Students' Perceptions of Their Learning Environments and Outcomes in Mathematics and Statistics Classrooms at Rajabhat Universities in Thailand

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ABSTRACT

The purposes of this study were first, to assess students' perceptions of their classroom environment in mathematics and statistics classrooms at Rajabhat Universities in Thailand using modified and validated versions of the *Questionnaire on Teacher Interaction* (QTI) and the *College and University Classroom Environment Inventory* (CUCEI); second, to gauge students' attitude toward mathematics and statistics using an abbreviated version of the *Test of Science-Related Attitude* (TOSRA); third, to investigate associations between students' learning environments, their attitudes toward mathematics and statistics as a subject, and their cognitive achievement scores, and last to investigate any differences between male and female students on their perceptions of their classroom in mathematics and statistics classes using the QTI and CUCEI.

A sample of 1860 students in mathematics and statistics classrooms was divided into two subgroups, the first subgroup of 860 students in 29 classes completed the QTI, and the second group of 1000 students in 32 classes completed the CUCEI. The first subgroup completed the QTI in two forms, the Actual and Preferred Forms. The procedure began with the Actual Form and the Preferred Form simultaneously. The students in the sample responded to the Actual Form first, and then the Preferred Form. When all students had finished, the TOSRA scale of "Attitude Towards Subject" was delivered.

Following the same procedure, the second subgroup completed the CUCEI in Actual Form first and then Preferred Form in the same way as the QTI. The TOSRA scale of "Attitude Towards Subject" was administered to students after they completed both the QTI and CUCEI in Preferred Forms.

Whilst students were completing the questionnaires, the teachers responded to the Questionnaire on *Teacher Interaction: Teacher Self Questionnaire,* teacher version. After all students and teachers had completed the questionnaires, they were collected for data analyzing.

The Actual Form and the Preferred Form of the QTI and the CUCEI were examined to find the Cronbach alpha reliability coefficients using individual and class mean as the unit of analyses. The Cronbach alpha reliability coefficients of TOSRA in the scale of "Attitude Towards Subject" were also investigated both in the QTI and the CUCEI subgroups for individual student scores and class mean scores as the units of analyses. Simple and multiple regression analyses were used to examine associations between the classroom learning environment scales and students' attitude toward mathematics and statistics and cognitive achievement scores.

The Cronbach Alpha reliability coefficients of the QTI's scales ranged from 0.48 to 0.85, for individual student scores as the unit of analysis and from values ranging from 0.71 to 0.85 using class mean scores as the unit of analysis. For the CUCEI, the Cronbach alpha reliability coefficients range from 0.68 to 0.85 and from 0.93 to 0.97 respectively, using the individual student scores and class mean scores as the units of analyses in Actual Form scores. For the Attitude Towards Subject, the Cronbach alpha reliability coefficients were 0.88 and 0.97 for individual student scores and class mean scores in the QTI subgroup and 0.87 and 0.95 for the CUCEI subgroup. These reliability coefficients of any instruments are high values for uses.

Simple, multiple correlation and regression analysis revealed reasonably strong and positive associations between each of the classroom learning environment scales and students' attitude toward mathematics and statistics, and cognitive achievement scores.

The QTI scales in Leadership, Helpful/Friendly, Understanding, and Student Responsibility were the strongest independent predictors of associations with the students' attitude toward mathematics and statistics, the subjects and 14% of the variances in students' attitude toward subjects could be attributed to their perceptions of their classroom learning environments.

In the same way, the Leadership, Helpful/Friendly, Understanding, Student Responsibility/ Freedom, Uncertain, Dissatisfied, Admonishing, and Strict scales were significantly ($p<0.001$) correlated and the strongest independent predictors of associations with the students' cognitive achievement scores. 57% of variance in students' cognitive achievement scores can be attributed to their teachers' behaviours.

For the CUCEI scales, the most positive and strongest independent predictors of association with students' attitude toward mathematics and statistics were the Personalisation, Involvement,

Student Cohesiveness, Satisfaction, Task Orientation, Innovation, and Individualisation scales and 13% of variances in students' attitudes toward subjects could be attributed to their perceptions of the classroom learning environments.

However the strongest positively independent predictors of association with the students' cognitive achievement scores were the Personalization, Involvement, Satisfaction, and Individualisation scales and 8% and 67% of variance in students' cognitive achievement scores accounted for, respectively, by the CUCEI scales using individual student and class mean as the units of analyses.

This study is significant because it is one of the first to use learning environment instruments to gauge students' perceptions of their learning environment in mathematics and statistics classrooms at Rajabhat Universities in Thailand. As a result, these instruments are now available and can be used by teachers to monitor what is occurring in their classrooms and thus guide improvements in their teaching, thereby leading to improve learning at Rajabhat Universities in Thailand.

Key words : Interpersonal Behaviours, Classroom Environment, Leaning Environment, Educational Environment Perceptions, QTI, CUCEI, TOSRA, Outcomes.

1. Background

This study focuses on the classroom learning environment of the students in mathematics and statistics classrooms at Rajabhat Universities in Thailand.

