all significant independent predictors of student attitudes. The associations were positive with all scales except Differentiation. These results suggest that the learning environment created by teachers could have an effect on student attitudes. Therefore, teacher wishing to improve student attitudes should include lessons that allow for more activities that exemplify of each of these five scales.

Bivariate associations between students' perceptions of the learning environment and Equity were positive and statistically significant for all of the scales except Differentiation (for which the correlation was nonsignificant). The multiple correlation between scores on learning environment scales and Equity were statistically significant at both the individual and class mean levels of analysis. At the individual level of analysis, the results indicate that all five of the learning environment scales uniquely accounts for a significant amounts of variance in Equity beyond that attributable to other environment scales. Cooperation, Differentiation and Responsibility for Own Learning were significant independent predictors of Equity at the class level of analysis. Again, all relationships were positive except for Differentiation. The results tentatively suggest that teachers are more likely to have equitable classrooms if they include more Investigation/Involvement, Cooperation, Personal Relevance and Responsibility for Own Learning and less Differentiation.

The results for simple correlations between students' perceptions of the learning environment and their academic achievement indicates that a positive and statistically significant relationship exists for Cooperation, Equity and Personal Relevance at the student level and for Personal Relevance at the class level. The multiple correlation between student achievement and the six learning environment scales was statistically significant at both the individual and class mean levels of analysis. The results indicate that, using the individual as the unit of analysis, five of the six learning environment scales uniquely accounts for variance in student achievement (Investigation/Involvement, Cooperation, Equity, Personal Relevance and Responsibility for Own Learning). Only Personal Relevance was a significant independent predictor of achievement at the class level.

MANOVA for repeated measures and effect sizes were used to investigate differences in scale scores between students' perceptions of the actual learning environment and their preferred learning environment. There was a significant difference for all six learning environment scales, with students preferring a more positive learning environment than the one that they presently perceive on all OBLEQ dimensions. The magnitude of the differences, calculated using effect sizes, range between approximately one standard deviation (1.10) and over two

standard deviations (2.20). These results suggest educationally important differences between students' perceptions of the actual and preferred learning environment. Overall, the finding that students in the Limpopo Province would generally prefer a more favourable learning environment than the one that they perceive replicates findings of past research in Western primary and secondary schools (Fraser, 1998).

To investigate differences between male and female students' perceptions of their learning environment, attitudes and achievement, we used MANOVA for repeated measures and effect sizes, using the within-class gender mean as the unit of analysis. The results indicate that the differences between male and female students are statistically nonsignificant for the actual and preferred versions of the OBLEQ, students' attitudes and achievement.

By critically evaluating the perceptions of learners' actual and preferred outcomes-based classroom learning environments, the results are expected to show the capability, as well as the success, of educators in the Limpopo Province in implementing outcomes-based education in their classrooms. Results from this study could have implications for both professional development programs for teachers and classroom practices in South Africa. The development of a new instrument to measure learners' perceptions of their outcomes-based learning environment thus provides an important new tool for educators, teacher educators and researchers in the Limpopo Province and elsewhere in South Africa. Hopefully, this instrument will prove useful in future efforts at monitoring the learning environment and guiding teachers towards changing their teaching towards a more outcomes-based focus.

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GRADE 8 LEARNERS' QUESTIONNAIRE
LENANEOPOTŠIŠO LA BAITHUTI BA MPHATO WA BO TSHELELA

