

ALD09130 - Using Students' Perceptions of the Learning Environment to Guide Teacher Action Research to Improve Senior Secondary Classrooms

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ABSTRACT

This paper reports the development and validation of an instrument designed to provide science teachers with information, based on students' perceptions, about their classroom environments. The instrument provides teachers with feedback for reflecting on their teaching practices and, in turn, guiding the development and implementation of strategies to improve their learning environments. To determine the reliability and validity of the new instrument, data from 2043 student responses from 147 classes in 9 schools were analysed. In addition, three case studies were used to examine the usefulness of student responses to learning environment questionnaire as a tool for reflection and a guide in transforming their classroom environments. These case studies (one of which is described in this paper) helped to determine the extent to which action research based on students' perceptions of the learning environment was useful in guiding teachers' improvement of their classroom learning environments.

OBJECTIVES

The objectives of the study reported in this paper were to:

1. Develop and validate an instrument to assess students' perceptions of the learning environment in terms of relationships, instructional delivery and assessment.
2. To examine the extent to which teacher action research, based on students' perceptions of the learning environment, can guide teachers' improvement of their classroom learning environments.

SIGNIFICANCE

To date, learning environment questionnaires have tended to focus on relationships and the instructional process, but to exclude aspects of assessment. The development and validation of a new instrument that includes dimensions that measures students' perceptions of the extent to which teachers use formative assessment and are clear about assessment criteria would be an important contribution to the field of learning environments.

This study is significant because of its implications for professional development programs for science teachers. By critically evaluating the perceptions of students' actual and preferred classroom learning environments, teachers are able to use an action research process in which they reflect on the results, plan for improvement, implement strategies and re-assess the learning environment.

The results support the ability of educators to transform their learning environment in ways that more closely match what students would prefer. As such, this instrument could become central to future efforts at improving the learning environment and guiding teachers towards changing their teaching.

BACKGROUND AND THEORETICAL UNDERPINNINGS

Reflection and Professional Development

Reflection has been described as a way of thinking about a problematic situation that needs to be resolved. According to Fullan (1999), it is only through reflection that teachers begin to question and think differently about their teaching practices. In this respect, reflection provides the opportunity to be aware that a problem exists.

According to Schön (1987), an understanding of alternative perspectives about one's teaching lies at the heart of professional development. As such, information about the perspectives of a teacher's students can provide a valuable source of data for personal reflection. Seeking alternative perspectives through the eyes of teachers' own students can help teachers to question assumptions and to view their own practice through the eyes of others (Rhine, 1998; Hoban & Hastings, 2006). Hoban and Hastings (2006) report a ten-year collaboration between a teacher and a researcher that explores the collection of data from students as a basis of teacher reflection. Methods include interviews, student logs, classroom observations and surveys that compare students' and teachers' perceptions of teaching practices.

Action research is a self-reflective form of inquiry undertaken by participants in social or educational situations in order to improve their own practices or their understanding of these practices and the situations in which these practices are carried out (Carr & Kemmis, 1983; Fazio & Melville, 2008; Kemmis & McTaggart, 1998; Malone, 1998). Carr and Kemmis (1983) maintain that professional autonomy for teachers implies that they cannot merely accept research findings concerning classroom practices and teaching skills and slavishly implement them. Instead, teachers themselves should conduct research about their classroom practices and teaching skills. Action research in the context of the present study involved teachers examining their own practice and taking action to improve what was happening in their classroom.

Action research begins with teachers deliberately and consciously reflecting on their teaching processes; feedback from the new instrument can provide a useful means of doing just that. The next section provides information about the field of learning environments, upon which we drew in developing the new instrument.

Using the Field of Learning Environments to Provide Teachers with Students' Perspectives

The study reported in this paper draws on and extends research carried out in the field of learning environments (Fraser, 1998a, 2007; Goh & Khine, 2002; Fisher & Khine, 2006). Contemporary research on school environments partly owes inspiration to Lewin's (1936) seminal work in non-educational settings, which recognised that both the environment and its interaction with characteristics of the individual are potent determinants of human behaviour. Since then, the notion of person-environment fit has been elucidated in education by Stern (1970), whereas Walberg (1981) has proposed a model of educational productivity in which the educational environment is one of nine determinants of student outcomes. Research specifically on classroom learning environments took off about thirty years ago with the work of Walberg (1979) and Moos (1974) which spawned many, diverse research programs around the world (Fisher & Khine, 2006; Fraser, 1998a) and the creation of *Learning Environments Research: An International Journal*. Past research on learning environments provides numerous research traditions, conceptual models and research methods that are relevant to the proposed study.

This study draws on the rich resource of diverse, valid, economical and widely-applicable assessment instruments available in the field of learning environments (Fraser, 1998b) as a starting point for developing the new questionnaire whose development is described in this paper (Research Aim 1).

Fraser and Fisher (1986) reported case studies of how classroom and school learning environment assessments have been used by teachers to provide valuable feedback about their teaching performance. Past studies have successfully employed feedback information based on students' perceptions of the actual and preferred classroom learning environment to guide improvement in the learning environments created by teachers (Aldridge & Fraser, 2008; Aldridge, Fraser & Sebela, 2004; Sinclair & Fraser, 2002; Thorp, Burden & Fraser, 1994; Yarrow, Millwater & Fraser, 1997). Typically these studies have used a five-step procedure:

1. assessing the actual and preferred learning environment using a questionnaire
2. providing feedback to teachers based on students' responses to the questionnaire
3. reflection and discussion based on feedback from the questionnaire in order to identify which aspects of the learning environment might be chosen for change and to consider teaching strategies that might be used
4. implementing an intervention over a period of time in an attempt to change the learning environment
5. re-administration of the questionnaire to students at the end of the intervention period to determine whether students perceive their learning environment differently from before.

