Designed on Associations between Students' Perception of their Actual and Preferred Science Laboratory Classroom Inventories and Science Attitudes at the 8th Grade Level

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Abstract
Using the *35-Items* of *Science Laboratory Environment Inventory (SLEI)* was developed to examine students' perspectives about their earth science laboratory classes. The SLEI is in two parallel forms to examine of five scales: *integration*, *rule clarity*, *student cohesiveness*, *open-endedness*, and *material environment* and consists of 7 items for each scale, which are answered through a 5-Point Likert scale. This study was to describe student's perceptions of their actual (assesses the class as it actually is) and preferred (asks the students what they would preferred their class to be like-the ideal situation) were assessed with a sample of 117secondary educational students in 3 classes at Grade level 8 in BorabuWittayakhan School. Associations between students' perceptions and their attitudes toward their science were determined, and students' attitudes were assessed with a short Thai version of the *Test Of Science-Related Attitude*for administrating research methodology. Statistically significant differences were found between students' perceptions of their actual and preferred earth science environment toward their science also were found. Cronbach's alpha reliability coefficients for the scales were adequate, and confirmatory factor analyzes provided support for the theoretical framework behind the questionnaire were omitted. The multiple correlations *R* is significant for the SLEI and considered associations and value indicates that with the TOSRA and the SLEI to assess the pre and post Actual and Preferred of the variances in students' attitude was also determined. This study showed that prefer students' perception perceived their learning environment more favourably than actually. These differences in perceptions are presented and some implications for science laboratory teaching are provided.

Keyword: Actual and preferred forms, the Science Laboratory Environment Inventory (SLEI)**,** the Test of Science-Related Attitude (TOSRA), science laboratory classroom learning environment, and student perception.

1. INTRODUCTION

Generally, researches on the classroom learning environment have spanned more than four decades with significant contributions to the field of education. Reviews of research (Fraser, 1986; Fraser, 1998; Fraser & Walberg, 1991; Haertel, Walberg &Haertel, 1981) reported that most of the studies on classroom learning environments used the perceptual measures approach to investigate the nature of classroom learning environments. This approach involved the use of classroom environment instruments to measure teachers' and students' perceptions of their classroom environments for investigating the nature of the classroom learning environment. These studies had developed many well-validated and robust classroom environment instruments for use in many countries in different classroom contexts (Fraser, B. J. (1998))[2].

Normally, sciencelaboratory teaching is one of the hallmarks of education in the sciences, but writers are questioning whether the great expense of maintaining and staffing laboratories is really justified, and whether many of the aims of laboratory teaching could be pursued more effectively and at less cost in non-laboratory settings. However, we know little about the effects of laboratory instruction on student learning and attitudes. In reviewing 16 recent studies, Gallagher (1987)[3].concluded that "Laboratory work is an accepted part of science instruction. Given its important place in the education of youth, it is surprising that we know so little about its functioning and effects" was assessed (p. 351). New research will illuminate students' views of laboratory settings and show the impact of laboratory classes on student outcomes.

The Science Laboratory Environment Inventory (SLEI) was developed to examine students' perspectives about their science laboratory courses (Fraser et al., 1993)[4]. The SLEI is unique in that it comes in two parallel forms, one which addresses the current class, and one which addresses how they would prefer the class to be (Fraser et al., 1993). The SLEI examines five subscales: integration, rule clarity, student cohesiveness, open-endedness, and material environment (Fraser et al., 1993)[4]. The SLEI consists of 7 items for each subscale, yielding 35 total items which are answered through a 5-Point Likert scale.

This research describes the development of a new instrument for assessing student perceptions of psychosocial environment in science laboratory classrooms, and reports comprehensive validation information for large samples of senior high school and university students from BorabuWittayakhanSchool, Mahasarakham in Thailand. The work is distinctive because it extends classroom environment research in non-laboratory settings to science laboratory classes, and provides one of the few classroom environment studies conducted in Thailand during the last decade.

The purpose of this study is beyond the scope of this article to summarize the decades of research on this topic; however, a perusal of the school and classroom climate literature indicates that the stability and efficacy of elementary school children's social interactions influence their academic and social development. This study is to focus on given the paucity of strong empirical research conducted with Thai secondary school students at the BorabuWittayakhanSchool at Grade 8 in Mahasarakham Province for demonstrating the reliability and validity of the Science Laboratory Environment Inventory (SLEI), before it could be recommended to school administration as a viable measure of school climate within the *Test Of Science-Related Attitude* (TOSRA), the instruments need to be thoroughly analyzed psychometrically.

Science Education Classroom Learning Environment

Science education classroom learning environment of research and evaluation in science education have relied heavily on the assessment of academic achievement and other

valued learning outcomes, an overview is given of several lines of past research involving environment assessments in science classrooms (including associations between outcomes and environment, use of environment dimensions as criterion variables, and person-environment fit studies of whether students achieve better in their preferred environment), consideration is given to teachers' use of classroom and educational institute environment instruments in practical attempts to improve their own classrooms and educational institute, currents trends and future desirable directions in research on educational environments are identified (e.g., combining quantitative and qualitative methods, educational institute-level environments, educational institute psychology, links between educational environments, cross-national studies, transition between primary and secondary schooling, teacher education and teacher assessment) (Fraser, 1998)[2].

