Chapter 1

LEARNING ENVIRONMENTS RESEARCH: YESTERDAY, TODAY AND TOMORROW

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Learning environments research has expanded remarkably over the past few decades on the international scene, with Asian researchers making important and distinct contributions particularly over the previous decade. Asian researchers have cross-validated the main contemporary classroom environment questionnaires that originated in the West and have undertaken careful translations and adaptations for use in the Chinese, Korean, Malay and Indonesian languages. Asian studies have replicated Western research in establishing consistent associations between the classroom environment and student outcomes, in using learning environment assessments in evaluating educational programs, and in identifying determinants of learning environments. Some desirable directions for future learning environment research in Asia include more use of qualitative research methods and using learning environment assessments to guide practitioners' attempts to improve their classrooms.

1. Introduction

The field of learning environments has undergone remarkable growth, diversification and internationalisation during the past 30 years (Fraser, 1998a). A striking feature of this field is the availability of a variety of economical, valid and widely-applicable questionnaires that have been developed and used for assessing students' perceptions of classroom environment (Fraser, 1998b). Although learning environment research originated in Western countries, Asian researchers in the last decade have made many major and distinctive contributions. In particular, some of the main questionnaires that were developed in the West have been adapted (sometimes involving translation into another language) and cross-validated for use in several Asian countries. In order to provide wide access to past research and to instruments that have proven valid and useful in Asian contexts, this chapter has a particular focus on

studies undertaken in Asia. Through this focus, it is hoped that this chapter will stimulate and guide future research agendas in the field of learning environments in Asian countries.

2. Instruments for Assessing Classroom Environment

Because few fields of educational research can boast the existence of such a rich array of validated and robust instruments, this section describes four contemporary instruments that have been used in Asia: Questionnaire on Teacher Interaction (QTI); Science Laboratory Environment Inventory (SLEI); Constructivist Learning Environment Survey (CLES); and What Is Happening In This Class? (WIHIC) questionnaire. Before discussing each of these instruments below, some historically-important questionnaires are briefly considered.

2.1. Historically-Important Questionnaires

The Learning Environment Inventory (LEI) and Classroom Environment Scale (CES) were developed in the USA in the late 1960s. The initial development of the LEI began in conjunction with evaluation and research related to Harvard Project Physics (Walberg & Anderson, 1968). The CES (Moos & Trickett, 1987) grew out of a comprehensive program of research involving perceptual measures of a variety of human environments including psychiatric hospitals, prisons, university residences and work milieus (Moos, 1974).

The LEI was used in the Hindi language in a large study involving approximately 3000 tenth grade students in 83 science and 67 social studies classes (Walberg, Singh & Rasher, 1977). Student perceptions on the LEI accounted for a significant increment in achievement variance beyond that attributable to general ability. In Indonesia, Paige (1979) used the CES and three scales selected from the LEI to reveal that individual modernity was enhanced in classrooms perceived as having greater task orientation, competition and difficulty and less order and organisation, while achievement was enhanced in classes higher in speed and lower in order and organisation. Hirata and Sako (1998) used an instrument in the Japanese language that incorporated scales from the CES. Factor analysis of the responses of 635 students suggested a four-

factor structure for this questionnaire (consisting of Teacher Control, Sense of Isolation, Order and Discipline, and Affiliation).

The My Class Inventory (MCI) is a simplified form of the LEI for use among children aged 8–12 years (Fisher & Fraser, 1981). In Singapore, Goh, Young and Fraser (1995) changed the MCI's original Yes-No response format to a three-point response format (Seldom, Sometimes and Most of the Time) in a modified version of the MCI which includes a Task Orientation scale. Goh *et al*. found the modified MCI to be valid and useful in research applications with 1512 primary mathematics students in 39 classes. In Brunei Darussalam, Majeed, Fraser and Aldridge (in press) used the original version of the MCI with 1565 mathematics students in 81 classes in 15 government secondary schools. When the Satisfaction scale was used as an attitudinal outcome variable, instead of as a measure of classroom environment, Majeed *et al*. (in press) found strong support for a three-factor structure for the MCI consisting of three of the four *a priori* scales, namely, Cohesiveness, Difficulty and Competitiveness.

Whereas the LEI, CES and MCI were designed for teacher-centred classrooms, the Individualised Classroom Environment Questionnaire (ICEQ) was the first learning environment instrument to focus on dimensions which distinguish individualised classrooms from conventional ones (Fraser, 1990). The ICEQ appears to have been used very little in the Asian context, but Asghar and Fraser (1995) used it in Brunei Darussalam to investigate associations between students' attitudes and their classroom environment perceptions at the lower secondary school level.

2.2. Questionnaire on Teacher Interaction (QTI)

Research which originated in The Netherlands focuses on the nature and quality of interpersonal relationships between teachers and students (Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993). Drawing upon a theoretical model of proximity (cooperation-opposition) and influence (dominance-submission), the QTI was developed to assess student perceptions of eight behaviour aspects (Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied,

Admonishing and Strict). Each item has a five-point response scale ranging from Never to Always. Typical items are "She/he gives us a lot of free time" (Student Responsibility and Freedom behaviour) and "She/he gets angry" (Admonishing behaviour). Research with the QTI has been completed at various grade levels in the USA (Wubbels & Levy, 1993) and Australia (Fisher, Henderson & Fraser, 1995).

The QTI has been used in several large-scale studies in Asia. Goh pioneered the use of the QTI in a simplified form in Singapore with a sample of 1512 primary mathematics students in 39 classes in 13 schools (Goh & Fraser, 1996, 1998, 2000). This study cross-validated the QTI for use in a new country and found it to be useful in several research applications. Also, further support for the validity and usefulness of the QTI in Singapore is provided by Quek, Fraser and Wong's (2001) study among 497 gifted and non-gifted chemistry students and by Fisher, Goh, Wong and Rickards' (1997) study involving 20 secondary science classes.