Because this five-step procedure has been used successfully at a range of educational levels, the teachers involved in our study made use of the same five-step procedure as a basis for reflection upon, discussion of and attempts to improve the learning environment (Research Aim 2).

DESIGN AND PROCEDURES

The study was based on three main assumptions. First, it was assumed that, generally, teachers are interested in improving their practice and want to create an environment that suits the needs of their students. Secondly, conscious and purposeful reflection on one's teaching can provide a catalyst for change and guide improvements in the way in which one teaches. Finally, we assumed that students, as the major stakeholders in the education process, are worth listening to.

Sample

Our study utilised different 'grain sizes' (Fraser, 1999) to collect and analyse data. At the largest grain size, a sample of students from Western Australia was used in investigating the validity and reliability of the new instrument. This sample consisted of 2043 students in 147 classes in 9 high schools. To provide a more representative sample of students in Western Australia, schools were drawn from regional and metropolitan areas. All schools were coeducational. A breakdown of the sample is provided in Table 1 according to geographical region and student sex.

Table 1: Sample sizes

Regional	Schools		Teachers	Students			Total
	Metropolitan	Total		Male	Female	Missing	
2	7	9	109	853	1039	151	2043

At the smallest grain size, qualitative data were obtained from three case-study classes that were involved in the action research component of the study. The selection of classes was based largely on the teachers' willingness to be involved in the study. Observations were carried out regularly during a 12-week period. Interviews were conducted at various times during and after the 12-week period in order to clarify points and to enhance understanding of the strategies that the teachers implemented and whether teachers felt that the strategies were effective. The teachers wrote a description of how they interpreted student responses and how strategies were developed and implemented. In each case, the teachers were given the resulting descriptions to ensure that they were accurate portrayals of what had taken place. The selection of students for interviewing was undertaken collaboratively by the teacher and researchers. One of the case studies (involving a science teacher) is reported in this paper.

Mixed Methods

Past studies in the field of learning environments have successfully combined qualitative and quantitative research methods (Aldridge, Fraser & Huang, 1999; Tobin & Fraser, 1998). Fraser (1999) used qualitative and quantitative data in studying the classroom learning environment at different 'grain sizes' to show how individual students and the teacher could be investigated not only at the smallest grain size, but also at the class level, school level or system level to clarify whether particular teachers or students were typical of larger groups. Multiple research methods (e.g., surveys, interviews) and various grain sizes (student, group and class) were used in this study.

A new instrument to assess students' perceptions was developed to ensure that it was relevant to the teaching, learning and assessment principals outlined by the Curriculum Council of Western Australia. The 11 dimensions assessed by the new instrument can be grouped into three broad categories: Relationships (including the scales of Student Cohesiveness, Teacher Support, Equity and Young Adult Ethos), Assessment (including the scales of Clarity of Assessment Criteria and Formative Assessment), and Delivery (including the scales of Task Orientation, Differentiation, Personal Relevance, Involvement, and Cooperation). The questionnaire was designed to include two adjacent response scales, one to record what students perceive as actually happening in their class and the other to record what students would prefer. Six of the eleven scales are based on the widely-used What Is Happening In this Class? (WIHIC) questionnaire that has been cross-validated across many subject areas and in numerous countries (Aldridge, Fraser & Huang, 1999; Khoo & Fraser, 2008). The scales and the reasons behind their selection are outlined below.

Qualitative data provided rich descriptions and enabled a better understanding of the learning environment from the view of the participants (Erickson, 1998; Gudmúndsdóttir, 2001; Patton, 2002). Classroom observations were used to help researchers to understand the complexities of classroom life as teachers attempted to improve their learning environments. Informal conversational interviews (Fontana & Frey, 2000), focus groups (Patton, 2002) and in-depth interviews with teachers (using an interview guide to ensure that the group remained focused) were used. Journals kept by teachers as they implemented strategies in their classrooms, captured the teachers' feelings and a personal evaluation of the process (Richardson, 2000).

DEVELOPING THE NEW QUESTIONNAIRE

As a first step, the study focused on the development of an instrument that could be used to assess the learning environment. Much time was spent ensuring that the learning environment instrument

was appropriate for the Western Australian setting. As a result of these efforts, a widely-applicable and distinctive questionnaire for assessing students' perceptions of their actual and preferred learning environment has been developed. This questionnaire has the potential to provide information to teachers about how they can improve their learning environments to better accommodate the needs of their students.

As a first step, we identified principles that are considered important in a learning environment from the Western Australian Curriculum Framework (Curriculum Council, 2001) and are consistent with a more constructivist pedagogy. We used these principles to delineate dimensions that could be used as a basis for developing specific scales that would give an indication of whether these principles were indeed being applied.

An important educational principle is acknowledgement that students differ in terms of their abilities, rates of learning and interests (Griffin & Smith, 1997; Spady, 1993). It is important, therefore, that teachers provide students with learning experiences that cater for this diversity. With this in mind, we identified a *Differentiation* scale to assess the extent to which students perceive that teachers cater for students differently based on students' capabilities and interests.

Another important principle is that students need to have goals, both short-term and long-term, to provide them with motivation and purpose (Killen, 2001; Spady, 1994). If these goals are clear and relevant, then students are more likely to be engaged in learning. Coupled with the need to have meaningful goals is the need to have clear expectations and frequent feedback and reinforcement to ensure that students' time-on-task is optimised. To assess the extent to which students' perceive that it is important to complete activities and understand the goals of the subject, the *Task Orientation* scale was selected.