Approaches to Studying Educational Environments

To approach students' perceptions to this study educational environments can be approached to studying educational environments involves application of the techniques of naturalistic inquiry, ethnography, interpretive research, to define the classroom environment in terms of the shared perceptions of the students has the dual advantage of characterising the setting through the eyes of the participants themselves and capturing data, students are at a good vantage point to make judgements about classrooms because they have encountered many different learning environments and have enough time in a class to form accurate impressions. Also, even if instructors are inconsistent in their day-to-day behaviour, they usually project a consistent image of the long-standing attributes of classroom environment. Later in this research, discussion focuses on the merits quantitative method when studying educational environments (Fraser & Tobin 1991)[5].

Historical Science Education Learning Environment Instruments

In the four last decades, there are educational researchers (Fraser, B. J. & Walberg, H. J.(1991))[6].began seminal independent programs of research which form the starting points for the work reviewed in this study. Walberg developed the widely-used *Learning Environment Inventory* (LEI) as part of the research and evaluation activities of Harvard Project Physics Moos, R.H. (1974)[7]. Moos began developing the first of his social climate scales, including those for use in psychiatric hospitals and correctional institutions, which ultimately resulted in the development of the *Classroom Environment Scale* (CES) (Moos 1979; Moos &Trickett 1984)[8]. The way in which the important pioneering work of Walberg and Moos on perceptions of classroom environment developed into major research programs and spawned a lot of other research is reflected in books (Wubbels, T., Brekelmans, M. &Hooymayers, H. (1991))[9], literature reviews (Fraser B. J. & Fisher, D. L. (1983a))[10]. and monographs sponsored by the American Educational Research Association's Special Interest Group (SIG) on the Study of Learning Environments (Fraser B. J. & Fisher, D. L. (1983a))[11].

Developing the contemporary instruments: Learning Environment Inventory (LEI); Classroom Environment Scale (CES); Individualised Classroom Environment Questionnaire (ICEQ); My Class Inventory (MCI); College and University Classroom Environment Inventory (CUCEI); Questionnaire on Teacher Interaction (QTI); Science Laboratory Environment Inventory (SLEI); Constructivist Learning Environment Survey (CLES); and What Is Happening In This Class (WIHIC) questionnaire. The name of each scale in each instrument, the level (primary, secondary, higher education) for which each instrument is suited, the number of items contained in each scale, and the classification of each scale according to Moos (1974)[7].scheme for classifying human environments.

Differences between Student Perceptions of Actual and Preferred Environment

Research reviews onstudent perceptions of Actual and Preferred Environment were differentiated and reviewed. The previous two decades have witnessed considerable international interest in the conceptualization, measurement, and investigation of perceptions of psychosocial characteristics of learning environment in elementary, secondary, and higher education classrooms (Fraser, B. J. & Walberg, H. J. (Eds.). (1991))[6]. Most recent classroom environment instruments have distinct versions measuring student perceptions of actual and preferred classroom environment. The preferred forms include goals and value orientations and preferred classroom environment. In the present study, parallel actual and preferred versions were developed and field-tested in six countries.

The most of the instruments is that they have, not only a form to measure perceptions of 'actual' or experienced classroom environment, but also another form to measure perceptions of 'preferred' or ideal classroom environment. The preferred forms are concerned with goals and value orientations and measure perceptions of the classroom environment ideally liked or preferred. Although item wording is similar for actual and preferred forms, slightly different instructions for answering each are used. A typical item in the actual form of the Student Cohesiveness scale is: "Students in this laboratory class get along well as a group." The wording of the preferred version is almost identical except for the use of such words as "would." For example, the item "Our laboratory class has clear rules to guide student activities" in the actual version is reworded in the preferred version to read "Our laboratory class would have to clear student activities"

Using Instruments on Science Laboratory Environment Inventory (SLEI) Classes

The initial version of the SLEI contained 72 items altogether, with 9 items in each of eight scales. However, extensive field-testing and instrument validation later led to a more economical and valid final version with 35 items, with 7 items in each of five of the original scales. Each item's response alternatives are Almost Never, Seldom, Sometimes, Often, and Very Often. The scoring direction is reversed for approximately half the items. Assessments of *the Science Laboratory Environment Inventory* of students' or teachers' perceptions of five dimensions of actual or preferred classroom environment, namely, Student Cohesiveness, Open-Endedness, Integration, Rule Clarity, and Material Environment. The instrument was field-tested in Canada, Australia, the United States, England, Israel, and Nigeria, both in secondary and in post-secondary institutions. Various analyses attested to each scale's internal consistency, reliability, factorial validity, predictive validity, and ability to differentiate between the perceptions of students in different classes. The instrument is equally valid for use in its actual and preferred versions, for senior secondary school and university laboratory classes, for the individual or the class mean as the unit of analysis, and for each of the six countries.