Scott and Fisher (2001) translated the QTI into Standard Malay and cross-validated it with 3104 primary school students in 136 classes in Brunei Darussalam. An English version of the QTI has been cross-validated for secondary schools in Brunei Darussalam for samples of 1188 science students (Khine & Fisher, 2002) and 644 chemistry students (Riah & Fraser, 1998). In Korea, Kim, Fisher and Fraser (2000) validated a Korean-language version of the QTI among 543 Grade 8 students in 12 schools, and Lee and Fraser (2001a) provided further cross-validation information for the QTI using a sample of 440 Grade 10 and 11 science students. In Indonesia, Soerjaningsih, Fraser and Aldridge (2001b) translated the QTI into the Indonesian language and cross-validated it with a sample of 422 university students in 12 research methods classes.

2.3. Science Laboratory Environment Inventory (SLEI)

Because of the importance of laboratory settings in science education, an instrument specifically suited to assessing the environment of science laboratory classes at the senior high school or higher education levels was developed (Fraser, Giddings & McRobbie, 1995; Fraser &

McRobbie, 1995). The SLEI has five seven-item scales (Student Cohesiveness, Open-Endedness, Integration, Rule Clarity and Material Environment) and the five response alternatives are Almost Never, Seldom, Sometimes, Often and Very Often. Typical items are "I use the theory from my regular science class sessions during laboratory activities" (Integration) and "We know the results that we are supposed to get before we commence a laboratory activity" (Open-Endedness). The SLEI was field tested and validated simultaneously with a sample of 5447 students in 269 classes in six different countries (the USA, Canada, England, Israel, Australia and Nigeria), and cross-validated with Australian students (Fisher, Henderson & Fraser, 1997; Fraser & McRobbie, 1995).

In Asia, the SLEI has been cross-validated and found useful in research involving both its original English form and translated versions. The validity of the English version of the SLEI has been established in Singapore by Wong and Fraser's (1995, 1996) study of 1592 Grade 10 chemistry students in 56 classes in 28 schools, and by Quek *et al.*'s (2001) study of 497 gifted and non-gifted chemistry students. Also, Riah and Fraser (1998) cross-validated the English version of the SLEI with 644 Grade 10 chemistry students in Brunei Darussalem.

A noteworthy program of research involving a Korean-language version of the SLEI has been initiated by Kim and built upon by Lee (Kim & Kim, 1995, 1996; Kim & Lee, 1997; Lee & Fraser, 2001b, 2002). For example, Lee and Fraser reported strong factorial validity for a Korean version of the SLEI and replicated several patterns from previous research in Western countries (e.g., low Open-Endedness scores and significant associations with students' attitudes).

2.4. Constructivist Learning Environment Survey (CLES)

According to the constructivist view, meaningful learning is a cognitive process in which individuals make sense of the world in relation to the knowledge which they already have constructed, and this sense-making process involves active negotiation and consensus building. The CLES (Taylor, Fraser & Fisher, 1997) was developed to assist researchers and teachers to assess the degree to which a particular classroom's

environment is consistent with a constructivist epistemology, and to assist teachers to reflect on their epistemological assumptions and reshape their teaching practice. The CLES has 36 items, with five response alternatives ranging from Almost Never to Almost Always, which assess Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation. Typical items are "I help the teacher to decide what activities I do" (Shared Control) and "Other students ask me to explain my ideas" (Student Negotiation).

In Singapore, Wilks (2000) expanded and modified the CLES for use among students studying English (a subject called General Paper) in junior colleges in Singapore. The revised GPCLES contains two new scales called Political Awareness (reflecting Habermas's notion of emancipatory interest and assessing the extent to which students analyse causes of social injustice and advocate political reform) and Ethic of Care (the degree of emotional warmth in the classroom), which are especially relevant in the teaching of General Paper. When Wilks administered the GPLES to 1046 students in 48 classes in junior colleges, the questionnaire displayed good factorial validity and internal consistency reliability and each scale differentiated significantly between the perceptions of students in different classrooms.

Kim, Fisher and Fraser (1999) translated the CLES into the Korean language and administered it to 1083 science students in 24 classes in 12 schools. The original five-factor structure was replicated for the Korean-language version of both an actual and a preferred form of the CLES. Similarly, Lee and Fraser (2001a) replicated the five-factor structure of a Korean-language version of the CLES among 440 Grade 10 and 11 science students in 13 classes. Furthermore, the CLES has been translated into Chinese for use in Taiwan (Aldridge, Fraser, Taylor & Chen, 2000). In this cross-national study, the original English version was administered to 1081 science students in 50 classes in Australia, while the new Chinese version was administered to 1879 science students in 50 classes in Taiwan. The same five-factor structure emerged for the CLES in the two countries and scale reliabilities were similar.

2.5. What Is Happening In This Class? (WIHIC) Questionnaire

The WIHIC questionnaire combines modified versions of salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns (e.g. equity and constructivism). The original 90-item nine-scale version was refined by both statistical analysis of data from 355 junior high school science students, and extensive interviewing of students about their views of their classroom environments in general, the wording and salience of individual items and their questionnaire responses (Fraser, Fisher & McRobbie, 1996). Analysis of data from an Australian sample of 1081 students in 50 classes (Aldridge & Fraser, 2000) led to a final form of the WIHIC containing the seven eight-item scales (Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, Equity). Response alternatives range from Almost Never to Very Often. Typical items are "I discuss ideas in class" (Involvement) and "I work with other students on projects in this class" (Cooperation).