The Rajabhat Universities are similar to other state universities in Thailand which provide higher education in the country. It is composed of 40 universities distributed across the five areas of Thailand: the northern, the northeastern, the southern, the central, and Bangkok zone. All Rajabhat Universities offer students courses in Diploma, Bachelor's degree, Master's degree, and Doctoral degree in four academic areas: the pure science, social science and humanities, management science, and education.

The students of the universities come from secondary schools for the Bachelor's degree and their ages range from seventeen onwards. They enroll in the first semester around June each year and study for at least two years for Diploma, four years for a Bachelor's degree and two years for a Master's degree. There are various programs they can choose, such as Applied Statistics, Mathematics, General Management, Computer Science, Drama, Chemistry, Biology, Physics and so on. All students have to enroll in one course in mathematics and statistics, such as Principles of Statistics, Statistics for Research, Thinking and Decision Making, and Business Statistics. The courses which the author has

taught include Principles of Statistics, Business Statistics, Statistics for Research, Calculus, and Thinking and Decision Making.

The classroom learning environments in the Rajabhat Universities, as in other universities elsewhere in Thailand, has not yet been the subject of study, although past researches have shown that the learning environments in classrooms affect the learning outcomes of students (Fraser & Walberg, 1981; Fraser & Fisher, 1982; Fraser, 1986). So, in this study I have concentrated on the learning environment in the classrooms, using students in mathematics and statistics classes at Rajabhat Universities as a sample. Two instruments – *the Questionnaire on Teacher Interaction* (QTI) and the *College and University Classroom Environment Inventory* (CUCEI) were used to measure students' perceptions of their classroom environments in mathematics and statistics classrooms. The other two instruments – the TOSRA (in scales Attitude Towards Subjects) and the Questionnaire on Teacher Interaction: Teacher Self Questionnaire – were used to assess students' perceptions about learning environments and to measure teachers' perceptions of their behaviours in mathematics and statistics classes respectively.

Teh and Fraser (1993) investigated the associations between the outcome-environment and a *Computer-Assisted Learning* (CAL) environment in geography classes with a sample of 671 students using the *Geography Classroom Environment Inventory* (GCEI). The results of this study showed that there were associations between student outcomes and the nature of classroom environment and confirmed the findings past the researches that both achievement and attitudes were enhanced by positive environment of all scales assessed, namely, Gender Equity, Innovation, Investigation, and Resource Adequacy.

In Thailand there have been few studies in classroom learning environment, especially in the Rajabhat Universities. Most teachers focus on the content of subjects and methods of teaching, but neglect the classroom environments. Past and present researchers have shown that positive classroom learning environments lead to higher achievement among students (Haertel & Walberg, 1988).

2. The Rajabhat Universities Context

To place this study in context I review here the geographical locations of the Rajabhat Universities in Thailand; the Rajabhat University Council (RUC); the Rajabhat University Curriculum and the approach to teaching adopted in the Rajabhat Universities.

2.1 Geographical Locations of Rajabhat Universities in Thailand

The 40 Rajabhat Universities are located in five areas in Thailand: the northern, the northeastern, the southern, the central, and Bangkok zone. Eight operate in the northern province;

12 in the northeastern; 5 in the southern; 8 in the central; and 7 in Bangkok. These Rajabhat Universities, established by the "Rajabhat Universities Act, B.E. 2547(2004)" (Government Gazette, 2005) in June 10, 2004, offer students one Diploma and three kinds of degrees: Bachelor's degree, Master's degree and Doctoral degree.

2.2 Rajabhat University Council (RUC)

The administrative structure and system of the Rajabhat Universities are organized and oriented to fulfill its mission and goals. In summary, the 40 Rajabhat Universities are controlled by the Ministry of Education and administered by the "Higher Educational Committee". Each Rajabhat University organizes by Rajabhat University Council (RUC), Rajabhat University Academic Committee Council, and Faculty and Official Council. The head of the university is the president approved by the RUC. The administrations of the university are divided into faculties or the unit of work. There are at least 4 faculties in each university; faculty of science, faculty of technology, faculty of management science and faculty of education.

2.3 Rajabhat University Curriculum and Teaching Approach

The board of each university can devise its own curriculum. There are three curriculum branches: Education, Science, and Art. Education contains programs: Primary Education, Secondary Education, Thai, and Mathematics; Science contains programs of Agriculture, Food Science, Applied Statistics, Computer Science; Art contains programs of English, Community Development, Drama, Business Management, and General Management.

The teaching approach in 40 Rajabhat Universities is almost identical. Instruction is the teacher-centred, during which teachers stand in front of the class each period, begin a lesson, write on the blackboard and the students listen. At the end of a period the teacher gives students some exercises to complete. There may be a few students who want to ask some questions, however there is little chance for the teachers (instructors) to talk with individuals because some classes are large (about 40-50 students in some class). A number of students desire only high grades in the final test; they often feel that they have no need for more knowledge or a new information from the teacher. Among the students of mathematics and statistics, 10% passed the final examination with high grades; 30% with medium grades and of 60% with the poor grades. The number of students who obtained poor grades motivated the author to learn more about the learning environment in mathematics and statistics classrooms in order to overcome this poor situation.