Research has established that, if students are actively involved in learning activities, then it is likely that learning will be more meaningful to students. According to the Curriculum Council (2001, p. 34) "students should be encouraged to think of learning as an active process on their part, involving a conscious intention to make sense of new ideas or experiences and improve their own knowledge and capabilities, rather than simply to reproduce or remember". To examine the extent to which this is happening in the leaning environment, the *Involvement* scale was selected. Involvement involves the extent to which students feel that they have opportunities to participate in discussions and have attentive interest in what is happening in the classroom. This scale assumes that language plays an important part in helping students to understand what they are learning (Taylor & Campbell-Williams, 1993). The selection of this scale assumes that giving students opportunities to participate in classroom discussions and to negotiate ideas and understandings with peers, rather than listening passively, are important aspects of the learning process.

It is becoming increasingly apparent that, to ensure that students engage in their learning, it is necessary for teachers to make the content relevant to the students' lives outside school (Taylor, Fraser & Fisher, 1997). In this way, teachers are able to provide a meaningful context in which they can introduce new knowledge. It is with this in mind that the *Personal Relevance* scale was introduced to examine the connectedness of a subject with students' out-of-school experiences.

In developing this questionnaire, a situation in which teachers encourage a cooperative learning environment, rather than a competitive one, was considered to be desirable (Johnson, Johnson & Smith, 2007; Tan, Sharan & Lee, 2007). Whilst it is acknowledged that students should be given opportunities to work as individuals, it is equally important that they work together collaboratively. Learning experiences should provide opportunities for students to cooperate with and learn from

each other. It was with this in mind that the *Cooperation* scale was selected to assess the extent to which students cooperate with one another in a collaborative atmosphere.

It was considered important that the learning environment created by teachers is supportive to students, providing the intellectual, social and physical conditions for effective learning. Students are more likely to do well in their learning if they feel accepted and do not experience harassment and prejudice from either the teacher or their peers. Two scales were selected for assessing the extent to which students feel that their learning environment is conducive to learning, namely, Student Cohesiveness and Teacher Support.

The first of these scales, *Student Cohesiveness*, assesses the extent to which students know, help and are supportive of one another. To make sure that the environment is supportive of student learning, teachers need to create policies and practices that help students to feel that they are accepted and supported by their peers (Curriculum Council, 2001). A supportive environment allows students to make mistakes without running the risk of being ridiculed. Social acceptance by peers and the need to have friends are important aspects that can affect students' learning.

The second scale, *Teacher Support*, assesses the extent to which the teacher helps, relates to, trusts and is interested in students. The teacher's relationship with his or her students is a pivotal aspect of any learning environment, which can lead the student to love or hate a subject, and to be inspired or turned away from learning. The supportiveness of a teacher helps to give students the courage and confidence needed to tackle new problems, take risks in their learning, and work on and complete challenging tasks. If students consider a teacher to be approachable and interested in them, then they are more likely to seek the teacher's help if there is a problem with their work. The teacher's relationship with his or her students, in many ways, is integral to a student's success and to creating a cooperative learning environment (Hijzen, Boekaerts & Vedder, 2007). It was with this in mind that the Teacher Support scale was selected.

It was considered important that the learning environment created by the teacher provides opportunities for all of the students in the class (Spady, 1994). The *Equity* scale assesses the extent to which students perceive that the teacher treats them in a way that encourages and includes them as much as their peers. This scale gives teachers an indication of whether students perceive that they are being treated fairly by the teacher.

It was also considered important that a senior school environment encourages students to be responsible for their own learning. This led to a scale called *Young Adult Ethos* being developed to assess whether students feel that teachers give them responsibility and treat them as young adults.

Two scales were also developed to examine students' perceptions of the assessment practices used by the teacher: Formative Assessment and Clarity of Assessment Criteria. Assessment, particularly formative assessment, is critical for knowing how a student is performing academically and how best to support that student in the classroom (Allen, Ort & Schmidt, 2009).

The Formative Assessment scale assesses the extent to which students feel that the assessment tasks given to them make a positive contribution to their learning. Formative assessment relates to assessment practices that are part of the learning process rather than a separate (summative) process conducted at the end of the learning journey. Formative assessment practices can provide opportunities for students to discuss their progress with their teachers as well as to engage in peer and self assessment as ways of monitoring and reflecting on their learning. If students are able to recognise the link between their learning and assessment, then assessment becomes educative,

contributes positively to student learning, enables students to plan for future learning and fosters self-directed learning practices. The *Formative Assessment* scale was developed to assess the extent to which students feel that the assessment tasks given to them make a positive contribution to their learning.

The *Clarity of Assessment Criteria* scale assesses the extent to which the assessment criteria are explicit so that the basis for judgements is clear and public. While clear and public criteria can support and enhance a teachers' ability to make professional judgements about student learning, as a matter of fairness, students should also know the criteria by which they are being assessed. This provides a powerful means of improving student learning by making clear the goals to which students are striving, providing useful feedback on their progress, encouraging them to reflect on their current understandings, and planning for success in their future learning.

The final version of the questionnaire, known as the Learning Environment Questionnaire (LEQ), has 11 scales with eight items in each (providing a total of 88 items). Although it is acknowledged that a questionnaire comprising 11 scales cannot assess every aspect of the learning environment, the selected scales are all considered to be especially relevant to teaching and learning environments in many contexts. Importantly, many of these scales have also been shown to be predictors of student outcomes in past research (e.g. Aldridge & Fraser, 2008). For each of the 11 LEQ scales, Appendix 1 provides a description of each scale and its relevance to the Curriculum Council's (2001) teaching and learning principles.

Students respond to each of the 88 items in the LEQ using a frequency scale of Almost Always, Often, Sometimes, Seldom and Almost Never. Importantly, this questionnaire enables students to provide information about the learning environment that is present in the classroom (the *actual* environment) as well as information about the learning environment that they would like to be present (preferred environment). To do this, the questionnaire makes use of a side-by-side response format for the actual and preferred versions (see Figure 1) in which students are able to respond to each item with respect to both their actual and preferred responses.