Although the WIHIC is a relatively recent instrument, its take-up in Asia has been frequent. Already it has been translated into several Asian languages and cross-validated:

- An English version has been cross-validated in Brunei Darussalam with samples of 644 Grade 10 Chemistry students (Riah & Fraser, 1998) and 1188 Form 5 science students (Khine & Fisher, 2001).
- Two studies have used an English version of the WIHIC in Singapore. Fraser and Chionh (2000) report strong validity and reliability for both an actual and a preferred form of the WIHIC when it was responded to for the subjects of mathematics and geography by a sample of 2310 students in 75 senior high school classes. Khoo and Fraser (1998) used the WIHIC with a sample of 250 adults attending computer courses in 23 classes in four Singaporean computing schools.
- A Chinese version of the WIHIC has been developed for use in Taiwan and cross-validated with a sample of 1879 junior high school students in 50 classes (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999).

- Chua, Wong and Chen (2001) developed a Chinese-language version of the WIHIC, based on the Taiwanese version of Aldridge, Fraser and Huang (1999). This is a bilingual instrument with every item presented in both English and Chinese. Detailed procedures were used to develop this Chinese version, which was cross-validated with a sample of 1460 students in 50 classes.
- The WIHIC has been translated into the Korean language and validated with a sample of 543 Grade 8 students in 12 schools (Kim *et al*., 2000).
- The WIHIC has been translated into the Indonesian language and used with university students in computing-related courses. The validity and usefulness of the WIHIC has been established for samples of 2498 university students in 50 computing classes (Margianti, Fraser & Aldridge, 2001a, 2001b) and 422 students in 12 research methods classes (Soerjaningsih, Fraser & Aldridge, 2001a).

3. Research Involving Classroom Environment Instruments

In order to illustrate the many and varied applications of classroom environment instruments, this section considers six types of past research which focus on (1) associations between student outcomes and environment, (2) evaluation of educational innovations, (3) differences between students' and teachers' perceptions of the same classrooms, (4) determinants of classroom environment, (5) use of qualitative research methods, and (6) cross-national studies.

3.1. Associations between Student Outcomes and Environment

The strongest tradition in past classroom environment research has involved investigation of associations between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classrooms. Fraser's (1994) tabulation of 40 past studies shows that associations between outcome measures and classroom environment perceptions have been replicated for a variety of cognitive and affective outcome measures, a variety of classroom

environment instruments and a variety of samples (ranging across numerous countries and grade levels).

Asian researchers have undertaken a wide variety of valuable studies into associations between student outcomes and students perceptions of their classroom learning environment. These studies also cover a wide range of environment instruments, student outcomes, school subjects and grade levels. While some studies have involved English-language versions of questionnaires, other studies have involved learning environment questionnaires that have been translated into various Asian languages:

- In Singapore, relationships have been established between a variety of student outcomes and students' classroom environment perceptions as assessed by several instruments. In one of the early learning environment studies in Singapore, Wong and Fraser (1996) established links between students' attitudes and scores on SLEI scales for a sample of 1592 Grade 10 chemistry students in 56 classes. In another pioneering study in Singapore, Goh used both the MCI and the QTI with 1512 primary mathematics students in 39 classes to establish associations between the classroom environment and mathematics achievement and attitudes (Goh & Fraser, 1998, 2000). Fraser and Chionh's (2000) unusually comprehensive study established associations between WIHIC scales and three student outcomes (examination results, attitudes and self-esteem) among a large sample of 2310 mathematics and geography students in 75 classes. Using both the SLEI and QTI, Quek *et al.* (2001) reported links with student attitudes for a sample of 497 gifted and non-gifted secondary school chemistry students. Khoo and Fraser (1998) established links between student satisfaction and dimensions of the WIHIC for a sample of 250 adults attending 23 computing classes. Using an instrument suited for computer-assisted instruction classrooms, Teh and Fraser (1995) found associations between classroom environment, achievement and attitudes among a sample of 671 high school geography students in 24 classes in Singapore. Finally, Waldrip and Wong (1996) reported attitude-environment

associations when they used the SLEI in both Singapore and Papua New Guinea.

- In Brunei Darussalam, outcome-environment associations have been established for: satisfaction and scales of the MCI for a sample of 1565 Form 2 mathematics students in 81 classes (Majeed *et al*., in press); for science attitudes and scales of both the WIHIC and QTI for a sample of 1188 Form 5 students in 54 science classrooms (Khine, 2001; Khine & Fisher, 2001, 2002); achievement and attitudes and scales of the WIHIC, QTI and SLEI for a sample of 644 chemistry students in 35 classes from 23 government secondary schools (Riah & Fraser, 1998); and for enjoyment of science lessons with scales of a primary school version of the QTI that had been translated into Standard Malay and used with 3104 students in 136 classes in 23 private schools (Scott & Fisher, 2001).
- In Korea, outcome-environment associations have been reported for: students' attitudes to science and a Korean-language version of the SLEI, CLES and QTI (Lee & Fraser, 2001a, 2001b, 2002) for a sample of 440 Grade 10 and 11 science students in 13 classes; and student attitudes and Korean-language versions of the CLES for a sample of 1083 science students in 24 classes (Kim *et al*., 1999) and of the QTI and WIHIC for 543 students in 12 schools (Kim *et al*., 2000).
- In Taiwan, outcome-environment relationships have been found for student satisfaction and a Chinese-language version of scales for both the WIHIC and CLES for a sample of 1879 science students in 50 classes (Aldridge & Fraser, 2000; Aldridge *et al*., 1999; Aldridge *et al*., 2000).
- In Indonesia, Margianti *et al*. (2001a, 2001b) reported associations between the outcomes of achievement and attitudes and students' perceptions on an Indonesian-language version of the WIHIC for a sample of 2498 university students in 50 classes. Similarly, Soerjaningsih *et al*. (2001a, 2001b) used Indonesian language-versions of both the WIHIC and QTI to establish links with student outcomes (course achievement, leisure interest in computers, and

attitude towards the internet) among 422 university students in 12 classes.