3. Objectives of the Study

The overall objective of the study was to examine students' perceptions of their learning

environment in mathematics and statistics classrooms at Rajabhat Universities in Thailand.

Specific objectives of the study were to:

1. modify and validate the *Questionnaire on Teacher Interaction* (QTI) in order to assess Thai students' perceptions of their teachers' behaviours in mathematics and statistics classrooms;

2. modify and validate the *College and University Classroom Environment Inventory* (CUCEI) in order to assess Thai students' perceptions of their learning environment in mathematics and statistics classrooms;

3. measure students' attitudes toward mathematics and statistics as subjects in classrooms using the TOSRA's scale "Attitude Towards Subject";

4. investigate associations between students' learning outcomes and their perceptions of the classroom learning environment as assessed by the modified QTI and the CUCEI;

5. investigate whether differences exist between male and female students in their perceptions of the learning environment in mathematics and statistics classrooms using the modified QTI and the CUCEI.

6. investigate the associations between students' learning environment and students' outcomes.

7. use the results of the study to improve learning and teaching in Rajabhat Universities.

8. apply foreign classroom environment instruments for use with Rajabhat Universities.

4. Research Questions

1. Is the modified QTI a valid and reliable instrument to assess students' perceptions of their teachers' behaviours in mathematics and statistics classrooms at Rajabhat Universities in Thailand?

2. Is the modified CUCEI a valid and reliable instrument to assess the students' perceptions of their classroom environments in mathematics and statistics classrooms at Rajabhat Universities in Thailand?

3. Are there any associations between students' perceptions of their classroom environments in mathematics and statistics classrooms and students' attitudes toward mathematics and statistics as subjects?

4. Are there any associations between students' perceptions of their classroom environment and students' cognitive achievement outcomes?

5. Are there any gender differences in the students' perceptions of students' actual and preferred classroom environments?

5. Rationale and Significance of the Study

Although in the past there have been many studies on the classroom environment in other countries, however, there have been very few such studies at Rajabhat Universities in Thailand,

consequently this study will be useful for teachers and students in Rajabhat Universities for the following reasons.

The study has the potential to describe ways to:

1. improve learning environment in mathematics and statistics classrooms;

2. monitor students' views of their classes and investigate the impact that different interpersonal behaviours have on student learning outcomes;

3. monitor teachers' instructions from the view points of their students;

4. examine student learning outcomes in two distinct areas: student attitudes, and students' cognitive achievement in mathematics and statistics classrooms;

5. investigate the associations between student's perceptions of their classroom environment in mathematics and statistics classes and students' attitudes and cognitive achievement outcomes.

6. Research Methodology

Population of the Study

The population of the study consisted of all Rajabhat university students in 40 universities distributed over area of Thailand who enrolled in mathematics and statistics courses (for example: Principles of Statistics, Statistics for Research, Business Statistics, Economics Statistics, Algebra, Calculus, Thinking and Decision Making) during the first and second semesters of the year 2005-2006.

Sample of the Study

The sample consisted of 1860 Rajabhat university students in 61 mathematics and statistics classrooms from 16 universities. The 1860 mathematics and statistics students were divided into two subgroups, the first group consisting of 860 students from 29 classes who completed the Actual and Preferred Forms of the *Questionnaire on Teacher Interaction* (QTI), and the second one consisting of 1000 students from 32 classes who completed the *College and University Classroom Environment Inventory* (CUCEI) questionnaire.

All students in a sample responded to the TOSRA scale of "Attitude Towards Subject". And 61 teachers responded the *Questionnaire on Teacher Interaction: Teacher Self Questionnaire.*

Instruments used in the Study

All classroom environment instruments have two forms, namely, the Actual and Preferred forms. The actual form measures perceptions of the actual or experienced classroom environment, whereas the preferred form measures the preferred or ideal classroom environment. The preferred form is concerned with goals or the things that students desire and measure perceptions of the classroom ideally liked or preferred. Although both forms have similar wording for each item, each has different

instructions for answering, such as "This teacher trusts us." in the QTI Actual Form, while the Preferred Form changes this item to "The teacher should trust students". "The teacher considers students' feelings" in the CUCEI actual form is changed to "The lecturer should consider students' feelings." in the preferred form. Thus, the actual form requires students to respond in terms of what they really feel or think about the current classroom environment, while the preferred form requires students to think about the classroom environment which they would prefer to have. Availability of separate actual and preferred forms of the instruments enables researchers and teachers to study the differences between the actual and preferred classroom environments experienced by students as well as by teachers, and to investigate whether students achieve better results in their preferred classroom environment.

In a more resent study involving learning environment, Fraser et al. (Fraser, Gidding & McRobbie, 1992, 1995; Fraser, Fisher & McRobbie, 1996) developed a "personal form" and a "class form" to measure on an individual student's perception in a class and to measure students' perceptions as a whole. For example, in a personal form "I find the classwork difficult" is changed to "The classwork is difficult." in the class form. So, the personal form of the instrument distinguishes personal perceptions from class perceptions of the classroom environment. The personal form of an instrument is sensitive for studying the learning environment within a class. Moreover, the personal form can be used to enrich data in qualitative studies of the classroom environment at different 'grain sizes' or degrees of analysis (Fraser, 1999). In this study I used four instruments: the first two being the QTI and the CUCEI.

