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**Development and Validation of an Instrument to Monitor  
the Implementation of Outcomes-Based Learning  
Environments in Science Classrooms in South Africa**

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This article describes the development and validation of an instrument that can be used to assess students' perceptions of their learning environment as a means of monitoring and guiding changes towards outcomes-based education. In the first phase, data collected from 2638 Grade 8 science students from 50 classes in 50 schools in the Limpopo Province of South Africa were analysed to provide evidence about the reliability and validity of the new instrument. In the second phase, two case studies were used to investigate whether profiles of class mean scores on the new instrument could provide an accurate and 'trustworthy' description of the learning environment of individual science classes. The study makes significant contributions to the field of learning environments in that it is one of the first major studies of its kind in South Africa and because the instrument developed captures important aspects of the learning environment associated with outcomes-based education.

### **Introduction**

In a bid to ensure a more inclusive education, outcomes-based education is currently being adopted by schools and post-school education and training systems in a number of countries around the world, including the United Kingdom (e.g., Faris, 1998), New Zealand (Bell, Jones, & Carr, 1995; Ministry of Education, 1993), Australia (Andrich, 2002) and South Africa (Botha, 2002) and, to some extent, the United States (also known as standards-based education) (e.g., Evans & King, 1994). 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 initial curriculum reforms have been implemented in all primary grades, with the first implementation in the secondary phase having taken place in Grade 8 in 2001. A revised version of C2005 (see, for example, Department of Education [2002]), established as a result of its review by Chisholm et al. (2000), will have been implemented across all junior secondary grades by 2008.

This study was carried out in the Limpopo Province (formerly known as the Northern Transvaal and later the Northern Province), one of nine provinces established after the 1994 democratic elections in South Africa (Krige, Dove, Makalima, & Scott, 1994). These provinces vary in regard to their populations' demographic profile. Excluding Gauteng, which is centred around Johannesburg, the three most populous provinces (i.e., KwaZulu-Natal, the Eastern Cape, and the Limpopo Province) are also the provinces in which 71% of South Africa's rural population is found (Statistics South Africa, 2003a [Table 3.1-1]). These three provinces together contain 77% of the country's rural school population (using the weighted data of the 1999 *October Household Survey* [1999 October Household Survey, 2000]) and 54% of South Africa's total Grade 8 to 12 school population (Department of Education, 2003). Given the three provinces' ruralness and similarity in other aspects (e.g., the high percentage of households using wood for cooking and having no toilet facilities, and the low proportion of households with access to piped water [Statistics South Africa, 2003b]), it is not unreasonable to assume that the vast majority of secondary schools in

these provinces are similar in character. In the Limpopo 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 develop an instrument that could be used to monitor the transformation of classrooms towards the new education goals of South Africa. To assist teachers, teacher educators and researchers to monitor and guide changes towards outcome-based classroom learning environments, we developed and validated an instrument that can be used to assess students' perceptions of their learning environments.

### **Background**

During the last three decades, the influence of the learning environment on the process of education has received a great deal of attention from educational researchers (Fraser, 1994, 1998, 2002; Goh & Khine, 2002). Several sources of data have been used in conducting research in the field of learning environments, including students' perceptions, observations and interviews, and ethnographic and interpretative case studies.

A hallmark of the field of learning environments has been the development of a variety of convenient questionnaires that have been carefully validated and widely used. Historically-important questionnaires include the *Classroom Environment Scale* (CES, Moos, 1979) and the *Learning Environment Inventory* (LEI, Walberg, 1979) to assess the environment in high school settings. These instruments were followed by

the development of other important questionnaires including the *My Class Inventory* (MCI, Fisher & Fraser, 1981), a simplified version of the LEI for students at the primary school level and the *Questionnaire on Teacher Interaction* (QTI; Wubbels & Levy, 1991), for assessment of students' perceptions of their teacher's interpersonal behaviour. More recently, contemporary questionnaires have been developed to assess specific learning environment, such as the *Constructivist Learning Environment Survey* (CLES; Taylor, Fraser & Fisher, 1997), for measuring the extent to which constructivist approaches are being adopted, and the *Science Laboratory Environment Inventory* (SLEI; Fraser, Giddings & McRobbie, 1995), for assessing dimensions that relate specifically to the learning environment of science laboratory classes.

The development of a new instrument for the present study drew heavily on the *What Is Happening In this Class?* (WIHIC) questionnaire. Past studies that have made use of the WIHIC, therefore, are of particular interest to this study. The WIHIC has been used to assess students' perceptions of the learning environment in a number of different subject areas, at a range of grade levels and in nine countries. In each case, the WIHIC has been used successfully and shown to be robust in terms of its reliability and validity. The WIHIC has been used in Singapore (Chionh & Fraser, 1998; Fraser & Chionh, 2000), Australia and Taiwan (Aldridge & Fraser, 2000; Aldridge, Fraser, & Huang, 1999; Yang, Huang & Aldridge, 2002), Brunei (Khine & Fisher, 2001; Riah & Fraser, 1998), Canada (Raaflaub & Fraser, 2002; Zandvliet & Fraser, 2004), Australia (Dorman, 2001), Indonesia (Adolphe, Fraser & Aldridge, 2003; Margianti, Fraser, & Aldridge, 2002), Korea (Kim, Fisher & Fraser, 2000), the United States (Allen & Fraser, 2002; Martin-Dunlop & Fraser, 2004; Moss & Fraser, 2001; Pickett & Fraser, 2004) and Canada, Britain and the US (Dorman, 2003). Within these countries, the WIHIC has been used to assess a range of subjects including