While many past learning environment studies have employed techniques such as multiple regression analysis, few have used multilevel analysis (Bryk & Raudenbush, 1992), which takes cognisance of the hierarchical nature of classroom settings. However, two studies in Singapore compared the results from multiple regression analysis with those from an analysis involving the hierarchical linear model. In Wong, Young, and Fraser's (1997) study involving 1592 Grade 10 students in 56 chemistry classes in Singapore, associations were investigated between three student attitude measures and a modified version of the SLEI. In Goh's study with 1512 Grade 5 mathematics students in 39 classes in Singapore, scores on modified versions of the MCI and QTI were related to student achievement and attitude. Most of the statistically significant results from the multiple regression analyses were replicated in the HLM analyses, as well as being consistent in direction (Goh *et al*., 1995; Goh & Fraser, 1998).

Some research into outcome-environment associations has involved the use of more than one classroom environment questionnaire in the same study. Several Asian studies have employed more than one learning environment questionnaire and have used commonality analysis to ascertain the unique and joint contributions made by each questionnaire to the variance in student outcomes. In Singapore, Goh and Fraser (1998) used the MCI and QTI in a study involving the achievement and attitudes of 1512 primary mathematics students. The MCI and the QTI each uniquely accounted for an appreciable proportion of the variance in achievement, but not in attitudes. Much of the total variance in attitude scores was common to the two questionnaires. A conclusion from this study was that it is useful to include the MCI and QTI together in a future study of achievement, but not of attitudes.

Other studies in Asia have reported similar commonality analyses for the unique and joint influences of two questionnaires on student outcomes. Quek *et al.* (2001) used the SLEI and QTI together in a study of science students' attitudes in Singapore. Lee and Fraser (2001a,

2001b, 2002) used the Korean-language versions of the SLEI, QTI and CLES in a study of science students' attitudes in Korea. Generally, these studies also confirmed that each classroom environment instrument accounted for variance in student outcome measures that is independent of that accounted for by the other instrument.

3.2. Evaluation of Educational Innovations

Classroom environment instruments can be used as a valuable source of process criteria in the evaluation of educational innovations. For example, an evaluation of the Australian Science Education Project (ASEP) revealed that, in comparison with a control group, ASEP students perceived their classrooms as being more satisfying and individualised and having a better material environment (Fraser, 1979). Despite the potential value of evaluating educational innovations and new curricula in terms of their impact on transforming the classroom learning environment, only a small number of such studies have been carried out in Asian countries. However, in Singapore, Teh used his own classroom environment instrument (the Geography Classroom Environment Inventory) as a source of dependent variables in evaluating computer-assisted learning (Fraser & Teh, 1994; Teh & Fraser, 1994). Compared with a control group, a group of students using micro-PROLOG-based computer-assisted learning had much higher scores for achievement (3.5 standard deviations), attitudes (1.4 standard deviations) and classroom environment (1.0–1.9 standard deviations). Khoo and Fraser (1998) used the WIHIC in evaluating adult computer application courses in Singapore among a sample of 250 people in 23 classes. Generally students perceived their computing classes as being relatively high in involvement, teacher support, task orientation and equity, but the course was differentially effective for students of different sexes and ages.

3.3. Differences between Student and Teacher Perceptions of Actual and Preferred Environment

An investigation of differences between students and teachers in their perceptions of the same actual classroom environment and of differences

between the actual environment and that preferred by students or teachers was reported by Fisher and Fraser (1983). Students preferred a more positive classroom environment than was actually present for all five environment dimensions. Also, teachers perceived a more positive classroom environment than did their students in the same classrooms on four of the dimensions. The pattern in which students prefer a more positive classroom learning environment than the one perceived as being currently present has been replicated using the WIHIC and QTI among Singaporean high school students (Fraser & Chionh, 2000; Wong & Fraser, 1996), and using the WIHIC among 2498 university students in Indonesia (Margianti *et al*., 2001b).

3.4. Determinants of Classroom Environment

Classroom environment dimensions have been used as criterion variables in research aimed at identifying how the classroom environment varies with such factors as teacher personality, class size, grade level, subject matter, the nature of the school-level environment and the type of school (Fraser, 1994). In Asia, learning environment scores have been used in numerous studies as dependent variables. Hirata and Sako (1998) found differences between the classroom environment perceptions of at-risk students (delinquent and non-attendees) and normal students in Japan. Quek *et al*. (2001) reported interesting differences in the perceived learning environments of gifted and non-gifted students in Singapore. In Brunei, Khine and Fisher (2001, 2002) reported cultural differences in students' classroom environment perceptions depending on whether the teacher was Asian or Western. In Korea, Lee and Fraser (2001a, 2001b, 2002) reported the use of the SLEI, CLES and QTI in investigating differences between streams (science-oriented, humanities-oriented) in student-perceived learning environment, whereas Kim *et al.* (1999) used the CLES in comparing the levels of perceived constructivism in Grade 10 with Grade 11. In Indonesia, differences in classroom environment were found for students in different university subjects, namely, statistics and linear algebra classes (Margianti *et al*., 2001a, 2001b) and in computer science and management classes (Soerjaningsih *et al*., 2001a, 2001b).