A. BACKGROUND QUESTIONS
DIPOTŠIŠO TŠA BOITSEBIŠO

Name of your school Leina la sekolo sa gago						
Your name Leina la gago						
You are in class Mphato wa gago ke						
Your age (*Please circle your answer*) Mengwaga ya gago (Dikološetša karabo ya gago)	13	14	15	16	17	18
Are you a girl or a boy? (*Please circle your answer*) O mošemane goba mosetsana? (Dikološetša karabo ya gago)				Girl	Boy	
Are you repeating this grade? (*Please circle your answer*) A o boeletša mphato wo? (Dikološetša karabo ya gago)				Yes Ee	No Aowa	
Based on your performance so far, how confident are you that you will do well in **English** this year? (*Please circle your answer*). Go ya ka moo o šomilego ka gona go fihla ga bjale o na le boitshepo bjo bo kakaang bja gore o tla atlega dithutong tša gago tša **Seisimane** lenyaga? (Dikološetša karabo ya gago)		A lot of confidence Boitshepo bjo bontšhi		Some confidence Boitshepo-nyana	Little or no confidence Go hloka Boitshepo	

B. INSTRUCTIONS
DITAELO

1. This questionnaire contains statements about practices that could take place in this **SCIENCE** class. You will be asked how often each practice takes place. / Lenaneopotšišo le le na le mebolelo yeo e lego mabapi le ditiro tšeo di ka diragalago mphatong wa **SAENSE**. O tla botšišwa gore a tiro ye nngwe le ye nngwe e diragala gakae.
2. There are no 'right' or 'wrong' answers. Your opinion is what is wanted. Your responses will be confidential. / Ga go na le dikarabo tše di 'nepagetšego' goba tše di 'fošagetšego'. Dikarabo tša gago di tla ba sephiri.
3. The 'Actual' column is to be used to describe how often each practice actually takes place in your class. / Karolo ya 'Ruri' e swanetše go šomišetšwa go hlalosa gore a tiro ye nngwe le ye nngwe e diragala gakae mphatong wa gago.
4. The 'Preferred' column is to be used to describe how often you would like each practice to take place (a wish list). / Karolo ya 'Rategago' e swanetše go šomišetšwa go hlalosa gore a ke gakae o ratago ge tiro ye nngwe le ye nngwe e ka diragala (lenaneo la dikganyogo).

*Now please respond to statements in **Section C** starting on the next page. Please circle your responses. / Bjale a nke o ikarabele go mebolelo mo **Karolong C**. Dikološetša dikarabo tša gago.*

Karalo C

	RURI How it is. Ka moo go lego ka gona.					DUMA How I want it. Ka moo ke dumago.				
Involvement **Botšeakarolo**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
1. I discuss ideas in class. Ke ahlaahla dikgopolo ka mphatong.	1	2	3	4	5	1	2	3	4	5
2. I give my opinions during class discussions. Ke fa dikakanyo tša ka ditherišanong tša mphato.	1	2	3	4	5	1	2	3	4	5
3. The teacher asks me questions. Morutiši o mpotšiša dipotšišo.	1	2	3	4	5	1	2	3	4	5
4. My ideas and suggestions are used during classroom discussions. Dikgopolo le ditšhišinyo tša ka di a šomišwa ditherišanong ka phapošing ya go rutela.	1	2	3	4	5	1	2	3	4	5
5. I ask the teacher questions. Ke botšiša morutiši dipotšišo.	1	2	3	4	5	1	2	3	4	5
6. I explain my ideas to other students. Ke hlalosetša baithuti ba bangwe dikgopolo tša ka.	1	2	3	4	5	1	2	3	4	5
7. Students discuss with me how to go about solving problems. Baithuti ba rerišana le nna gore mathata a ka rarollwa bjang.	1	2	3	4	5	1	2	3	4	5
8. I am asked to explain how I solve problems. Ke kgopelwa go hlalosa gore mathata ke a rarolla bjang.	1	2	3	4	5	1	2	3	4	5
Investigation **Nyakišišo**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
9. I carry out investigations to test my ideas. Ke dira dinyakišišo go leka dikgopolo tša ka.	1	2	3	4	5	1	2	3	4	5
10. I am asked to think about the supporting facts for statements. Ke kgopelwa go nagana ka bohlatse bja mebolelo.	1	2	3	4	5	1	2	3	4	5
11. I carry out investigations to answer questions coming from discussions. Ke dira dinyakišišo go araba dipotšišo tše di tšwago ditherišanong.	1	2	3	4	5	1	2	3	4	5
12. I explain the meaning of statements, diagrams and graphs. Ke hlalosa gore mebolelo, dithalwa le dikerafo di ra eng.	1	2	3	4	5	1	2	3	4	5

Please continue on page 3. / Ka kgopelo, tšwela pele go letlakala la bone.