primary school science (Pickett & Fraser, 2004), high school science (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Moss & Fraser, 2001; Riah & Fraser, 1998), mathematics (Margianti, Fraser & Aldridge, 2001; Soerjaningsih, Fraser & Aldridge, 2001), mathematics and science (Raaflaub & Fraser, 2002) and mathematics and geography (Chionh & Fraser, 1998; Fraser & Chionh, 2000).

In 2003, Dorman (2003) used confirmatory factor analysis with a sample of 3980 high school students from Australia, Britain and Canada to support the seven-scale *a priori* structure of the WIHIC. In this study, all items loaded strongly on their *a priori* scale, although model fit indices revealed a degree of scale overlap. Overall, the study strongly supported the international applicability of the WIHIC as a valid measure of the classroom environment.

These studies using the WIHIC replicated past research by reporting associations between the learning environment and students' outcomes, and they provided suggestions to teachers 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. Studies that used both forms consistently 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). The present study involved the use of a preferred form of a questionnaire, to allow teachers and researchers to examine students' perceptions of their ideal learning environment, as well as an actual form.

Our study drew on valid, economical and widely-applicable assessment instruments available in the field of learning environments, but it also extended past research by modifying existing scales to make them more suitable for assessing outcomes-based classroom environments and by validating the new instrument for use in South Africa.

### **Research Methods**

Data collection for the present study involved different sources and kinds of information (as recommended by Erickson [1998] and Tobin and Fraser [1998]), including survey data, observations of science classrooms, field notes, interview comments and tape recordings of interviews. The collection and analysis of the data were integrally linked, each informing the other during a recursive process. Quantitative survey data were collected in order to establish to what extent important elements of outcomes-based education were incorporated in science classrooms in the Limpopo Province (i.e., class profiles), whereas qualitative data were used to establish whether survey-based class profiles could provide an accurate and 'trustworthy' (Creswell, 2001) description of the learning environment of individual classes.

### *Sample*

The sample for the quantitative data collection included 2638 Grade 8 science students from 50 classes in 50 schools in the Limpopo Province, South Africa. Of the 50 schools, 37 were rural schools, nine were township schools and four were urban schools. These schools can be considered a representative sample for this province and were selected to represent the range of schools located in this part of South Africa.

The sample for the qualitative data collection included two science classes at different schools, whose selection was based on the profiles of classroom environment means generated through the large-scale quantitative data collection and the schools' location. One class was situated in a suburban school, and the other in a rural school.

### *Development of Classroom Environment Instrument*

A major contribution of our study was the development and validation of a widely-applicable and distinctive questionnaire for assessing students' 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. *Curriculum 2005* and national and international literature on outcomes-based education (OBE) were examined in order to identify dimensions central to the educational philosophy of OBE.



2. Interviews with science curriculum advisors and with Grade 8 science teachers were conducted to ensure that the scales were considered salient to the actual school context (Fraser, 1994).
3. Scales were selected to ensure that the dimensions are consistent with Moos' (1979) scheme for classifying the dimensions of any human environment: Relationship dimensions (which measure the degree of people's involvement in the environment and the assistance given to each other); Personal Development dimensions (which measure the kind and strength of the personal relationships in the environment); and 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 questionnaires such as the *What Is Happening In this Class?* (WIHIC) questionnaire (Aldridge & Fraser, 2000), *Constructivist Learning Environment Survey* (Aldridge, Fraser, Taylor, & Chen, 2000; Taylor, Fraser & Fisher, 1997) and *Individualized Classroom Environment Questionnaire* (Fraser, 1990).
5. A parallel preferred form was developed to accompany the actual form to assess students' perceptions of the environment that they would prefer.
6. As English is the second language for the majority of students in the Limpopo Province, the items and instructions were translated into Sepedi (or North Sotho), the local vernacular.

7. Finally, the instrument was field-tested with four classes of Grade 8 science students in four schools in South Africa, with subsamples of students subsequently being 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, as well as a newly-developed scale entitled Responsibility for Own Learning. The OBLEQ assesses:

- Involvement (the extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class)
- Investigation (the extent to which emphasis is placed on the skills and processes of inquiry and their use in problem solving and investigation)
- Cooperation (the extent to which students cooperate rather than compete with one another on learning tasks)
- Equity (the extent to which students are treated equally and fairly by the teacher)
- Differentiation (the extent to which teachers cater for students differently on the basis of ability, rates of learning and interests)
- Personal Relevance (the extent to which teachers relate science to students' out-of-school experiences)

- Responsibility for Own Learning (the extent to which students perceive themselves as being in charge of their learning process, motivated by constant feedback and affirmation).