Undoubtedly, the determinant of classroom environment that has been most extensively researched in Asia is student gender. Generally within-class comparisons of students' perceptions reveal that females typically have more favourable views of their classroom learning environment than do males. These studies of gender differences have encompassed numerous Asian countries, including Singapore (Fraser & Chionh, 2000; Goh & Fraser, 1998; Khoo & Fraser, 1998; Quek *et al*., 2001; Wong & Fraser, 1996), Brunei (Khine & Fisher, 2001, 2002; Riah & Fraser, 1998), Indonesia (Margianti *et al*., 2001a, 2001b) and Korea (Kim *et al*., 2000).

3.5. Use of Qualitative Research Methods

Significant progress has been made in using qualitative methods in learning environment research and in combining quantitative and qualitative methods within the same study of classroom environments (Fraser & Tobin, 1991; Tobin & Fraser, 1998). For example, Fraser's (1999) multilevel study of the learning environment incorporated a teacher-researcher perspective as well as the perspective of six university-based researchers. The research commenced with an interpretive study of a Grade 10 teacher's classroom at a school which provided a challenging learning environment in that many students were from working class backgrounds, some were experiencing problems at home, and others had English as a second language. Qualitative methods involved several of the researchers visiting this class each time it met over five weeks, using student diaries, and interviewing the teacher-researcher, students, school administrators and parents. A video camera recorded activities for later analysis. Field notes were written during and soon after each observation, and team meetings took place three times per week. The qualitative component of the study was complemented by a quantitative component involving the use of a classroom environment questionnaire.

Surprisingly, the use of quantitative methods has tended to dominate Asian research into learning environments. But there are some notable exceptions in which qualitative methods have been used to advantage. Quite a few Asian studies have used qualitative methods in a minor way,

such as in interviews of a small group of students aimed at checking the suitability of a learning environment questionnaire and modifying it before using it in a large-scale study (e.g., Margianti *et al*., 2001a, 2001b; Soerjaningsih *et al*., 2001a, 2001b; Khine, 2001). For example, in Singapore, Khoo and Fraser (1998) randomly selected 46 students for interviews in order to cross-check students' questionnaire responses and to obtain richer insights into students' perceptions of their classroom environments. Similarly, in Brunei, Khine and Fisher (2001, 2002) conducted a pilot study in which students were interviewed concerning difficulties experienced in responding to classroom environment surveys.

Wilks' (2000) study of English classes at the senior high school level in Singapore used interpretative and narrative methods to support the validity of a modified version of the Constructivist Learning Environment Survey. Also these qualitative methods, in conjuction with the questionnaire survey, were used to investigate the extent to which the teaching and learning environment in English classes (a subject called General paper) is consistent with critical constructivism.

Lee's study in Korea involved a strong quantitative component involving the administration of the SLEI, CLES and QTI to 439 students in 13 classes (four classes from the humanities stream, four classes from the science-oriented stream and five classes from the science-independent stream) (Lee & Fraser, 2001a, 2001b, 2002). However, also, two or three students from each class were selected for face-to-face interview in the humanities stream and the science-oriented stream. In the case of students in the science-oriented stream, interviews were conducted via e-mail to overcome practical constraints. All of the face-to-face interviews were audiotaped and later transcribed in Korean and translated into English. When the Korean transcriptions were completed, they were shown to the students to obtain comments and feedback from them, in order to make sure that their voices had been clearly understood. Furthermore, one class from each stream was selected for observation. While the researcher was observing, she wrote down any salient events occurring in the classroom whenever possible. Some photographs were also taken. Field notes were made and translated into English in order to transfer the images into English.

Overall, the findings from interviews and observations replicated the findings from using the learning environment surveys. The information from interviews with students mainly contributed to clarifying their replies to the questionnaire, but the interviews with teachers also contributed to drawing conclusions by providing background information about the practical situation in classrooms and schools.

In Hong Kong, qualitative methods involving open-ended questions were used to explore students' perceptions of the learning environment in Grade 9 classrooms (Wong, 1993, 1996). This study found that many students identified the teacher as the most crucial element in a positive classroom learning environment. These teachers were found to keep order and discipline whilst creating an atmosphere that was not boring or solemn. They also interacted with students in ways that could be considered friendly and showed concern for the students.

3.6. Cross-National Studies

Educational research that crosses national boundaries offers much promise for generating new insights for at least two reasons (Fraser, 1997). First, there usually is greater variation in variables of interest (e.g. teaching methods, student attitudes) in a sample drawn from multiple countries than from a one-country sample. Second, the taken-for-granted familiar educational practices, beliefs and attitudes in one country can be exposed, made 'strange' and questioned when research involves two countries. In a cross-national study, six Australian and seven Taiwanese researchers worked together on a study of learning environments (Aldridge *et al*., 1999, 2000; She & Fisher 2000). The WIHIC and CLES were administered to 50 junior high school science classes in Taiwan (1879 students) and Australia (1081 students). An English version of the questionnaires was translated into Chinese, followed by an independent back translation of the Chinese version into English again by team members who were not involved in the original translation (Aldridge *et al*., 2000).

Qualitative data, involving interviews with teachers and students and classroom observations, were collected to complement the quantitative information and to clarify reasons for patterns and differences in the

means in each country. Data from the questionnaires guided the collection of qualitative data. Student responses to individual items were used to form an interview schedule to clarify whether items has been interpreted consistently by students and to help to explain differences in questionnaire scale means between countries. Classrooms were selected for observations on the basis of the questionnaire data, and specific scales formed the focus for observations in these classrooms. The qualitative data provided valuable insights into the perceptions of students in each of the countries, helped to explain some of the differences in the means between countries, and highlighted the need for caution when interpreting differences between the questionnaire results from two countries with cultural differences (Aldridge *et al*., 1999, 2000).