<i>Equity</i>	ACTUAL					PREFERRED				
	Almost Never	Seldom	Some times	Often	Almost Always	Almost Never	Seldom	Some times	Often	Almost Always
50. I get the same amount of help from the teacher as do other students.	1	2	3	4	5	1	2	3	4	5

Figure 1: Illustration of Side-by-Side Response Format for Actual and Preferred Items

VALIDATING THE QUESTIONNAIRE

As a first step it was important to ensure that the new questionnaire could be used to provide teachers with reliable feedback. To this end, the data collected from the 2043 students in 147 classes described earlier were analysed in various ways to support the validity and reliability of both actual and preferred versions of the instrument at the high school level.

Factor structure of LEQ. When the researcher's goal is to construct a multiscale questionnaire, factor analysis provides a means of determining whether items within the same scale are tapping into the same construct and whether each scale is assessing a distinct construct. Principal axis factor analysis with oblique rotation was used to extract a factor structure for the LEQ and to check it

against the *a priori* 11-scale structure of the LEQ. A separate factor analysis was conducted for actual and preferred data.

Factor analysis confirmed the structure for the actual and preferred forms of the LEQ. The two criteria used for retaining any item were that it must have a factor loading of at least 0.40 on its own scale and less than 0.40 on each of the other ten LEQ scales. Table 2 reports the factor loadings and percentage of variance for each of the scales of the actual and preferred versions of the LEQ. For the actual version of the LEQ, 82 of the 88 items had a loading of at least 0.40 on their *a priori* scale and no other scale. In all cases, the remaining 6 of the 88 items did not load on their own scale or on any other scale with at least 0.40. These six items include two items from the Student Cohesiveness scale (Items 6 and 8), two items from the Task Orientation scale (Items 26 and 27) and two from the Differentiation scale (Items 57 and 58). For the preferred version, 85 of the 88 items had a loading of at least 0.40 on their *a priori* scales and no other scale. For the remaining three items, two had a loading of at least 0.40 on neither their own scale nor any other scale (Item 8 from the Student Cohesiveness scale and Item 57 from the Differentiation scale). Item 67 of the Young Adult Ethos scale loaded both on its own scale and the Clarity of Assessment Criteria scale.

For the actual version, the percentage of variance varied from 1.80% to 33.71% for different scales, with the total variance accounted for being 64.97%. For the preferred version, the percentage of variance ranged from 1.71% to 35.33% for different scales, with a total variance accounted for being 65.75% (see Table 2).

Internal consistency reliability, discriminant validity and ability to differentiate between classrooms for LEQ. Three further indices of scale reliability and validity were generated separately for the actual and preferred versions of the LEQ. A convenient discriminant validity index (namely, the mean correlation of a scale with other scales) was used as evidence that each LEQ scale measures a separate dimension that is distinct from the other scales in this questionnaire. The Cronbach alpha reliability coefficient was used as an index of scale internal consistency. Finally, an analysis of variance (ANOVA) was used to check the ability of each scale in the LEQ's actual form to differentiate between the perceptions of students in different classrooms.

Once we had established the factor structure of the LEQ, our next step was to establish that each item in the same scale assesses a common construct. The internal consistency of each LEQ scale was established using Cronbach's alpha coefficient for two units of analysis (the individual student and the class mean) and is reported separately for the actual and preferred versions in Table 3. Using the individual as the unit of analysis, scale reliability estimates ranged from 0.82 to 0.94 for the actual form and from 0.83 to 0.94 for the preferred form. Generally reliability figures were even higher with the class mean as the unit of analysis (ranging from 0.89 to 0.98 for the actual form and from 0.86 to 0.97 for the preferred form). These internal consistency indices are comparable to those in past studies that have used the WIHIC (Aldridge & Fraser, 2008; Fraser & Chionh, in press; Wolf & Fraser, 2007).

Discriminant validity assesses the extent to which a scale is unique in the dimensions that it covers (i.e. the construct is not included in another scale of the instrument). The factor analysis provided support for the independence of factor scores and evidence relevant to the discriminant validity of factor scores on the LEQ. As a convenient index of the discriminant validity of raw scores on different scales, the mean magnitude of the correlation of one scale with other scales in the LEQ was calculated using two units of analysis.

Using the individual as the unit of analysis, the discriminant validity results (mean correlation of a scale with other scales) for the 11 scales of the LEQ ranged from 0.38 to 0.54 for the actual form and from 0.38 and 0.54 for the preferred form with the student as the unit of analysis. With the class mean as the unit of analysis, scale discriminant validity ranged from 0.34 to 0.63 for the actual form and from 0.27 to 0.62 for the preferred form. These results suggest that raw scores on the LEQ assess somewhat overlapping aspects of learning environment. However, the factor analysis supports the independence of factor scores on the 11 scales.

It was important to determine the degree to which the actual form of the LEQ is capable of differentiating between the perceptions of students in different classes. To do this, a one-way analysis of variance (ANOVA), with class membership as the independent variable ($N=147$), was computed for each LEQ scale. The proportion of variance accounted for by class membership was calculated using the η^2 statistic (the ratio of 'between' to 'total' sums of squares). The ANOVA results reported in Table 5 show that all 11 LEQ scales differentiated significantly between classes ($p<0.01$). That is, students within the same class perceived the environment in a relatively similar manner, while the within-class mean perceptions of the students varied between classes. The η^2 statistic (an estimate of the strength of association between class membership and the dependent variable) ranged from 0.19 to 0.46 for different LEQ scales.