Table 1 provides a description of each OBLEQ scale and its relevance to outcomes-based education according to *Curriculum 2005* (Department of Education, 1997a). The items in the OBLEQ are listed in the Appendix.

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Insert Table 1 about here

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Both the English and Sepedi version of each item was included on the same questionnaire. Although English is the medium for education in the Limpopo Province, it is in fact the second language—after their home language—for the majority of students. In line with its policy of additive multilingualism (see, for example, Plüddemann, 1997), the South African Department of Education requires all students to learn their home language and to demonstrate competence in this language with respect to listening, speaking, reading, viewing, and writing as part of the outcomes for the languages up to grade 9 (Department of Education, 2002). In general, Grade 8 Sepedi-speaking students are thus able to read and write this language. To assist students to complete the OBLEQ accurately, it was therefore considered desirable to provide students with both the English and a Sepedi equivalent for each item. The OBLEQ was translated into Sepedi 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 Sepedi in translating the questionnaire. Next, a language expert from a local university in the Limpopo Province fluent in English and Sepedi then back-translated the items into

English. The two English versions were then compared for accuracy. During this process, that was repeated a number of times, changes were made to the Sepedi version to ensure an accurate translation of the original OBLEQ. Beneath each English item in the OBLEQ, the Sepedi translation is given in italics as illustrated below:

I discuss ideas in class.

*Ke ahlaahla dikgopolo ka mphetong.*

This arrangement is provided also for the instructions and response scale (Figure 1).

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Insert Figure 1 about here

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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 in the questionnaire 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 (Figure 1).

The actual and preferred response scales of the OBLEQ items were placed side-by-side on a single form of the questionnaire to provide a more economical format. Using this format, students are required to record what they perceive as actually happening in their class in the actual column and to record what they would prefer to happen in their class in the preferred column (Figure 1).

### *Case Studies*

The present research also involved a qualitative case study approach (Merriam, 1988; Wolcott, 1988). Validity of the qualitative data was guided by Guba and Lincoln's (1989) criteria of: *prolonged engagement* (the amount of time spent building up a rapport and trust with participants in order to understand the context more fully); *persistent observation* (the duration and number of observations, which should be sufficient to enable the researcher to identify crucial characteristics of the case); *negative case analyses* (accounting for all cases, including counterexamples, to check whether an assertion is true); *progressive subjectivity* (checking on developing constructions and individual subjectivity at regular intervals); and *member checks* (sharing of ideas and emerging hypotheses with participants to establish credibility and to ensure that a realistic picture is presented).

Data collection relied heavily on four observations per class over a period of three weeks, as well as one in-depth focus-group interview with six randomly-selected students per class (three boys and girls) and one in-depth semi-structured interview with the teacher. Student interviews were used to provide a sense of what was happening in the class and why students responded to items in the way in which they did. Discussions with each of the teachers, both formal and informal, were often based on the problems and successes experienced by the teachers as they implemented outcomes-based teaching strategies in their classes. All interviews were tape recorded and transcribed for analysis. During observations, the researcher took on the role of

‘peripheral-member-researcher’, by attempting to gain an insider’s perspective without being involved in activities (Adler & Adler, 1987).

## **Findings**

### *Validity and Reliability of the OBLEQ*

A major objective of our study was to develop and validate a questionnaire for monitoring outcomes-based classroom learning environments in South Africa. The data collected from 2638 students in 50 schools were used to examine the reliability and validity of the actual and preferred versions of the Outcomes-Based Learning Environment Questionnaire (OBLEQ).

Because the factors in the set of learning environment scales are expected to be correlated, principal axis factoring followed by oblique (direct oblimin) rotation was conducted (Coakes & Steede, 2000) for the data for the actual and preferred forms of the OBLEQ (reported in Table 2). Factor loadings of less than 0.30 (a decision based upon conventional researcher agreement [Grimm & Yarnold, 1995]) were omitted. 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. Also, during factor analysis, the Investigation and Involvement scales came together, suggesting that this sample of students regarded Involvement and Investigation in similar ways. For these scales, Items 1, 3, 11, 13, 14, 15 and 16 were considered problematic. 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 from the actual version and Item 35 from the preferred

version (from the Differentiation scale) that did not have a loading of at least 0.30 on their own or any other scale. Table 2 reports the factor loadings for all items in the actual and preferred forms of the refined version of the OBLEQ.

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Insert Table 2 about here

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Table 2 also reports the percentage of variance and the eigenvalue for each scale. For the actual form, the percentage of variance varies from 3.13% to 13.66% for different scales, with the total variance accounted for being 35.70%. The value of the eigenvalue varies from 1.38 to 6.01 for the different scales. For the preferred form, the percentage of variance ranges from 2.81% to 20.71% for different scales, with the total variance accounted for being 41.90. The value of the eigenvalue varies from 1.24 to 9.11 for different scales. Overall the pattern of factor loadings, for both the actual and preferred versions in Table 2, provides good support for the *a priori* structure of the OBLEQ (albeit with the original Involvement and Investigation scales coming together to form one scale).