The third instrument was the attitude questionnaire, the TOSRA (the scale of "Attitude Towards Subject" only), and the fourth instrument was the cognitive achievement test, constructed by myself.

1. The first instrument was the *Questionnaire on Teacher Interaction* (QTI) in two forms: the Actual and Preferred Forms. Both forms had 48 items in eight scales, with six items per scale designed to measure the perceptions of mathematics and statistics students toward their instructors. All 48 items were translated into a Thai Version. This instrument was used to measure the students' perceptions of their teachers' behaviors in mathematics and statistics classes and to determine the association between the classroom environment and students' cognitive achievement outcomes.

2. The second instrument was the *College and University Classroom Environment Inventory* (CUCEI) in two forms: the Actual and Preferred Forms similar to the QTI. The CUCEI consisted of 49 items in seven scales with seven items per scale, designed to measure

the students' perceptions of their mathematics and statistics classes and to determine associations between the learning environment and students' cognitive achievement outcomes found in 1 above.

3. The third instrument was an attitude questionnaire, the *Test of Science-Related Attitudes* (TOSRA) scale. The constructs are : namely, *Attitude and Efficacy* which contained three scales: *Attitude Towards Subject, Attitude Towards Computer Usage, and Academic Efficacy.* In this study the author used only the *Attitude Towards Subject* scale which contained eight items with a five-point response scale of Very often, Often, Sometimes, Seldom, and Almost Never. Both subgroups were administered the TOSRA (the scale of "Attitude Towards Subject" only) to gauge the students' attitude toward the subjects (mathematics and statistics) after instruction. This instrument was modified from the original *Test Of Science-Related Attitudes* (TOSRA) version (Fraser, 1981) to reconcile it with the Thai language. The purpose of this questionnaire was to measure students' attitudes toward mathematics and statistics, the associations between students' learning environments; their attitudes toward the subject, and their cognitive achievement scores (final scores) in mathematics and statistics classes.

4. The fourth instrument was *Questionnaire on Teacher Interaction: Teacher Self Questionnaire.* This questionnaire parallels to the QTI Student Version. The purpose was used to measure teachers' self behaviours.

7. Data Analysis and the Results

The four instruments: the QTI, CUCEI, the TOSRA, and the QTI for teacher were analyzed to find the validity and reliability of the instruments. The QTI is a valid instrument followed the circumplex pattern of the Leary's Model of Interpersonal Behaviour (Leary, 1957) both using individual student scores and class mean scores as the units of analysis (see Figures 1,2).

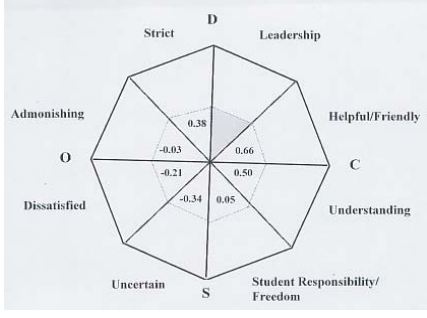

Figure 1. Correlation between the Leadership Scalc and Other Scales using the Individual Student Scores as the Unit of Analysis

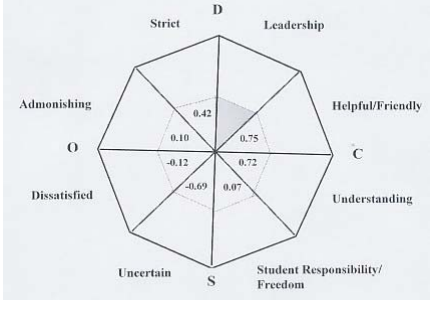

Figure 2. Correlation between the Leadership Scale and Other Scales using the Class Mean Scores as the Unit of Analysis

The reliabilities for each scale of the QTI instrument were in the acceptable ranges as shown in Table 1 using the Actual Form scores and Table 2 using the Preferred Form scores.

Table 1

The Cronbach Alpha and ANOVA Results in the Thai Version of the QTI (Actual Form)

QTI Scales	Alpha Reliability Coefficients			ANOVA Results Eta^2
	No of Items	Individual Student Scores	Class Mean Scores	
DC: Leadership	6	0.73	0.85	0.20***
CD: Helpful/Friendly	6	0.65	0.70	0.35***
CS: Understanding	6	0.70	0.82	0.18***
SC: Student Responsibility/ Freedom	6	0.48	0.71	0.33***
SO: Uncertain	6	0.77	0.82	0.63***
OS: Dissatisfied	6	0.85	0.81	0.64***
OD: Admonishing	6	0.83	0.74	0.78***
DO: Strict	6	0.52	0.72	0.16**
All 48 items	**48**	**0.89**	**0.87**	