Continued from page 2
Tšweletšopele ya letlakala la boraro.

	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
13. I carry out investigations to answer questions that puzzle me. Ke dira dinyakišišo go araba dipotšišo tšeo di nkgakantšhago.	1	2	3	4	5	1	2	3	4	5
14. I carry out investigations to answer the teacher's questions. Ke dira dinyakišišo go araba dipotšišo tša morutiši.	1	2	3	4	5	1	2	3	4	5
15. I find out answers to questions by doing investigations. Ke hwetša dikarabo tša dipotšišo ka go dira dinyakišišo.	1	2	3	4	5	1	2	3	4	5
16. I solve problems by using information obtained from my own investigations. Ke rarolla mathata ka go šomiša tsebo yeo ke e hwetšago dinyakišišong tša ka.	1	2	3	4	5	1	2	3	4	5
Cooperation **Tšhomišano**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
17. I cooperate with other students when doing assignment work. Ke šomišana le baithuti ba bangwe ge re dira mešomo.	1	2	3	4	5	1	2	3	4	5
18. I share my books and resources with other students when doing assignments. Ke abelana dipuku le dišomišwa tše dingwe tša ka le baithuti ba bangwe ge re dira mošomo.	1	2	3	4	5	1	2	3	4	5
19. When I work in groups in this class, there is teamwork. Ge ke šoma ka dihlophana mphatong wo, go ba le tšhomišano..	1	2	3	4	5	1	2	3	4	5
20. I work with other students on projects in this class. Ke šoma le baithuti ba bangwe go dira diprotšeke mphatong wo.	1	2	3	4	5	1	2	3	4	5

Please continue on page 4. / Ka kgopelo, tšwela pele go letlakala la bone.

Continued from page 3
Tšweletšopele ya letlakala la boraro

	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
21. I learn from other students in this class. Ke ithuta ka baithuti ba bangwe mphatong wo.	1	2	3	4	5	1	2	3	4	5
22. I work with other students in this class. Ke šoma le baithuti ba bangwe mphatong wo.	1	2	3	4	5	1	2	3	4	5
23. I cooperate with other students on class activities. Ke šomišana le baithuti ba bangwe medirwaneng ya mphato.	1	2	3	4	5	1	2	3	4	5
24. Students work with me to achieve class goals. Baithuti ba šoma le nna go fihlelela dinepo tša mphato.	1	2	3	4	5	1	2	3	4	5
Equity Tekalekanyo	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
25. The teacher gives as much attention to my questions as to other students' questions. Morutiši o hlokomela dipotšišo tša ka go no swana le ka fao a hlokomelago tša baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
26. I get the same amount of help from the teacher as do other students. Ke hwetša sebaka sa thušo go morutiši go swana le ka fao baithuti ba bangwe ba se hwetšago ka gona.	1	2	3	4	5	1	2	3	4	5
27. I have the same amount of say in this class as other students. Ke na le tekano ya go bolela mphatong ya go lekana le ya baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
28. I am treated the same as other students in this class. Ke swarwa go no swana le baithuti ba bangwe mphatong wo.	1	2	3	4	5	1	2	3	4	5