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 the internal consistency of each actual and preferred scale. A convenient discriminant validity index (namely, the mean correlation of a scale with the other five scales) was used as evidence that raw scores on each scale in the actual and preferred versions of the OBLEQ measure a separate dimension that is distinct from the other scales within the questionnaire. Analysis of variance (ANOVA) results were used to provide information about the ability of the

actual form of each scale to differentiate between the perceptions of students in different classrooms.

Table 3 shows that the internal consistency reliability (Cronbach alpha coefficient) for the actual version of OBLEQ scales 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 suggest that the internal consistency for both the actual and preferred versions of the OBLEQ is satisfactory.

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Insert Table 3 about here

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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 version of 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. The  $\eta^2$  statistic (a measure of the proportion of variance accounted for by class membership) for the actual version of the OBLEQ ranges from 0.08 to 0.13 for different scales.

Overall, results suggest that the actual and preferred versions of the Outcomes-Based Learning Environment Questionnaire (OBLEQ) are valid and reliable for use in high school science classes in South Africa. Therefore teachers and researchers can use the OBLEQ with confidence in the future.

#### *Using the OBLEQ to Describe Typical Science Classrooms in the Limpopo Province*

The data collected using the OBLEQ were also used in describing typical science classroom environments. The learning environment of science classes was depicted using descriptive statistics based on students' responses to the questionnaire. Because the number of items in each scale varied from six to sixteen, 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 4 reports the average item means, using the class as the unit of analysis, for the actual and preferred version of each of the learning environment scales of Involvement/Investigation, Cooperation, Equity, Differentiation, Personal Relevance and Responsibility for Own Learning.

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Insert Table 4 about here

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With the class mean as the unit of analysis, average item mean for students' perceptions of the actual learning environment ranges from 2.62 to 3.63 for different scales. The average item mean for the learning environment that students would prefer ranges from 3.04 to 4.01 for different scales. Figure 1 also shows that the level of each OBLEQ dimension perceived to be actually present is considerably lower for every scale than students' preferred level.

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Insert Figure 2 about here

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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 actual-preferred 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 4 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 actual and preferred scores expressed in standard deviation units) were calculated as recommended by Thompson (1998, 2001).

The results reported in Table 4 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 sizes for different OBLEQ scales reported in Table 4 range 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

many 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 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 unusually large differences between students’ actual and preferred perceptions.

#### *Using the OBLEQ for Describing the Learning Environment of Individual Classes*

Close inspection was made of the individual profiles of the learning environment scores for each of the 50 different classes surveyed. In many ways, the trends were similar. However, close inspection of the profiles showed that, for some classes, the discrepancies between students’ perceptions of the actual learning environment and their preferred learning environment were unusually large or small. To investigate whether the profiles generated for the individual classes were a valid and ‘trustworthy’ reflection of what was happening, two classes were selected for observations. Virtually none of the classes uniformly had either good or poor correspondence between actual and preferred scores on all dimensions. Therefore classes were selected based on the context in which they were situated. One class is in a suburban school and the other is in a rural school.

#### Class A

The first case study class was situated in a combined primary and secondary school. The school was selected because of its participation as a focus school in South Africa’s National Strategy for Mathematics, Science and Technology Education

(Department of Education, 2001, 2004). The aim of this strategy is to increase the participation of previously-disadvantaged students in mathematics and science. This school is thus well-resourced in terms of its infrastructure (availability of electricity, water, and laboratories), textbooks and teaching aids. With an enrolment of 622 and 481 students in the primary and secondary phases, respectively, this comparatively large school is staffed by well-qualified teachers, and the school governing body is able to supplement the supply of the 23 teachers funded by the provincial education department with another 13 teachers through the payment of comparatively sizeable school fees (i.e., 1000 rands per year) by the parents. The school is fenced, and caters mainly for Indian students, with African students constituting about 45% of the total student population of the school.

The Grade 8 science teacher of this class completed her initial teacher education overseas, and had been a teacher in Europe for about a decade before joining the school four years prior to this study. She indicated that outcomes-based teaching methodology was not foreign to her, as she had been practising it in her teaching back in Europe. With having to teach 12 30-minute lessons of science out of 18 lessons per week, this teacher did not have a particularly heavy teaching load.

The average item mean for students' actual and preferred scores for each OBLEQ scale for Class A is given in Figure 2. A striking feature of the learning environment profile of this class is the large disparity between actual and preferred scores for Equity and, to a lesser degree, Cooperation and Personal Relevance. The large student-perceived actual-preferred disparity on Equity surprised the teacher. From classroom observations, however, it became apparent that students compete to answer the teacher's questions, and that she would select the ones whom she thought knew the

answer. She confirmed this rationale by reflecting that “maybe it is because I always point at those students who are confident of the answers that some might be seeing that as not being given equal opportunity to attempt answers”.