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 LEQ

Scale	Unit of Analysis	No of Items	Alpha Reliability		Mean Correlation with other Scales		ANOVA
			Actual	Preferred	Actual	Preferred	Eta ² Actual
Student Cohesiveness	Individual	8	0.86	0.88	0.45	0.45	0.19**
	Class Mean		0.90	0.92	0.51	0.55	
Teacher Support	Individual	8	0.93	0.91	0.49	0.49	0.46**
	Class Mean		0.98	0.93	0.61	0.59	
Involvement	Individual	8	0.89	0.91	0.49	0.49	0.21**
	Class Mean		0.92	0.94	0.61	0.59	
Task Orientation	Individual	8	0.87	0.91	0.53	0.53	0.19**
	Class Mean		0.92	0.95	0.63	0.59	
Personal Relevance	Individual	8	0.93	0.94	0.43	0.44	0.25**
	Class Mean		0.96	0.97	0.55	0.54	
Cooperation	Individual	8	0.90	0.92	0.50	0.50	0.24**
	Class Mean		0.95	0.96	0.56	0.59	
Equity	Individual	8	0.94	0.94	0.51	0.51	0.29**
	Class Mean		0.97	0.96	0.61	0.60	
Differentiation	Individual	8	0.82	0.83	0.38	0.38	0.27**
	Class Mean		0.89	0.86	0.34	0.27	
Young Adult Ethos	Individual	8	0.93	0.93	0.49	0.49	0.25**
	Class Mean		0.97	0.96	0.62	0.57	
Formative Assessment	Individual	8	0.92	0.92	0.54	0.54	0.21**
	Class Mean		0.96	0.97	0.60	0.62	
Clarity of Assessment	Individual	8	0.94	0.95	0.50	0.50	0.22**
	Class Mean		0.96	0.94	0.63	0.54	

** $p<0.01$

The sample consisted of 2043 students in 147 classes.

The η^2 statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.

The statistics obtained for the internal consistency (alpha reliability) and the ability of each scale to differentiate between the perceptions of the students in different classrooms (η^2 statistic from ANOVA) can be considered acceptable. The results presented in Table 3, in conjunction with the factor analysis results in Table 2, support the contention that the LEQ is a valid and reliable classroom environment instrument for the assessment of students' perceptions of their psychosocial environments at the high school level.

In summary, the instrument displayed satisfactory factorial validity for both its actual and preferred versions, with all items having a factor loading of at least 0.40 on their *a priori* scale and no other scale for both the actual and preferred versions. At both the individual and class mean levels of analysis, the internal consistency reliability and discriminant validity were satisfactory for both the actual and preferred form of the new instrument. Further analyses supported the ability of the actual responses to differentiate between classrooms on all learning environment scales. Because all of these results supported the reliability and validity of the new instrument, we believe that teachers and researchers can use it with confidence in the future.

To examine the usefulness of student responses to the LEQ, as a tool for reflection and a guide in transforming their classroom environments, we used three case studies. These case studies (one of which is described in the next section) helped to determine the extent to which action research based on students' perceptions of the learning environment was useful in guiding teachers' improvement of their classroom learning environments. The next section provides details on one of the case studies, Britt, who was teaching in a small rural school in the South-West of Western Australia.

One Teacher's Story

This was Britt's first year of her involvement in the project. Britt was persuaded to join the project by colleagues who had been involved the year before. When to select a class with whom she would like to work with to improve her learning environment, Britt chose a Year 11 Human biology class with eight students.

The LEQ was administered to students in the human biology class that Britt had selected. Based on students responses to the LEQ a circular profile was generated to provide a snapshot of students' perceptions of the learning environment created (see Figure 2). This profile provides a graphical depiction of the average item mean, or the scale mean divided by the number of items in a scale, for students' responses to each of the 11 scales. The profile has 11 equal sectors, each of which represents a different learning environment scale. Each segment is divided into two parts, with the yellow part representing students' perceptions of their actual learning environment and the green part representing the learning environment that students would prefer. The profile can be used to compare students' actual and preferred responses and between different scales.

When Britt examined her profiles, she tried to identify which scales had the largest actual-preferred differences to help her to decide what she would like to work on. The largest actual-preferred differences were for the Clarity of Assessment Criteria scale and the Personal Relevance scale. Britt considered both of these scales to be important and to this end she wrote:

I think that, in order for students to be engaged, they must feel that their assessments are going to positively contribute to their learning. In order for [students] to do well in these assessments, my expectations must be clear. I aimed to implement strategies that would address these areas.