Please continue on page 5. / Ka kgopelo, tšwela pele go letlakala la botlhano

Continued from page 4
Tšweletšopele ya letlakala la bone

	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
29. I receive the same encouragement from the teacher as other students do. Ke hwetša tlhohleletšo ya morutiši ya go no swana le yeo baithuti ba bangwe ba e hwetšago go yena.	1	2	3	4	5	1	2	3	4	5
30. I get the same opportunity to contribute to class discussions as other students. Ke hwetša sebaka sa go swana le sa baithuti ba bangwe sa go lahlela la ka ditherišanong tša mphato.	1	2	3	4	5	1	2	3	4	5
31. My work receives as much praise as other students' work. Mošomo wa ka o retwa go no swana le wa baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
32. I get the same opportunity to answer questions as other students. Ke hwetša sebaka sa go swana le sa baithuti ba bangwe sa go araba dipotšišo.	1	2	3	4	5	1	2	3	4	5
Differentiation **Pharologanyo**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
33. I work at my own speed. Ke šoma ka lebelo la ka.	1	2	3	4	5	1	2	3	4	5
34. Students who work faster than me move on to the next topic. Baithuti bao ba šomago ka lebelo go mpheta ba fetela go hlogotaba ye e latelago.	1	2	3	4	5	1	2	3	4	5
35. I am given a choice of topics. Ke fiwa boikgethelo medirong.	1	2	3	4	5	1	2	3	4	5
36. I am set tasks that are different from other students' tasks. Ke fiwa mediro yeo e fapanago le ya baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5

Please continue on page 6. / Ka kgopelo, tšwela pele go letlakala la botshelela

Continued from page 5
Tšweletšopele ya letlakala la bohlano

	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
37. I am given work that matches my ability. Ke fiwa mošomo wo o swanetšanago le bokgoni bja ka.	1	2	3	4	5	1	2	3	4	5
38. I use different materials from those used by other students. Ke šomiša ditlabela tšeo di fapanago le tšeo di dirišwago ke baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
39. I use different assessment methods from other students. Ke fiwa medirokelo ye e fapanago le ya baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
40. I do work that is different from other students' work. Ke dira mošomo wo o fapanago le wa baithuti ba bangwe.	1	2	3	4	5	1	2	3	4	5
Attitude to Science **Maikutlo mabapi le thutamahlale/saense**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
41. I look forward to lessons in science. Ke hlologela dithutwana tša saense.	1	2	3	4	5	1	2	3	4	5
42. Lessons in science are fun. Dithutwana tša saense ke boipshino.	1	2	3	4	5	1	2	3	4	5
43. I dislike lessons in science. Ga ke rate dithutwana tša saense.	1	2	3	4	5	1	2	3	4	5
44. Lessons in science bore me. Dithutwana tša saense di a nngena.	1	2	3	4	5	1	2	3	4	5
45. Science is one of the most interesting school subjects. Thuto ya saense ke ye nnge ya dithuto tša sekolo tša go kgahliša kudukudu.	1	2	3	4	5	1	2	3	4	5
46. I enjoy lessons in science. Ke ipshina ka dithutwana tša saense.	1	2	3	4	5	1	2	3	4	5
47. Lessons in science are a waste of time. Dithutwana tša saense ke go senya nako fela.	1	2	3	4	5	1	2	3	4	5
48. These lessons make me interested in science. Dithutwana tše tša saense di dira gore ke e rate thutwana ye.	1	2	3	4	5	1	2	3	4	5

Please continue on page 7. / Ka kgopelo, tšwela pele go letlakala la bošupa.

Continued from page 6
Tšweletšopele ya letlakala la botshelela.