Unlike students in classes observed at other schools, students in Class A sat in traditional rows at tables facing the teacher and chalkboard ‘in front’. Observations revealed that cooperative work (e.g., group work) took place very seldom, if at all. The teacher’s rationale for this lack of cooperation and group work among students was an organisational one: “Considering the available time at my disposal [30 minutes per lesson], I feel that I won’t be able to do justice to group work. Hence I decided to leave [the students] seated as they are. ... The length of my period is short and I think that, if students are to sit in groups, this is going to waste much of my time. ... Maybe, if the period length is changed, I will consider forming permanent groups.” However, it seemed to have escaped the teacher’s notice that four of the six periods taught by her in Grade 8 science were in fact arranged as *double* periods.

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Insert Figure 3 about here

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The disparity between the actual and preferred mean score on the Personal Relevance dimension was comparatively small (Figure 2), and observations revealed the teacher attempted to provide relevance for concepts taught. Indeed, the teacher recognised the importance of providing such relevance (“I always make sure that I search for relevance for any activity in which the students are to be engaged”), but also felt that such relevance might not always be easily provided for all concepts due to the abstract nature of some of them (“I must however acknowledge that ... [providing relevance] ... is not always easy because some concepts are on an abstract level”).

## Class B

The school involved in the second case study was located in a rural area, 25 kilometres from the provincial capital. Except for its proximity to the capital, it can be considered a fairly typical rural school. It has a comparatively small enrolment of 468 students, a small staff complement of six teachers, and a class size of almost 50 students at the Grade 8 level. The school is poorly resourced, and has to use one of the eight classrooms at the school for a combined staffroom, office, storeroom and duplicating room. Staff and student toilets are pit-latrines, and the school has no electricity, no running water, no laboratories, and not enough textbooks to ensure that each student has one per subject. Students in this class are sitting on chairs but not at desks, and so they write on their laps. The school has no perimeter fence, and consequently suffers from periodic vandalism and theft. Night security staff are unaffordable to the school, as school fees paid by parents are very low indeed (i.e., 100 rands per year). African students from the surrounding villages constitute 100% of the total student population of the school.

The Grade 8 science teacher was locally certified, has 24 years of teaching experience, and teaches science in Grade 8 and 9, as well as mathematics and science in Grade 11 and 12 at the school. His stated familiarity with OBE is limited to attending two three-hour OBE workshops conducted by district curriculum advisors of the provincial education department. With having to teach about 50 30-minute lessons per week, this teacher must be regarded as having a comparatively high teaching load.

The average item means for students' actual and preferred scores on the OBLEQ scales for Class B are graphed in Figure 3. The discussion below focuses on the

dimensions of Investigation/Involvement, Differentiation, Personal Relevance, and Responsibility for Own Learning, with each one being discussed in turn. The large actual-preferred discrepancy in the Investigation/Involvement dimension surprised the teacher, and dispelled his preconceived idea with respect to "... rarely involving ... [students] ... in investigations because ... they do not like searching for information".

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Insert Figure 4 about here

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The small actual-preferred discrepancy on the Differentiation dimension was in part probably a result of the teacher's conscious classroom behaviour which was based on his conviction that "... students do not like to be treated differently from others in the same class". Students confirmed this view by claiming that "if [students] are given different activities, some might be regarded as [the] teacher's pet". Furthermore, the teacher had logistical reasons for treating all his students in the same way. "I have a big group of about 48 students in my class and thus it is most difficult if not impossible to cater for student differences on the basis of their abilities. I therefore give the same activities to all students in my class." In addition, the teacher felt that treating students differently on the basis of ability, rates of learning, and interests would not be possible because "...[such] activities are textbook bound ... [and] ... I cannot afford to make copies for all the students particularly as that will be done out of my pocket" (i.e., he would have to pay for the duplication himself).

The teacher attempts to make classroom activities relevant to students' everyday life experiences, and student accounts confirmed this. In fact, the students related the example of milky water sometimes coming out of their taps at home to the importance

of water purification, which was broached by the teacher during the lessons on the separation of mixtures.

The comparatively large actual-preferred discrepancy on the Responsibility for Own Learning dimension was in part likely to be a result of the teacher's perception of the students' attitude towards teachers: "I sometimes give students the responsibility of being in charge of their learning process, but I found out that they are not always keen mainly because they are in Grade 8 and still believe in the teacher 'dishing' out the subject matter." This view was confirmed by the students who indicated that they liked "... the teacher to be in charge of the learning process". The teacher, however, also believed that logistical reasons accounted for not giving students a greater opportunity for being responsible for their own learning, as he felt that "... for them to be in charge of their learning progress, they need to have the learning materials, which they don't because they are sharing textbooks".

### **Discussion and Conclusions**

With the exception of earlier isolated work on learning environments (Adams, 1996, 1997; Sebela, Aldridge & Fraser, 2004), this study of learning environments is the first published research of its kind in South Africa (Fisher & Fraser, 2003). 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 this country, in general, and in the Limpopo Province, in particular.