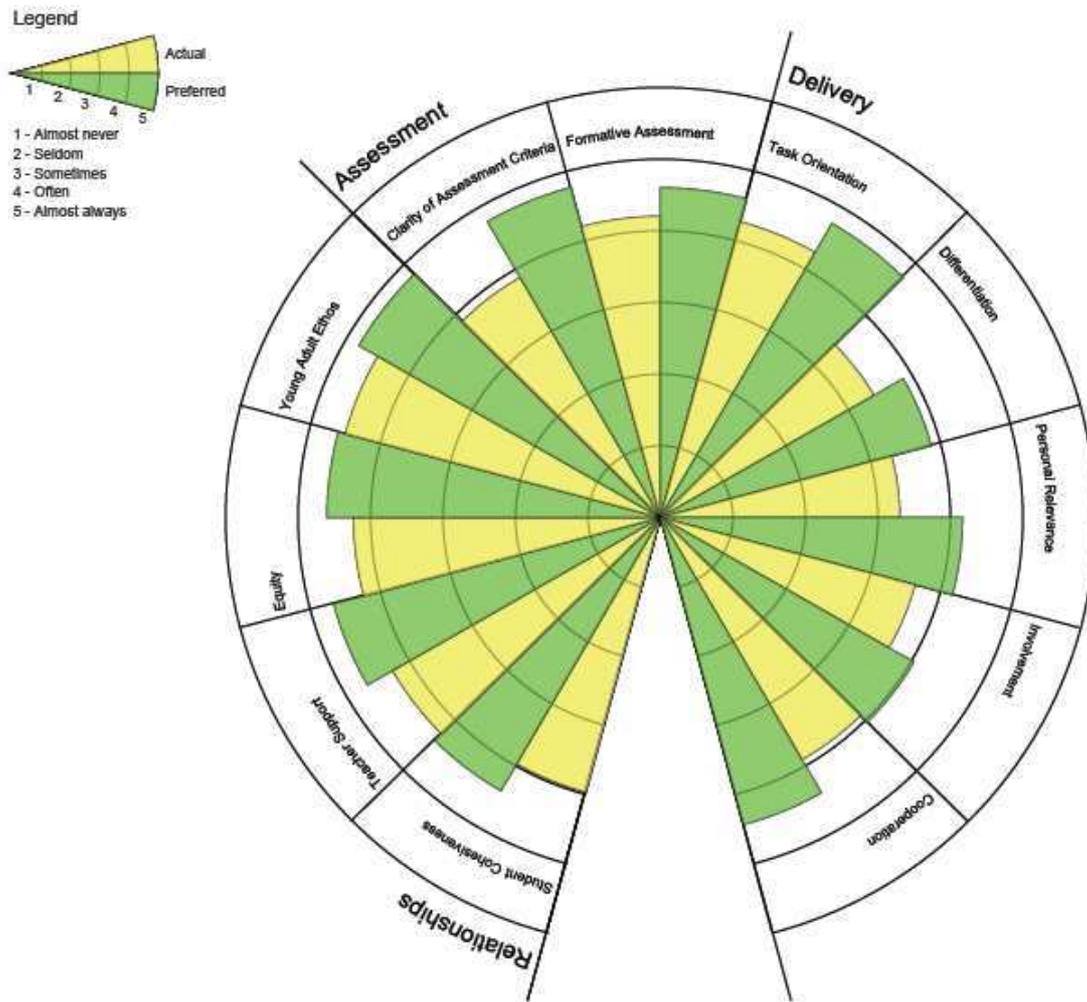


Figure 2: Mean Actual and Preferred Scores for Students' Perceptions of the Learning Environment on the Pretest

These actual-preferred differences were used to guide the development of strategies aimed at reducing the gaps. Britt hoped that, as a result of the strategies she would see a positive change in the quality of assessments being submitted and in the level of student engagement in her classroom.

Once Britt had viewed the profile, and decided on which scales she would focus, she immediately began to document the changes that she wanted to make in the classroom. She then used this as a guide when implementing different strategies. Britt consulted a wide range of materials gathered from professional development activities which had an emphasis on teaching strategies that she had attended over the past year. She also reflected on the teaching strategies and type of assessment that she had used during the year.

Having done some professional development related teaching strategies I decided to go back to my resources and refresh my memory on the range of strategies which I had been introduced over the years. I had found that I had become too comfortable using only a few different strategies, and there were numerous effective strategies that could be implemented. It was just a matter of remembering them and finding ways and activities in which to implement them.

At this point, Britt decided to show the profile to the students in her class and to give them the opportunity to discuss the results. Students were encouraged to discuss their expectations (the preferred response) and how they felt that these differed from what was actually happening in the classroom.

It was at this point that the teacher decided to focus on four aspects of the classroom environment rather than two: Clarity of Assessment Criteria, Formative Assessment, Personal Relevance and Differentiation. In describing the initial change that she made in the classroom, Britt stated:

I decided to modify a couple of assessments so as they became more student directed. This was easy and just a matter of letting the students pick a research topic that they personally found interesting or perhaps was relevant in their lives at that time. The students had to get my approval before beginning the research so I could ensure that it was directly related to the course objectives.

To address the issues that she identified as being associated with the Clarity of Assessment Criteria scale, Britt made changes to the way in which she administered assessment tasks in the classroom. The changes included: distributing marking keys with assessment tasks to ensure that students were clear about the expectations; spending more time explaining to students the expectations of the task and its intended outcomes; and encouraging students to submit a draft to minimise the risk of confusion regarding the expectations of the assessment task. With respect to these changes, Britt commented:

To address the disparity in the Clarity of Assessment Criteria scale, I had to rethink my presentation of each assessment and to improve the communication of my expectations. It concerned me that students weren't aware of my expectations. How were they meant to succeed to their full potential if they were confused about what the task was asking them to do?

Britt decided to address issues related to the Formative Assessment scale and Personal Relevance scales simultaneously. She highlighted the outcomes that were specifically related to assessment tasks and, for each assessment task, she also reinforced which outcomes were being addressed.

To help to make the subject more relevant to students, and thus improve the level Personal Relevance, Britt decided that, for selected assessment tasks, she would allow students to pick their own topic (relevant to the subject being studied). Wherever possible, students were actively involved in the assessment tasks. For example, for one task, students were required to examine their energy input and output and determine if they had a healthy diet. Another task required students to design and implement a fitness program that they could use to assess their own fitness.

In addition, Britt tried to encourage classroom discussions that focused on areas where the content immediately related the personal life of the students:

As a teacher of Human Biology, I knew how relevant the content of the subject was to my students. My challenge was getting the students to see this! When implementing my plan, I tried to include activities that would help the students to identify the personal relevance that my lessons held for them. I hoped that this, in turn, would positively impact on the level of engagement in class tasks and assessments, as well as the quality of work (not only assessment items) that was being presented.

To address issues related to Differentiation, Britt decided to incorporate a range of teaching strategies that would cater for a wider difference in preferred learning styles. Based on student

feedback from previous assessments, students were allowed to use PowerPoint instead of a formal report to present their assessment.

The teacher also made use of ‘Think, Pair, Share’ activities, group work activities, role play. Once a week, she provided opportunities for the whole class to reflect on their week’s learning as well to participate in a team activity.