Personal relevance **Go holega**	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
49. I learn about the world outside of school. Ke ithuta ka lefase la ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
50. My new learning starts with problems about the world outside of school. Thutompsha ya ka e thoma ka mabapi le lefase la ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
51. I learn how science can be part of my out-of-school life. Ke ithuta ka fao saense e ka bago seripa sa bophelo bja ka ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
52. I get better understanding of the world outside of school. Ke ba le kwešišo ye kaone ya lefase la ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
53. I learn interesting things about the world outside of school. Ke ithuta ka dilo tše di kgahlišago tša lefase la ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
54. What I learn has nothing to do with my out-of-school life. Se ke ithutago sona ga se nyallane le bophelo bja ka bja ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
55. What I learn I can use in my out-of-school life. Se ke ithutago sona nka se šomiša bophelong bja ka bja ka ntle ga sekolo.	1	2	3	4	5	1	2	3	4	5
56. What I learn I can link to what I already know. Se ke ithutago sona nka se amanya le seo ke šetšego ke se tseba.	1	2	3	4	5	1	2	3	4	5

Please continue on page 8. / Ka kgopelo, tšwela pele go letlakala la boseswai.

Continued from page 7
Tšweletšopele ya letlakala la bošupa

	ACTUAL RURI How it is. Ka moo go lego ka gona.					PREFERRED DUMA How I want it. Ka moo ke dumago.				
Responsibility for own learning **Boikarabelo godimo ga go ithuta ga ka**	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla	Never Le ga tee	Seldom Ga se gantši	Some times Nako e ngwe	Often Gantši	Always Ka mehla
57. The teacher encourages me to plan what I'm going to learn. Morutiši o ntlhohleletša go beakanya seo ke yago go ithuta sona.	1	2	3	4	5	1	2	3	4	5
58. The teacher encourages me to decide how well I am learning. Morutiši o ntlhohleletša go tšea sephetho godimo ga gore ke ithuta gabotse bjang.	1	2	3	4	5	1	2	3	4	5
59. The teacher encourages me to decide which activities are best for me. Morutiši o ntlhohleletša go tšea sephetho godimo ga medirwana ye e lego ye mekaone go nna.	1	2	3	4	5	1	2	3	4	5
60. The teacher encourages me to decide how much time I spend on learning activities. Morutiši o ntlhohleletša go tšea sephetho godimo ga botelele bja nako yeo ke e šomišago medirwaneng ya go ithuta.	1	2	3	4	5	1	2	3	4	5
61. The teacher encourages me to decide which activities I do. Morutiši o ntlhohleletša go tšea sephetho godimo ga gore ke medirwana efe ye ke e dirago.	1	2	3	4	5	1	2	3	4	5
62. The teacher encourages me to assess my learning. Morutiši o ntlhohleletša go ikalela go ithuta ga ka.	1	2	3	4	5	1	2	3	4	5
63. The teacher encourages me to decide the pace at which I learn best. Morutiši o ntlhohleletša go tšea sephetho godimo ga lebelo leo ke ithutang ka lona gabotsebotse.	1	2	3	4	5	1	2	3	4	5
64. The teacher encourages me to think about areas in my learning that I need to improve upon. Morutiši o ntlhohleletša go nagana ka mafelo go ithuteng ga ka ao ke swanetšego go dira kaonafatšo go ona.	1	2	3	4	5	1	2	3	4	5

Now please complete* Section D *on the next page.
Bjalo, ka kgopelo, fetela go* Karolo D *letlakaleng le le latelago.

Achievement Test

Please read the text below and answer the questions that follow.

Candles in the market

Tebogo's granny was complaining about how many different kinds of candles there were to buy in the market. She was not sure whether to buy thin candles or thick candles. Tebogo set up a simple experiment to help her decide. He used four candles that were the same in everything except thickness. He lit the four candles together and then let them burn for ten minutes. Then he blew out each flame and measured the length of the candles.

He recorded the results in a table.

Candle	Thickness (cm)	Length at the beginning (cm)	Length after 10 minutes (cm)
1	2	15.0	10.0
2	4	15.0	12.0
3	6	15.0	14.0
4	8	15.0	14.5

Now please answer the following 5 questions:

1. What problem was Tebogo trying to solve?

2. What variable did he change on purpose?

3. What variables did he control?

4. Was it a fair test? *Give a reason for your answer.*

5. Draw a labelled bar graph of the results (recorded in the table on page 9) on the graph paper provided.

Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL, April 2003

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