Researchers from Singapore and Australia also have carried out a cross-national study of secondary science classes (Fisher, Goh *et al*., 1997). The QTI was administered to students and teachers from a sample of 20 classes from 10 schools in each of Australia and Singapore. Australian teachers were perceived as giving more responsibility and freedom to their students than was the case for the Singapore sample, whereas teachers in Singapore were perceived as being stricter than their Australian counterparts. These differences are not surprising given the different cultural backgrounds and education systems in the two countries.

4. Conclusion: Looking Ahead

The history of the first two decades of learning environments research in Western countries shows a strong emphasis on the use of a variety of validated and robust questionnaires that assess students' perceptions of their classroom learning environment (Fraser, 1998a). The past decade of research into learning environments in Asian countries shows a very similar pattern. Asian researchers have completed numerous impressive studies that have cross-validated the main contemporary classroom environment questionnaires (the Questionnaire on Teacher Interaction, Science Laboratory Environment Inventory, Constructivist Learning Environment Survey, and What Is Happening In This Class?) that were

originally developed in English. Not only have these questionnaires been validated for use in English in countries such as Singapore and Brunei, but Asian researchers also have undertaken painstaking translations and have validated these questionnaires in the Chinese, Indonesian, Korean and Malay languages. These researchers have laid a solid foundation for future learning environment research in Asia by making readily accessible a selection of valid, reliable and widely-applicable questionnaires for researchers and teachers to use in a range of languages for a variety of purposes.

While Asian researchers have an impressive record in terms of cross-validating and/or translating questionnaires that originated in English, they have been less active in the development of new instruments. In the future, there is scope for Asian researchers to make internationally significant contributions to the field by developing new questionnaires that tap the nuances and uniqueness of Asian classrooms, and/or which focus on the various information technology-rich learning environments (e.g., web-based, online learning) that currently are sweeping education worldwide. Similarly, there is scope to adapt currently widely-used paper-and-pencil questionnaires to online formats.

As in the case for Western research, the most common line of learning environment research in Asia has involved investigating associations between students' outcomes and their classroom environment perceptions. This impressive series of studies has been carried out in Singapore, Brunei, Korea and Indonesia in a variety of subject areas (science, mathematics, geography, English and computing), at various grade levels (primary, secondary and tertiary), and using numerous student outcome measures (achievement, attitudes, self-efficacy) and different learning environment questionnaires. Overall, these Asian studies provide consistent support for the existence of associations between the nature of the classroom environment and a variety of valued student outcomes. These findings hold hope for improving student outcomes through the creation of the types of classroom environments that are empirically linked to favourable student outcomes.

Whereas the use of questionnaires in Asian learning environment research has been prolific, studies which include qualitative methods

such as interview and observation have been less common. Although some recent Asian studies demonstrate the benefits of combining qualitative and quantitative methods in learning environment research (Lee & Fraser, 2002; Wilks, 2000), it is desirable for learning environment research in Asia to make greater use of qualitative methods.

Feedback information based on student or teacher perceptions of actual and preferred environment has been employed in Western countries in a five-step procedure as a basis for reflection upon, discussion of, and systematic attempts to improve classroom environments (Thorp, Burden & Fraser, 1994; Yarrow, Millwater & Fraser, 1997). Surprisingly, this important practical benefit has not yet been realised in Asia as no published article could be located that reported teachers' attempts to use learning environment assessments to guide improvements in their classroom environments.

Finally, there is scope for Asian researchers to adopt, adapt or create new theoretical frames to guide the next generation of learning environment studies. For example, this could build upon Roth's (1999) advice against conceptualising the environment as being independent of the person, and on his use of lifeworld analysis as a new theoretical underpinning. Roth, Tobin and Zimmermann (in press) break with past traditions by taking researchers into the front lines of the daily work of schools, thereby assisting in bringing about change. They propose coteaching as an equitable inquiry into teaching and learning processes in which all members of a classroom community participate — including students, teachers, student teachers, researchers and supervisors. Roth and colleagues articulate coteaching in terms of activity theory and the associated first-person methodology for doing research on learning environments that is relevant to practice.

References

Aldridge, J.M. & Fraser, B.J. (2000). A cross-cultural study of classroom learning environments in Australia and Taiwan. *Learning Environments Research, 3*, 101–134.

Aldridge, J.M., Fraser, B.J. & Huang, T.-C.I. (1999). Investigating classroom environments in Taiwan and Australia with multiple research methods. *Journal of Educational Research, 93*, 48–62.

Aldridge, J.M., Fraser, B.J., Taylor, P.C. & Chen, C.-C. (2000). Constructivist learning environments in a cross-national study in Taiwan and Australia. *International Journal of Science Education, 22*, 37–55.

Asghar, M. & Fraser, B. (1995). Classroom environment and attitudes to science in Brunei Darussalam. *Journal of Science and Mathematics Education in Southeast Asia*, XVIII(2), 41–47.

Bryk, A.S. & Raudenbush, S.W. (1992). *Hierarchical linear models: Applications and data analysis method*. Newbury Park, CA: Sage.

Chua, S.L., Wong, A.F.L. & Chen, D.-T. (2001, December). *Validation of the Chinese Language Classroom Environment Inventory (CLCEI) for use in Singapore secondary schools*. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Fisher, D.L. & Fraser, B.J. (1981). Validity and use of My Class Inventory. *Science Education, 65*, 145–156.

Fisher, D.L. & Fraser, B.J. (1983). A comparison of actual and preferred classroom environment as perceived by science teachers and students. *Journal of Research in Science Teaching, 20*, 55–61.