These strategies and activities were implemented for six weeks, after which, the LEQ was readministered to the students in Britt’s class. To help teachers to determine whether the students perceived the learning environment differently after they have implemented their strategies, a second profile was provided to the teachers. This profile represents students’ scores on the LEQ for the pretest and the posttest. Like the first profile, there are 11 equal sectors, each of which represents a different learning environment scale. These sectors are further divided into four to represent student scores for the pretest – actual (yellow) and preferred (green) learning environment – and for the posttest –actual (red) and preferred (blue) learning environment (see Figure 3).

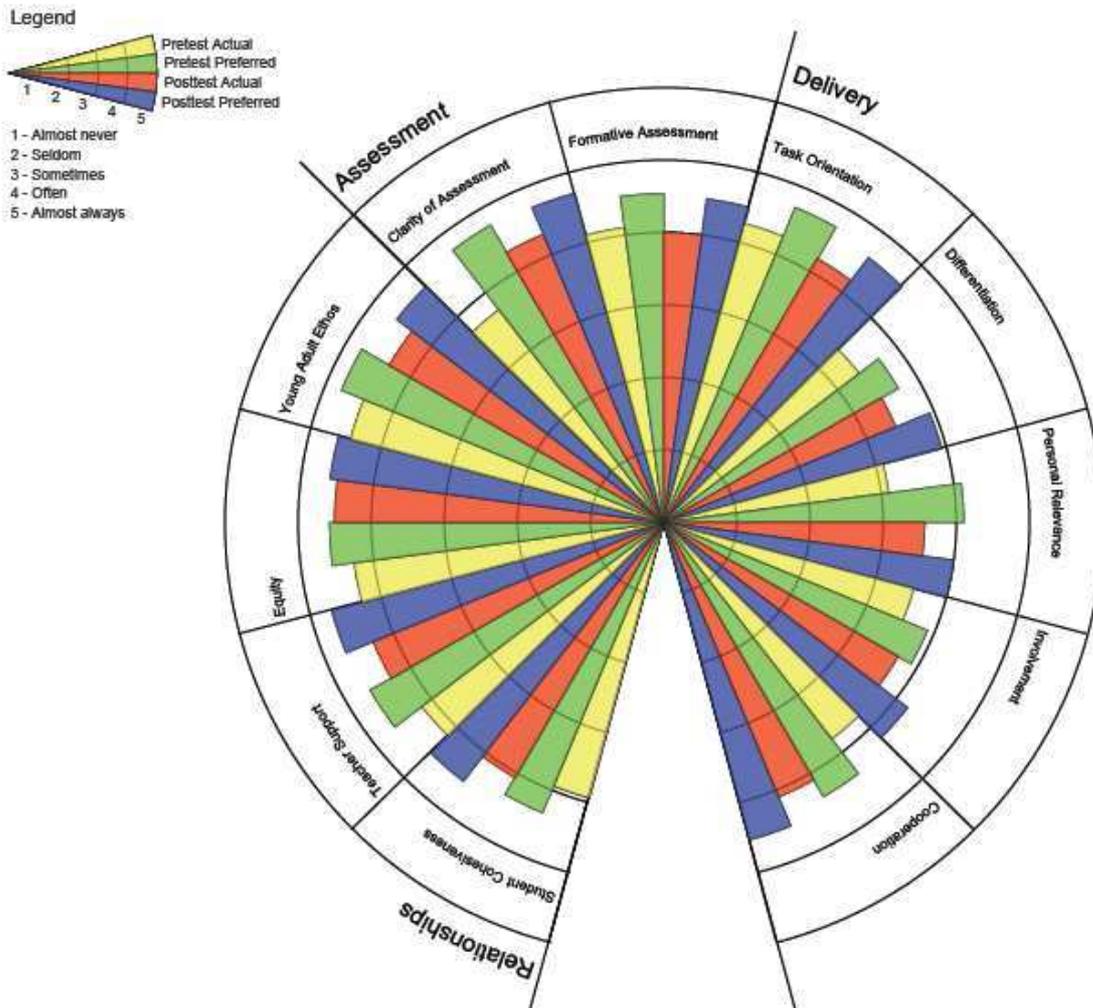


Figure 2: Mean Actual and Preferred Scores for Students’ Perceptions of the Learning Environment on the Posttest

Britt then used this profile (Figure 3) to examine whether the strategies that she had implemented had affected students' perceptions of the learning environment.

Britt noted that the gap between the actual and preferred scores for the Personal Relevance scale was reduced. She felt that that this was most likely because of the modifications that she had made to the assessment tasks in which students were required to use themselves as subjects in two of the assessments and apply knowledge learnt in class to modify and improve their lifestyle.

Overall, Britt felt that the students were more engaged when completing their assessments. To this end, Britt stated:

The students saw how their knowledge could be applied outside the classroom and seemed eager to do so (e.g. , how to increase their energy output if their input of certain foods was high or talking to their parents about smoking after a presentation they did on emphysema).

There was also a considerable reduction in the gap between actual and preferred scores for the Clarity of Assessment Criteria scale between the pretest and the posttest. With respect to the strategy used to reduce the gap between actual and preferred, Britt stated:

Students submitted drafts of their assessments to make sure that there were no misunderstandings about what the task required them to do. Feedback about this idea from the students was positive and they greatly appreciated having the marking schemes in advance. Their results also indicated that they had a better understanding of what was expected. For Clarity of Assessment Criteria, it was also evident in the posttest results that the strategies were beneficial with a notable increase in actual scores and a decrease in the difference between actual and preferred scores.

The results for the Formative Assessment scale indicated that students perceived slightly less of this dimension for the posttest than for the pretest. Therefore Britt decided to revise strategies and consider modifying assessments for subsequent classes in the subject to ensure the relevance of the task in terms of their learning outcomes were made more explicit to students. While student perceptions of the learning environment increased slightly for differentiation, there was also a notable increase in what students would prefer in this area. This perhaps indicated that the changes made by the teacher to cater for individual learning were not only recognised by students but impacted positively on the way in which they learn.