**p<0.01 ***p<0.001 *n = 860, 29 classes*

Table 2

The Cronbach Alpha and ANOVA Results in the Thai Version of the QTI (Preferred Form)

QTI Scales	Alpha Reliability Coefficients			ANOVA Results Eta^2
	No of Items	Individual Student Scores	Class Mean Scores	
DC: Leadership	6	0.73	0.86	0.09**
CD: Helpful/Friendly	6	0.65	0.82	0.21***
CS: Understanding	6	0.70	0.82	0.12***
SC: Student Responsibility/ Freedom	6	0.55	0.60	0.13***
SO: Uncertain	6	0.75	0.85	0.54***
OS: Dissatisfied	6	0.84	0.89	0.53***
OD: Admonishing	6	0.45	0.70	0.44***
DO: Strict	6	0.46	0.75	0.10**
All 48 items	**48**	**0.84**	**0.88**	

**p<0.01 ***p<0.001 *n = 860, 29 classes*

For the CUCEI instrument, the Cronbach Alpha reliability coefficients which shown in Table 3 ranges from 0.68 to 0.85 and from 0.93 to 0.97 using individual student scores and class mean scores as the units of analyses in Actual Form.

Table 3

The Cronbach Alpha and ANOVA Result in the Thai Version of the CUCEI (Actual Form)

QTI Scales	Alpha Reliability Coefficients			ANOVA Results Eta^2
	No of Items	Individual Student Scores	Class Mean Scores	
DO: Strict	6	0.52	0.72	0.16**
Personalisation	7	0.78	0.94	0.47***
Involvement	7	0.68	0.93	0.58***
Student Cohesiveness	7	0.85	0.97	0.50***
Satisfaction	7	0.77	0.96	0.40***
Task Orientation	7	0.73	0.95	0.55***
Innovation	7	0.77	0.95	0.60***
Individualisation	7	0.74	0.94	0.58***
All 49 items	**49**	**0.95**	**0.99**	

****p<0.001, n = 1000, 32 classes*

For the CUCEI instrument, the Cronbach Alpha reliability coefficients which shown in Table 4 ranges from 0.46 to 0.70 and from 0.82 to 0.91 using individual student scores and class mean scores as the units of analyses in Preferred Form.

Table 4

The Cronbach Alpha and ANOVA Results in the Thai Version of the CUCEI (Preferred Form)

CUCEI Scale	Alpha Reliability Coefficients			ANOVA Results Eta^2
	No of Items	Individual Student Scores	Class Mean Scores	
Personalisation	7	0.67	0.85	0.25***
Involvement	7	0.46	0.84	0.23***
Student Cohesiveness	7	0.70	0.91	0.23***
Satisfaction	7	0.70	0.91	0.23***
Task Orientation	7	0.69	0.91	0.25***
Innovation	7	0.54	0.88	0.22***
Individualisation	7	0.50	0.82	0.18***
All 49 items	**49**	**0.92**	**0.96**	

***p<0.001, *n = 1000, 32 classes*

The reliabilities of the TOSRA scale (the scale of "Attitude Towards Subject") which both using with QTI and CUCEI are in the acceptable values shown in Table 5.

Table 5

Internal Consistency Reliability Coefficients (Cronbach Alpha) for Individual Student Scores and Class Mean Scores

Scale	Unit of Analysis	Number of Items	Alpha Reliability Coefficients	
			QTI subgroup	CUCEI subgroup
Attitude Towards Subject	Individual student scores	8	0.88	0.87
	Class Mean Scores	8	0.97	0.95

8. Answers to the Research Questions

Based on analysis of both the quantitative and qualitative data in previous section, all major findings and research questions are described in the sections following.

Research Question 1

Is the modified QTI a valid and reliable instrument to assess students' perceptions of their teachers' behaviours in mathematics and statistics classrooms at Rajabhat Universities in Thailand?

The data analyses confirmed the QTI was a valid instrument according to Leary's circumplex model (Fisher & Poh, 1997) using the individual student scores as the unit of analysis. The Leadership scale highly correlated with the Helpful/Friendly scale, which was the adjacent scale (to the Leadership scale) on the circumplex model.

The circumplex pattern of this instrument was validated by both using the individual student scores and the class mean scores as the unit of analyses. Consequently, the Thai version of the QTI was found to be a valid instrument for use to measure students' perceptions of learning environments in mathematics and statistics classrooms at Rajabhat Universities in Thailand.

The Cronbach Alpha reliability coefficients were computed to determine the internal consistency reliability of the QTI, with both the individual student and the class mean as the units of analyses. Using individual student and class mean as the units of analysis, the Cronbach Alpha reliability coefficients of the eight scales of the QTI both were in acceptable ranges (see Tables 1,2). Therefore, the Cronbach Alpha reliability coefficients of the QTI (Thai Version) in this study were acceptable, so the QTI can be use to measure students' perceptions of their teachers' behaviours in Thai mathematics and statistics classroom with confidence. In addition, from ANOVA results the seven scales of the QTI in Thai version could differentiate students' perceptions of their teachers' behaviours between classrooms.