Fisher, D.L., Goh, S.C., Wong, A.F.L. & Rickards, T.W. (1997). Perceptions of interpersonal teacher behaviour in secondary science classrooms in Singapore and Australia. *Journal of Applied Research in Education, 1*(2), 2–13.

Fisher, D.L., Henderson, D. & Fraser, B.J. (1995). Interpersonal behaviour in senior high school biology classes. *Research in Science Education, 25*, 125–133.

Fisher, D., Henderson, D. & Fraser, B. (1997). Laboratory environments & student outcomes in senior high school biology. *American Biology Teacher, 59*, 214–219.

Fraser, B.J. (1979). Evaluation of a science-based curriculum. In H. J. Walberg (Ed.), *Educational environments and effects: Evaluation, policy, and productivity* (pp. 218–234). Berkeley, CA: McCutchan.

Fraser, B.J. (1990). *Individualised Classroom Environment Questionnaire*. Melbourne, Australia: Australian Council for educational Research.

Fraser, B.J. (1994). Research on classroom and school climate. In D. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 493–541). New York: Macmillan.

Fraser, B.J. (1997). NARST's expansion, internationalization and cross-nationalization (1996 Annual Meeting Presidential Address). *NARST News, 40*(1), 3–4.

Fraser, B.J. (1998a). Science learning environments: Assessment, effects and determinants. In B.J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 527–564). Dordrecht, The Netherlands: Kluwer.

Fraser, B.J. (1998b). Classroom environment instruments: Development, validity and applications. *Learning Environments Research*, *1*, 7–33.

Fraser, B. (1999). 'Grain sizes' in learning environment research: Combining qualitative and quantitative methods. In H. Waxman & H.J. Walberg (Eds.), *New directions for teaching practice and research* (pp. 285–296). Berkeley, CA: McCutchan.

Fraser, B.J. & Chionh, Y.-H. (2000, April). *Classroom environment, self-esteem, achievement, and attitudes in geography and mathematics in Singapore*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Fraser, B.J., Fisher, D.L. & McRobbie, C.J. (1996, April). *Development, validation, and use of personal and class forms of a new classroom environment instrument*. Paper presented at the annual meeting of the American Educational Research Association, New York.

Fraser, B.J., Giddings, G.J. & McRobbie, C.J. (1995). Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environments. *Journal of Research in Science Teaching*, *32*, 399–422.

Fraser, B.J. & McRobbie, C.J. (1995). Science laboratory classroom environments at schools and universities: A cross-national study. *Educational Research and Evaluation*, *1*, 289–317.

Fraser, B.J. & Teh, G.P.L. (1994). Effect sizes associated with micro-PROLOG-based computer-assisted learning. *Computers in Education*, *23*, 187–196.

Fraser, B.J. & Tobin, K. (1991). Combining qualitative and quantitative methods in classroom environment research. In B.J. Fraser & H.J. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 271–292). London: Pergamon.

Goh, S.C. & Fraser, B.J. (1996). Validation of an elementary school version of the Questionnaire on Teacher Interaction. *Psychological Reports*, *79*, 512–522.

Goh, S.C. & Fraser, B. (1998). Teacher interpersonal behaviour, classroom environment and student outcomes in primary mathematics in Singapore. *Learning Environments Research*, *1*, 199–229.

Goh, S.C. & Fraser, B.J. (2000). Teacher interpersonal behavior and elementary students' outcomes. *Journal of Research in Childhood Education*, *14*, 216–231.

Goh, S.C., Young, D.J. & Fraser, B.J. (1995). Psychosocial climate and student outcomes in elementary mathematics classrooms: A multilevel analysis. *Journal of Experimental Education, 64*, 29–40.

Hirata, S. & Sako, T. (1998). Perceptions of school environment among Japanese junior high school, non-attendant, and juvenile delinquent students. *Learning Environments Research, 1*, 321–331.

Khine, M.S. (2001). *Associations between teacher interpersonal behaviour and aspects of classroom environment in an Asian context*. Unpublished doctoral thesis, Curtin University of Technology, Perth, Australia.

Khine, M.S. & Fisher, D.L. (2001, December). *Classroom environment and teachers' cultural background in secondary science classes in an Asian context*. Paper presented at the annual meeting of the Australian Association for Research in Education, Perth, Australia.

Khine, M.S. & Fisher, D.L. (2002, April). *Analysing interpersonal behaviour in science classrooms: Associations between students' perceptions and teachers' cultural background*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

Khoo, H.S. & Fraser, B.J. (1998, April). *Using classroom environment dimensions in the evaluation of adult computer courses*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Kim, H.-B., Fisher, D.L. & Fraser, B.J. (1999). Assessment and investigation of constructivist science learning environments in Korea. *Research in Science and Technological Education, 17*, 239–249.

Kim, H.B., Fisher, D.L. & Fraser, B.J. (2000). Classroom environment and teacher interpersonal behaviour in secondary school classes in Korea. *Evaluation and Research in Education, 14*, 3–22.

Kim, H.B. & Kim, D.Y. (1995). Survey on the perceptions towards science laboratory classroom environment of university students majoring in education. *Journal of the Korean Association for Research in Science Education, 14*, 163–171.

Kim, H.B. & Kim, D.Y. (1996). Middle and high school students' perceptions of science laboratory and their attitudes in science and science subjects. *Journal of the Korean Association for Research in Science Education, 16*, 210–216.

Kim. H.B. & Lee, S.K. (1997). Science teachers' beliefs about science and school science and their perceptions of science laboratory learning environment. *Journal of the Korean Association for Research in Science Education, 17*, 210–216.