Because outcomes-based education is currently being implemented in a number of countries around the world, including Australia (Andrich, 2002; Brindley, 2001), New



Zealand (Bell, Jones, & Carr, 1995; Ministry of Education, 1993) and South Africa (Cross, Mungadi, & Rouhani, 2002; Jansen, 1998; Muller, 1998), the development of a questionnaire (Outcomes-Based Learning Environment Questionnaire, OBLEQ) to monitor the impact of outcomes-based education 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 provides teachers and researchers with a convenient means of monitoring changes within science classes.

This study involved the collection of data from a large sample of 2638 students in 50 classes in 50 schools in the Limpopo Province. 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 and preferred forms of the OBLEQ suggested 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 for both the actual and preferred forms.

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 that used other instruments on which some OBLEQ scales were based (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 perceptions of students in different classes. Overall, the validation provides support for the confident future use of the OBLEQ in under-privileged high school science classes in South Africa.

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 magnitudes of the differences, calculated using effect sizes, range between approximately one standard deviation (1.10) and over two standard deviations (2.20) for different OBLEQ scales. 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 past research in Western primary and secondary schools (Fraser, 1998).

Case studies of two quite different classrooms, using classroom observations and interviews with students and teachers, confirmed that profiles of class mean scores on OBLEQ scales can provide an accurate and 'trustworthy' description of the learning environment of individual classes. Moreover, the findings of this study suggest that the success or otherwise of implementing different components of outcomes-based learning environments is not necessarily dependent on the 'quality' of the teacher and school, but could be related to logistical and organisational factors (e.g., length of periods, large class sizes, availability of textbooks, etc.), teachers' views of students'

attitudes towards and conceptions of learning, and the perceived difficulty of the science content to be taught.

A critical evaluation of the perceptions of students' actual and preferred outcomes-based classroom learning environments could show the degree of capability, as well as the level of success, of teachers 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 students' perceptions of their outcomes-based learning environment provides an important new tool for teachers, teacher educators and researchers in South Africa and elsewhere. Hopefully, this instrument will prove useful in future efforts at monitoring the learning environment and guiding teachers to change their teaching towards a more outcomes-based focus.

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***English version of the Outcomes-Based Learning Environment Questionnaire  
(OBLEQ)***

**Involvement**

1. I discuss ideas in class.
2. I give my opinions during class discussions.
3. The teacher asks me questions.
4. My ideas and suggestions are used during classroom discussions.
5. I ask the teacher questions.
6. I explain my ideas to other students.
7. Students discuss with me how to go about solving problems.
8. I am asked to explain how I solve problems.

**Investigation**

9. I carry out investigations to test my ideas.
10. I am asked to think about the supporting facts for statements.
11. I carry out investigations to answer questions coming from discussions.
12. I explain the meaning of statements, diagrams and graphs.
13. I carry out investigations to answer questions that puzzle me.
14. I carry out investigations to answer the teacher's questions.
15. I find out answers to questions by doing investigations.
16. I solve problems by using information obtained from my own investigations.

**Cooperation**

17. I cooperate with other students when doing assignment work.
18. I share my books and resources with other students when doing assignments.
19. When I work in groups in this class, there is teamwork.
20. I work with other students on projects in this class.
21. I learn from other students in this class.
22. I work with other students in this class.
23. I cooperate with other students on class activities.
24. Students work with me to achieve class goals.

**Equity**

25. The teacher gives as much attention to my questions as to other students' questions.
26. I get the same amount of help from the teacher as do other students.
27. I have the same amount of say in this class as other students.
28. I am treated the same as other students in this class.
29. I receive the same encouragement from the teacher as other students do.
30. I get the same opportunity to contribute to class discussions as other students.
31. My work receives as much praise as other students' work.

32. I get the same opportunity to answer questions as other students.

**Differentiation**

33. I work at my own speed.
34. Students who work faster than me move on to the next topic.
35. I am given a choice of topics.
36. I am set tasks that are different from other students' tasks.
37. I am given work that matches my ability.
38. I use different materials from those used by other students.
39. I use different assessment methods from other students.
40. I do work that is different from other students' work.

**Personal relevance**

41. I learn about the world outside of school.
42. My new learning starts with problems about the world outside of school.
43. I learn how science can be part of my out-of-school life.
44. I get better understanding of the world outside of school.
45. I learn interesting things about the world outside of school.
46. What I learn has nothing to do with my out-of-school life.
47. What I learn I can use in my out-of-school life.
48. What I learn I can link to what I already know.

**Responsibility for own learning**

49. The teacher encourages me to plan what I'm going to learn.
50. The teacher encourages me to decide how well I am learning.
51. The teacher encourages me to decide which activities are best for me.
52. The teacher encourages me to decide how much time I spend on learning activities.
53. The teacher encourages me to decide which activities I do.
54. The teacher encourages me to assess my learning.
55. The teacher encourages me to decide the pace at which I learn best.
56. The teacher encourages me to think about areas in my learning that I need to improve upon.

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)
		<i>The extent to which ...</i>	<i>OBE advocates the following on the part of learners:</i>
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?