The results of this study confirmed the validity and reliability of Thai version of the QTI and thus have answered the Research Question 1, that is, the QTI is a valid and reliable instrument for use in mathematics and statistics classes at Rajabhat Universities in Thailand.

Research Question 2

Is the modified CUCEI a valid and reliable instrument to assess the students' perceptions of their classroom environments in mathematics and statistics classrooms at the Rajabhat Universities in Thailand?

The ANOVA results indicated that all scales of the CUCEI could differentiate students' perceptions of their classroom environment significantly between the mathematics and statistics classrooms. Consequently, the Thai version of the CUCEI is a valid instrument which has a discriminant validity, so it was appropriate instrument for use to measure students' perceptions of their learning environments in mathematics and statistics classrooms.

Using the student Actual Form scores for data analysis, the Cronbach Alpha reliability coefficients of the CUCEI were in acceptable ranges, both using the individual student scores and the class mean scores as the units of analysis (see Tables 3 and 4). These findings demonstrated that the CUCEI is a reliable instrument. In answer to the Research Question 2, the Thai Version of the CUCEI could be utilize to gauge students' perceptions of their classroom environments in mathematics and statistics classrooms at Rajabhat Universities in Thailand with confidence.

Research Question 3

Are there any associations between the students' perceptions of their classroom environments in mathematics and statistics classrooms and students' attitudes toward mathematics and statistics as the subjects?

The three instruments: the QTI, the CUCEI and the TOSRA (the scale of "Attitude Towards Subject" only) were used to examine the associations between students' perceptions of classroom environments and their attitudes toward mathematics and statistics as the subjects. The statistics used to find the associations were the simple correlation, multiple correlation and the standardized regression coefficients using both individual student scores and class mean scores as the units of analyses.

The results of the study indicated that the four scales of the QTI–Leadership, Helpful/Friendly, Understanding, and Student Responsibility/Freedom behaviours – correlated significantly with the students' attitude towards subject when both using the individual student scores and class mean scores as the unit of analyses. These findings indicated that the teachers and instructors who demonstrated above behaviours positively influenced students' attitude toward the subjects. The 14% and 44% of variances in students' attitude toward subject could be attribute to their perceptions of their teachers' behaviours both using individual student scores and class mean scores as the unit of analyses respectively. These findings indicated that, on the whole, teachers' behaviours influenced students' attitude toward mathematics and statistics.

The simple correlations between the CUCEI scales and the students' attitudes toward subject scale were positively correlated with the seven scales: Personalization, Involvement, Student Cohesiveness, Satisfaction, Task Orientation, Innovation, and Individualization when using the individual student scores as the unit of analysis. Consequently, the higher degree of Personalization, Involvement, Satisfaction, Task Orientation, Innovation, and Individualization the students perceived their classroom environment the better were their attitude towards subject. However, the CUCEI scales of Satisfaction correlated with the students'

attitude toward subject when using the class mean scores as the unit of analysis.

Using individual student scores as the unit of analysis, the multiple correlation (R=0.36) between the CUCEI scales and students' attitude towards subject was positively significant. The R^2 were 0.13 and 0.34 for individual and class mean as the unit of analyses indicating that the 13% and 34% of the variances in students' attitude toward subject could be attributed to their perceptions of their classroom learning environments.

Research Question 4

Are there any associations between the students' perceptions of their classroom environments in mathematics and statistics classrooms and students' cognitive achievement outcomes?

To this question the simple correlations between the QTI scales and students' cognitive achievement scores revealed that there were significant in the eight scales of Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing, and Strict behaviours using the individual student as the units of analysis, but only three scales of the QTI, Uncertain, Dissatisfied, and Strict behaviours, were negatively correlated and significant when using individual student as the units of analysis. The strong evidences of the negative correlation between the Uncertain, Dissatisfied and Strict scales with the students' cognitive achievement scores indicated that the teachers who had been more rated in the three behaviours: Uncertain, Dissatisfied, and Strict scales the lower were their achievement scores, in contrast, the teachers who had been more rated in the scales of Leadership and Understanding the better were their achievement scores in the final examination.

The regression analysis using the individual student scores as the unit of analysis indicated that, as a whole, all scales of the QTI affected the students' cognitive achievement scores. The teachers who achieved more in the scales of Helping/Friendly, Understanding, Admonishing, and Strict behaviours appeared to influence students' cognitive achievement scores. The portion of variance in students' cognitive achievement outcomes that can be attributed to their perceptions of teacher behaviour (QTI scale) were respectively 14% and 57%, using the individual student scores and class mean scores as the unit of analyses as indicated that teacher's behaviour is a factor to enhance students' cognitive achievement outcomes. These findings of the study have answered the Research Question 4 for using the QTI instrument. That is, there are associations between classroom environment and students' cognitive achievement outcomes.

To answer Research Question 4 for using the CUCEI instrument, the results from data

analysis in Table 3 were examined. The simple correlations between the CUCEI scales and the students' cognitive achievement scores using the individual student scores as the unit of analysis were positively significantly correlated with the scales of Personalisation, Involvement, Satisfaction, and Individualisation. These results indicated that the teachers who possessed behaviours related to these four scales may have contributed to higher students' cognitive achievement scores.