Lee, S.S.U. & Fraser, B.J. (2001a, March). *High school science classroom learning environments in Korea*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, St. Louis, MO.

Lee, S.S.U. & Fraser, B. (2001b, December). *Science laboratory classroom environments in Korea*. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Lee, S.S.U. & Fraser, B.J. (2002, April). *High school science classroom learning environments in Korea*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Majeed, A., Fraser, B.J. & Aldridge, J.M. (in press). Learning environment and its associations with student satisfaction among mathematics students in Brunei Darussalam. *Learning Environments Research*.

Margianti, E.S., Fraser, B.J. & Aldridge, J.M. (2001a, April). *Classroom environment and students' outcomes among university computing students in Indonesia*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.

Margianti, E.S., Fraser, B. & Aldridge, J. (2001b, December). *Investigating the learning environment and students' outcomes in university level computing courses in Indonesia*. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Moos, R.H. (1974). *The Social Climate Scales: An overview*. Palo Alto, CA: Consulting Psychologists Press.

Moos, R.H. & Trickett, E.J. (1987). *Classroom Environment Scale manual* (2nd ed.). Palo Alto, CA: Consulting Psychologists Press.

Paige, R.M. (1979). The learning of modern culture: Formal education and psychosocial modernity in East Java, Indonesia. *International Journal of Intercultural Relations*, *3*, 333–364.

Quek, C.L., Fraser. B. & Wong, A.F.L. (2001, December). *Determinants and effects of perceptions of Chemistry classroom learning environments in secondary school gifted education classes in Singapore*. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Riah, H. & Fraser, B. (1998, April). *Chemistry learning environment and its association with students' achievement in chemistry*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Roth, W.-M. (1999). Learning environments research, lifeworld analysis, and solidarity in practice. *Learning Environments Research*, *2*, 225–247.

Roth, W.-M., Tobin, K. & Zimmermann, A. (in press). Coteaching/cogenerative dialoguing: Learning environments research as classroom praxis. *Learning Environments Research.*

Scott, R. & Fisher, D. (2001, December). *The impact of teachers' interpersonal behaviour on examination results in Brunei*. Paper presented at the Annual conference of the Australian Association for Research in Education, Fremantle, Australia.

She, H.C. & Fisher, D.L. (2000). The development of a questionnaire to describe science teacher communication behavior in Taiwan and Australia. *Science Education*, *84*, 706–726.

Soerjaningsih, W., Fraser, B.J. & Aldridge, J.M. (2001a, April). *Achievement, satisfaction and learning environment among Indonesian computing students at the university level*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.

Soerjaningsih, W., Fraser, B. & Aldridge, J. (2001b, December). *Learning environment, teacher-student interpersonal behaviour and achievement among university students in Indonesia*. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Taylor, P.C., Fraser, B.J. & Fisher, D.L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research*, *27*, 293–302.

Teh, G. & Fraser, B.J. (1994). An evaluation of computer-assisted learning in terms of achievement, attitudes and classroom environment. *Evaluation and Research in Education*, *8*, 147–161.

Teh, G. & Fraser, B.J. (1995). Associations between student outcomes and geography classroom environment. *International Research in Geographical and Environmental Education*, *4*(1), 3–18.

Thorp, H., Burden, R.L. & Fraser, B.J. (1994). Assessing and improving classroom environment. *School Science Review*, *75*, 107–113.

Tobin, K. & Fraser, B.J. (1998). Qualitative and quantitative landscapes of classroom learning environments. In B.J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 623–640). Dordrecht, The Netherlands: Kluwer.

Walberg, H.J. & Anderson, G.J. (1968). Classroom climate and individual learning. *Journal of Educational Psychology*, *59*, 414–419.

Walberg, H.J., Singh, R. & Rasher, S.P. (1977). Predictive validity or student perceptions: A cross-cultural replication. *American Educational Research Journal*, *14*, 45–49.

Waldrip, B.G. & Wong, A.F.L. (1996). Association of attitudes with science laboratory environments in Singapore and Papua New Guinea. *Journal of Science and Mathematics in South East Asia, 14,* 26–37.

Wilks, D.R. (2000). *An evaluation of classroom learning environments using critical constructivist perspectives as a referent for reform*. Unpublished doctoral thesis, Curtin University of Technology, Perth, Australia.

Wong, A.F.L. & Fraser, B.J. (1995). Cross-validation in Singapore of the Science Laboratory Environment Inventory. *Psychological Reports, 76*, 907–911.

Wong, A.L.F. & Fraser, B.J. (1996). Environment-attitude associations in the chemistry laboratory classroom. *Research in Science and Technological Education, 14,* 91–102.

Wong, A.F.L., Young, D.J. & Fraser, B.J. (1997). A multilevel analysis of learning environments and student attitudes. *Educational Psychology, 17*, 449–468.

Wong, N.Y. (1993). Psychosocial environments in the Hong Kong mathematics classroom. *Journal of Mathematical Behavior*, *12*, 303–309.

Wong, N.Y. (1996). Students' perceptions of the mathematics classroom in Hong Kong. *Hiroshima Journal of Mathematics Education*, *4*, 89–107.

Wubbels, Th. & Brekelmans, M. (1998). The teacher factor in the social climate of the classroom. In B.J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 565–580). Dordrecht, The Netherlands: Kluwer.

Wubbels, Th. & Levy, J. (Eds.). (1993). *Do you know what you look like: Interpersonal relationships in education*. London: Falmer Press.

Yarrow, A., Millwater, J. & Fraser, B.J. (1997). Improving university and primary school classroom environments through preservice teachers' action research. *International Journal of Practical Experiences in Professional Education, 1*(1), 68–93.