ICEQ – Individualised Classroom Environment Questionnaire

CLES – Constructivist Learning Environment Survey

Table 2. Factor Loadings for Actual and Preferred Forms of the OBLEQ in South Africa

Item	Factor Loading												
	Involvement/ Investigation		Cooperation		Equity		Differentiation		Personal Relevance		Responsibility for Learning		
	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	Act	Pref	
2	0.36	0.40											
4	0.39	0.48											
5	0.35	0.47											
6	0.36	0.46											
7	0.44	0.48											
8	0.60	0.64											
9	0.42	0.43											
10	0.54	0.59											
12	0.45	0.49											
17			0.51	0.57									
18			0.46	0.39									
19			0.33	0.37									
20			0.47	0.46									
22			0.47	0.56									
23			0.45	0.50									
24			0.31	0.35									
25					0.39	0.40							
26					0.40	0.46							
27					0.41	0.50							
28					0.52	0.58							
29					0.54	0.58							
30					0.48	0.50							
31					0.43	0.59							
32					0.45	0.53							
34							–	0.30					
35							–	–					
36							0.58	0.62					
38							0.52	0.52					
39							0.58	0.65					
40							0.64	0.61					
49									0.57	0.59			
50									0.40	0.40			
51									0.54	0.47			
52									0.57	0.68			
53									0.56	0.59			
55									0.41	0.49			
57											0.36	0.39	
58											0.45	0.57	
59											0.63	0.68	
60											0.53	0.59	
61											0.49	0.56	
62											0.42	0.51	
63											0.49	0.53	
64											0.39	0.42	
% Variance	3.46	5.10	3.13	2.81	13.66	20.71	6.68	6.14	4.75	3.63	3.46	3.51	
Eigenvalue	1.52	2.24	1.38	1.24	6.01	9.11	2.94	2.70	2.09	1.60	1.52	1.55	

Factor loadings smaller than 0.30 have been omitted.

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

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
			Actual	Preferred	Actual	Preferred	Eta <sup>2</sup> Actual
Involvement/ Investigation	Individual	16	0.70	0.79	0.32	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 eta<sup>2</sup> statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.



Table 4. Average Item Mean, Average Item Standard Deviation and Difference between Actual and Preferred Perceptions on Each OBLEQ Scale (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	<i>F</i>
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.

<b>Involvement</b> <b>Botšeakarolo</b>	<b>ACTUAL RURI</b> How it <u>is</u> . Ka moo go lego ka gona.					<b>PREFERRED DUMA</b> How I <u>want</u> it. Ka moo ke dumago.				
	Never	Seldom	Some times	Often	Always	Never	Seldom	Some times	Often	Always
	Le ga tee	Ga se gantši	Nako e ngwe	Gantši	Ka mehla	Le ga tee	Ga se gantši	Nako e ngwe	Gantši	Ka mehla
1. I discuss ideas in class. Ke ahlaahla dikgopolo ka mpatong.	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

Figure 1. An extract from the OBLEQ, illustrating the inclusion of both the English and Sepedi version of each item and the answer format.

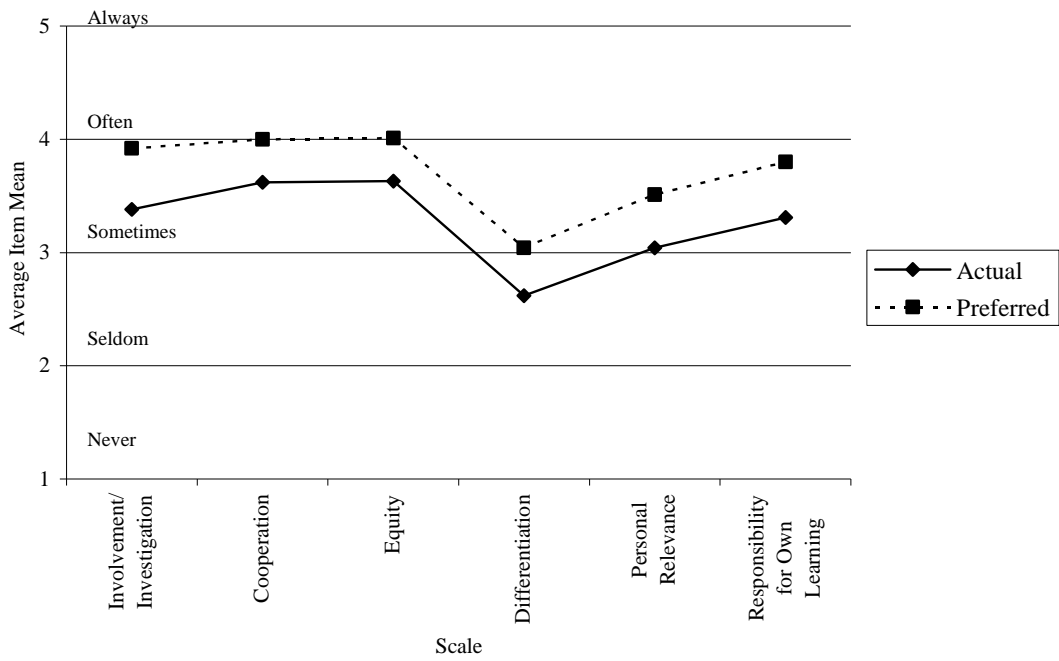


Figure 2. Whole Sample: Average Item Mean for Students' Actual and Preferred Scores on the OBLEQ