As for using the class means as the units of analysis, none of the scales of the CUCEI was positively and significantly correlated with the students' cognitive achievement scores. But two scales of Student Cohesiveness and Task Orientation were negatively correlated with students' cognitive achievement scores.

The multiple correlation analysis showed that, as a whole, the CUCEI scales were significantly correlated with students' cognitive achievement scores and the percentage of variance in students' cognitive achievement scores were accounted for by the CUCEI scales in 8% and 67% for individual student and class mean as the unit of analyses respectively.

These findings of the study have answered Research Question 4 for using the CUCEI instrument. That is, the Personalization, Involvement, Satisfaction, and Individualisation scales were positively correlated with the students' cognitive achievement scores and the scales of Student Cohesiveness, Task Orientation scales were negatively correlated with attitude towards subject when using the individual student scores as the unit of analysis.

Research Question 5

Are there any gender differences in the students' perceptions of students' actual and preferred classroom environments?

Answering Research Question 5, the t-test for independent variables was used. Using Actual Form scores of the QTI for data analysis, the mean scores of male and female students were significant difference in the scales of Uncertain, Dissatisfied, and Admonishing. For using Preferred Form scores, there were significant gender differences in the scales of Student Responsibility/Freedom and Uncertain behaviours. The findings indicated that the male and female students interpreted their teachers' behaviours differently in the scales of Student Responsibility /Freedom, Uncertain, Dissatisfied, and Admonishing.

The scale means of the QTI for both male and female students in the Preferred Form scores were higher than the scale means of the Actual Form in the scales of Leadership, Helpful/ Friendly, Understanding, Student Responsibility/Freedom, Dissatisfied, and Admonishing. In contrast, the means of the Preferred Form of both the male and female students were lower than the means of the Actual Form scores in the

scales of Uncertain, and Strict behaviours.

These findings indicated that the male and female students preferred the teachers to exert more Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Dissatisfied and Admonishing behaviours than they actually did.

To measure students' perceptions of classroom environment using the CUCEI, the Actual and Preferred Form scores were examined. Comparing the Actual and Preferred Form score means between male and female students indicated that the scales of Involvement, Student Cohesiveness, and Individualisation in the Actual Form displayed significant gender differences, but not in the other four scales.

And when the Preferred Form scores were used, the male and female students perceived their classroom environment differently in scales of Involvement, Task Orientation, Innovation, and Individualisation. Both male and female students perceived their learning environment in Preferred Form scores more than the Actual Form scores for every scales of the CUCEI.

These findings answered Research Question 5 about gender differences in students' perceptions of classroom environment. That is, there were gender differences in the scales of Student Responsibility/Freedom, Uncertain, Dissatisfied, and Admonishing of the QTI scales and the Involvement, Student Cohesiveness, Individualisation of the CUCEI scales when using individual student scores as the unit of analysis in Actual Form.

All research questions were answered.

9. Conclusion and Discussion

Two instruments, the QTI and the CUCEI are valid and reliable for use to assess Thai students' perceptions of their learning environment in mathematics and statistics classrooms at the Rajabhat Universities in Thailand. The Cronbach Alpha reliability coefficients of the QTI' scales ranged from 0.48 to 0.85 and from 0.70 to 0.85 using the individual student scores and the class mean scores as the units of analyses in Actual Form scores. But in using the Preferred Form scores, the Cronbach Alpha coefficients ranged from 0.45 to 0.84 and from 0.60 to 0.89 using individual student scores and class mean scores as the units of analyses. The Cronbach Alpha reliability coefficients of the CUCEI scales ranged from 0.68 to 0.85 and from 0.93 to 0.97 using individual student scores and class mean scores as the units of analyses in Actual Form scores. But using the Preferred Form scores, the Cronbach Alpha reliability coefficients ranged from 0.50 to 0.70 and 0.82 to 0.91 using individual student scores and class mean scores as the units of analyses.

Associations between students' perceptions of their classroom environment using the QTI and students' attitudes toward subjects were positively related in scales of Leadership,

Helpful/Friendly, Understanding, and Student Responsibility/Freedom and 14% of variances in students' attitude toward subject could be attributed to their perceptions of their teachers' behaviours.

Using the CUCEI, the scales of Personalization, Involvement, Satisfaction, Student Cohesiveness, Task Orientation, Innovation, and Individualization were positively and significantly related with students' attitudes toward subjects. The 13% of variances in students' attitudes toward subjects was explained by classroom learning environment assessed by the CUCEI scales.

Comparison of students' perceptions of their teachers' behaviours and classroom learning environments between male and female students indicated that the male and female students perceived differently in scales of Uncertain, Dissatisfied, and Admonishing measured by the QTI, but when measured by CUCEI, the male and female students perceived differently in scales of Involvement, Student Cohesiveness, and Individualisation; both the QTI and CUCEI used in Actual Form scores.

Comparison of students' perceptions of their teachers' behaviours with the teachers perceived themselves indicated that the teachers responded more than students did in scales of Leadership, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, and Admonishing, but the students perceived more than teachers did in scales of Helpful/Friendly, and Strict.