Reflecting on what she learnt from this activity in terms of her own teaching, Britt commented:

I need to incorporate a broader range of teaching strategies in my lessons and to avoid getting comfortable with only a few strategies. Analysing expectations of assessments is essential, as is delivering the marking key with the assessments. Making Human Biology relevant is easy – I just need to remember to do it. Also I need to give students the opportunity to directly apply their knowledge to their everyday life. Just because I tell students how to do it, doesn't mean that they will, and so they were given the opportunity to do so in assessments.

In terms of student learning, Britt added:

In my opinion, students are more likely to do well if they can see the relevance in their studies. They need to see the positive contribution that tasks make to their learning. It is also important that expectations are made explicitly clear to students so that they know how to succeed. I already knew that students have a variety of learning preferences; this study encouraged me to revise old

strategies and implement these in my classroom. Personal relevance is a powerful tool that can be used to engage students (along with the additional benefits that it holds in their personal lives).

CONCLUSION

The Learning Environment Questionnaire (LEQ) measures 11 dimensions of the actual and preferred classroom environments, namely, Student Cohesiveness, Teacher Support, Involvement, Personal Relevance, Task Orientation, Cooperation, Equity, Differentiation, Young Adult Ethos, Formative Assessment and Clarity of Assessment Criteria. Incorporated into the questionnaire is a side-by-side response format which enables students to record their views of their actual and preferred learning environment.

To establish the reliability and validity of the LEQ, a sample of 2043 student responses from 147 classes in 9 schools in Western Australia was used. For the actual version, all but six items had a loading of at least 0.40 on their *a priori* scale and no other scale. None of the remaining items loaded on their own or any other scale. For the preferred version of the questionnaire, all but three of the items had a loading of at least 0.40 on their *a priori* scales and no other scale. The total percentage of variance accounted for was 64.97% for the actual version and 65.75% for the preferred version.

For the actual and preferred versions of the LEQ, the internal consistency reliability and discriminant validity were both found to be satisfactory at the class mean and individual levels of analysis. Scale reliability estimates with the individual as the unit of analysis ranged from 0.85 to 0.94 for the actual form and from 0.86 to 0.95 for the preferred form. Further analyses supported the ability of the actual form of all 11 LEQ scales to differentiate between classrooms. These results support the reliability and validity of the LEQ at the senior high-school level.

Our case studies provide evidence to suggest that this instrument can be useful to teachers as a tool for reflection. The results of the efforts of the case study teacher reported in this paper, as reflected in changes in her students' scores on the new instrument, indicated that she was able to use feedback based on her students' learning environment perceptions to improve her classroom environment.

An important contribution of this paper is its reporting of a case study of how a science teacher used students' responses to a learning environment instrument in teacher action research aimed at improving the learning environment. Information provided through student responses to the instrument prompted valuable reflections for the teacher that culminated in implementing changes that led to improvements in her classroom learning environment. This component of our study replicated past teacher action research which has been successful in improving classroom environments (Aldridge & Fraser, 2008; Fraser & Fisher, 1986; Sinclair & Fraser, 2002; Thorp, Burden & Fraser, 1994; Yarrow, Millwater & Fraser, 1997), but it also identified the need for a more-structured approach to teacher action research in future attempts to improve learning environments.

The reflective nature of this study, that involved encouraging teachers to examine their teaching practices through the eyes of their students, offers promise. The results of our research suggest that generally teachers are able to use feedback based on students' perceptions of the learning environment in a meaningful and constructive way that can enhance their teaching practice.

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Appendix 1: Descriptive Information for Each Scale in the LEQ and its Relevance to the Principles of Learning, Teaching and Assessment

Scale	Description	Relevance to the Teaching, Learning and Assessment Principles in the Curriculum Framework (Curriculum Council, 2001)
	<i>The extent to which ...</i>	
Student Cohesiveness	...students know, help and are supportive of one another.	Supportive Environment: The learning environment should provide a cooperative atmosphere in which students feel that they are supported by their peers.
Teacher Support	...the teacher helps, befriends, trusts and is interested in students.	Supportive Environment: To ensure that the atmosphere is conducive to effective learning teachers should provide a supportive learning environment in which they fostering a sense of trust and belonging.
Involvement	...students have attentive interest, participate in discussions, ask questions and share ideas.	Action and Reflection: Learning experiences should encourage students to be active participants in the learning process.
Personal Relevance	...subject is relevant to students' everyday out-of-school experiences.	Connection and Challenge: Learning experiences should connect with students' existing knowledge, skills and values while extending and challenging their current ways of thinking and acting.
Task Orientation	...it is important to complete activities planned and to stay on the subject matter.	Motivation and Purpose: Purposeful learning can be enhanced by making clear the long-term outcomes expected to result from students' engagement with the learning experiences provided.
Cooperation	...students cooperate rather than compete with one another on learning tasks.	Independence and Collaboration: Learning experiences should provide students with opportunities to work collaboratively with others and contribute in various ways.
Equity	...students are treated equally by the teacher.	Supportive Environment: Education is for all students – the learning environment should provide an atmosphere in which all students feel that they are treated in a way that is fair.
Differentiation	...teachers cater for students differently on the basis of ability, rates of learning and interests.	Inclusivity and Difference: Learning experiences should accommodate differences between students by providing time and conditions that acknowledge that students bring with them a range of experiences and develop at different rates.
Formative Assessment	...students feel that the assessment tasks given to them make a positive contribution to their learning.	Educative: Assessment should make a positive contribution to learning.
Assessment Criteria	... the assessment criteria are explicit so that the basis for judgments is clear and public	Explicit: Assessment criteria should be explicit so that the basis for judgements is clear and public.
Young Adult Ethos	...teachers give students responsibility and treat them as young adults.	Independence and Collaboration: Classroom practices should encourage students to take responsibility for their own learning.