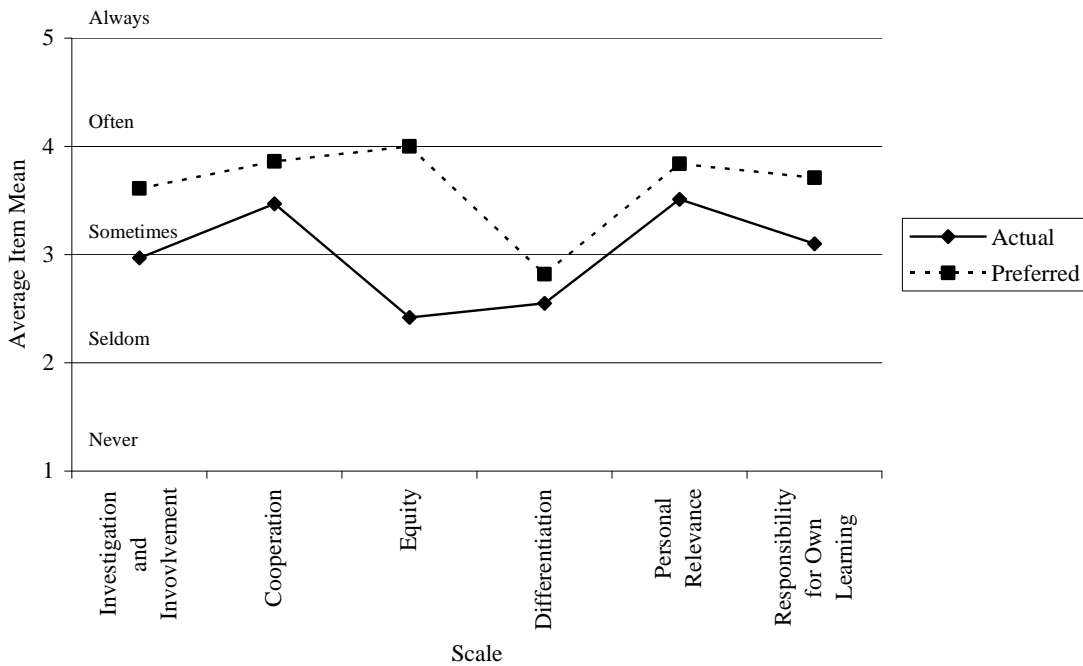


Figure 3. Case Study Class A: Average Item Mean for Students' Actual and Preferred Scores on the OBLEQ

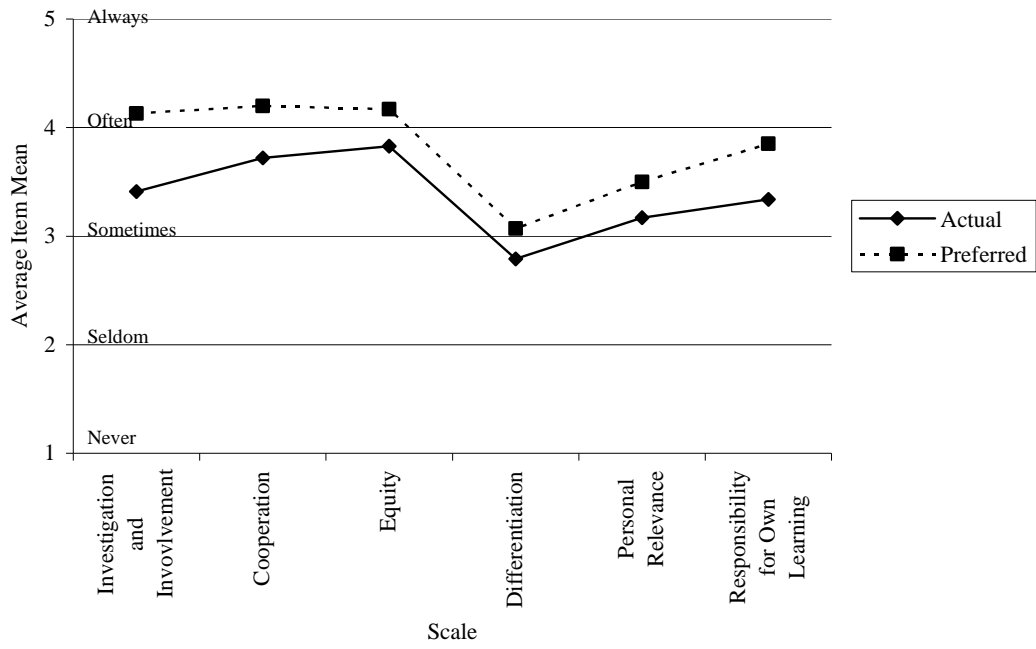


Figure 4. Case Study Class B: Average Item Mean for Students' Actual and Preferred Scores on the OBLEQ