10. Suggestion for the Future Research

The results of study suggested that the QTI and the CUCEI instruments provided a framework to measure important dimensions of the classroom environments at Rajabhat Universities in Thailand. A number of suggestions for future research are as follows:

1. These instruments should be used in other areas or subjects to assess students' perceptions of their learning environments.

2. Assessing students' learning environments should be succeeding in higher education for improvement of students' outcomes.

3. The teachers or instructors should use the Questionnaire on Teacher Interaction both the student and teacher versions once a year to see students' perceptions and their own views.

References

1. DeMar, G. (1988). **Behaviourism.** Retrieved March 13, 2004, from http://forerunner.com/forerunner/X0497_DeMar_-_Behaviorism.html.
2. Fisher, D. L. & Poh, I. (1997). **Sensitivity of the QTI to micro climate in the classroom.** Paper presented at the 1997 International Conference on Science, Mathematics and Technology Education, Hanoi, Vietnam.

3. Fraser, B. J. (1981). **Test of Science-Related Attitudes Handbook (TOSRA).** Melbourne: Australian Council for Educational Research.
4. Fraser, B. J. (1986). **Classroom Environment.** London: Croom Helm.
5. Fraser, B. J. (1994). Research in classroom and school climate. In D. Gabel (Ed.), **Handbook of Research on Science Teaching and** Learning (pp. 493-541). New York: Macmilland.
6. Fraser, B. J. (1998a). Science learning environments: Assessment, effect and determinants. In B. J. Fraser & K. Tobin (Eds.), **The International Handbook of Science Education** (pp. 527-564). Dordrecht, The Netherlands: Kluwer.
7. Fraser, B. J. (1998b). The birth of new journal: Editor's introduction. **Learning Environments Research.** 1, 1-5.
8. Fraser, B. J. (1999). "Grain sizes" in learning environment research: Combining qualitative and quantitative methods. In H. C. Waxman & H. J. Walberg (Eds.), **New Directions for Teaching Practice and Research** (pp.285-296). Berkeley, CA: McCutchan.
9. Fraser, B. J., Fisher, D. L., & McRobbie, C. J. (1996, April). **Development, Validation and use of Personal and Class form in a new Classroom Instrument.** Paper presented at the annual meeting of the American Educational Research Association, New York City.
10. Fraser, B. J. & Fisher, D. L. (1982). Predicting student's outcomes from their perceptions of classroom psychosocial environment. **American Education Research Journal,** 19, 498-518.
11. Fraser, B. J. Giddings, G. J. & McRobbie, C. J. (1992). Assessment of the psychosocial environment of university science laboratory classrooms: A cross-national study. **Higher Education,** 24, 431-451.
12. Fraser, B. J. & Walberg, H. J. (Eds.)(1991). **Educational Environments: Education, Antecedents and Consequences.** Oxford, England: Pergamon Press.
13. Government Gazette. (2548). **General Promulgation.** Vol. 122, 25/05/2005.
14. Haertel, G. D. & Walberg (1988). Assessing social-psychological classroom environments in program evaluation. In K. J. Conrad & C. Roberts-Gray (Eds.), **Evaluating Program Environments** (pp. 45-61). San Francisco: Jossey-Bass.
15. Leary, T. (1957). **An Interpersonal Diagnosis of Personality.** New York: Ronald Press.
16. Lewin, K. (1936). **Principles of Topological Psychology.** New York: McGraw.
17. Ministry of Education. (1995). **The Rajabhat Institute Act 1995.** Bangkok : Kuruspa, Thailand.
18. Moos, R. H. (1974). **The Social Climate Scales: An overview.** Palo Alto, CA: Consulting Psychologists Press.
19. Parker, S. P. (Ed.). (1989). **Dictionary of**

Scientific and Teaching Terms. (4th ed.) New York : McGraw Hill.

20. Stern, G. G. (1970). **People in Context: Measuring Person-Environment Congruence in Education and Industry.** New York: Wiley.
21. Teh, G. P. L. & Fraser, B. J. (1993). **A study of computer assisted learning environments in Singapore.** Paper presented at annual meeting of American Educational Research Association, Atlanta, GA.
22. Tobin, K. & Fraser, B. J. (1998). Qualitative and quantitative landscapes of classroom learning environment In B. J. Fraser & K. Tobin (Eds.), **The International Handbook of Science Education** (pp. 623-640). Dordrecht, The Netherlands: Kluwer.
23. Von Graserfield, E. (1989). Cognition, construction of knowledge. In D. L. Fisher (Ed.) **Study of Learning Environment** (Vol. 7, 1-2), Western Australia, Perth: Science and Mathematics Center, Curtin University of Technology.
24. Walberg, H. J. (Ed.) (1979). **Educational Environments and Effects: Evaluation, Policy and Productivity.** Berkeley, CA: McCutchan.
25. Walberg, H. J. (1981). A psychology theory of educational productivity. In F Farley & N. J. Gordon (Eds.), **Psychology and Education: The State of the Union** (pp. 81-108). Berkeley, CA: McCutchan.