The Test Of Science-Related Attitude (TOSRA)

To investigate of associations between Actual and Preferred students' perceptions of their science laboratory environment classes in Burabu Wittayakhan School. A Test Of Science-Related Attitude (TOSRA) previously by Fraser (1981)[14] was modified, adapted, and selected for this study. Because the scale was intended to measure students' attitudes on the eight items are suitable for group administration and all can be administered within the duration of Actual and Preferred students' perceptions of their science laboratory environment classes. Furthermore, the TOSRA has been carefully developed and extensively field tested and has been shown to be highly reliable that it has been translated to Thai version in this study.

Research Purposes

1. To investigate and compare students' perceptions of their actual and preferred science laboratory class inventories.
2. To associate between students' perceptions of their actual science laboratory class inventories and their actual and preferred s and their preferred science laboratory class inventories and their actual and preferred science attitudes.

2. MATERIALS AND METHODS

Research Procedure

Using the SLEI was follows as for assessing students' perception of their actual form on the 10th week, and preferred form on the 15th week and the TOSRA on the 15th week for associating science laboratory classroom learning environments in science classroom learning environment for secondary educational students at Grade 7 in 2 classes in Burabu Wittayakhan School, Maha Sarakham Province.

Each scale of the SLEI were composed with the 7-item, minimum scoring is 7 and maximum score is 35. The first scale, Student Cohesiveness is composed the item of 1, 6, 11, 16, 21, 26, 31; the second scale, Open-Endedness is composed the item of 2, 7, 12, 17, 22, 27, 32; the third scale, Integration is composed the item of 3, 8, 13, 18, 23, 28, 33; the fourth scale, Rule Clarity is composed the item of 4 ,9 ,14 ,19 ,24 ,29, 34; and the fifth scale ,Material Environment is composed the item of 5, 10, 15, 20, 25, 30, 35.

Data Analyses

The scaling of the items approximated a 5-point ranking scale, internal consistency reliabilities (alpha coefficients) were computed for each of the derived factors of the actual and preferred SLEI forms and the Attitude scale as specified in Fraser (1989)[19]. Factorial validity and adequacy of fit for the dimensionality of the SLEI were assessed through principal component analyses. The multiple correlations were significant of students' perceptions of their school climate for the Actual Form of the SLEI with students' attitudes to associate were analyzed.

Sample

This study is improved and developed students' science laboratory classroom environment with actual and preferred student's perceptions with a sample size of 117 secondary educational students in 3 classes at Grade 8 in Borabu Wittayakhan School, Maha Sarakahm Province, in the first semester in academic year 2015.

3. RESULTS

Validity and Reliability of Research Instruments

This section reports typical validation data for selected classroom environment scales. Table 1, 2, and 3 provide a summary of a limited amount of statistical information for the SLEI and TOSRA instruments considered previously. Attention is restricted to the student actual form and to the use of the individual student as the unit of analysis. Table 2 provides information about each scale's internal consistency reliability (alpha coefficient) and the ability of a scale to differentiate between the perceptions of students in different classrooms (significance level with F-test).

A. Validation of the SLEI

Description of quantitative data of analyzing responses for Master of Science teacher student's assessments is reported in Table 1.

The results given in Table 1 shows that on average item means for each of the five SLEI scales, that they contain five items, so that the minimum and maximum score possible on each of these scales is 7and 35, respectively. Because of this difference in the number of

items in the five scales, the average item mean for each scale was calculated so that there is a fair basis for comparison between different scales. These means were used as a basis for constructing the simplified plots of significant differences between forms of the SLEI. For the remaining five scales, namely; *Cohesiveness*, *Friction*, *Difficulty*, *Satisfaction*, and *Competitiveness* scales

Table 1. Scale Average Mean Scores, Standard Deviation of the Actual1, Actual 2, and the Preferred Forms for the SLEI

Scale	Preferred Form		Actual Form			
			The first phase		The second phase	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Student Cohesiveness	4.12	0.42	3.24	0.42	4.08	0.43
Opened-Endedness	4.33	0.46	3.35	0.56	4.32	0.48
Integration	4.60	0.20	3.76	0.42	4.58	0.23
Rule Clarity	4.12	0.03	3.76	0.03	4.12	0.03
Material Environment	3.99	0.51	3.71	0.39	3.96	0.51

Table 1 reports the average mean scores and standard deviations of the science laboratory classroom environment in terms of the assessing students' perceptions of their actual 1, actual 2, and preferred classes. These findings are in the mean scores ranged from 3.24 (Student Cohesiveness) to 3.76 (Integration) for the actual 1 form, ranged from 3.96 (Material Environment) to 4.58 (Integration) for the actual 2, and ranged from 3.99 (Material Environment) to 4.60 (Integration) for the preferred form of the unit analysis. The Standard Deviations were also shown that students' responses ranged from 0.03 to 0.56) for the actual 1 form, ranged from 0.03 to 0.51) for the actual 2 form, and ranged from 0.03 to 0.51) for the preferred form of the units of analysis.

Table 2. *Scale Comparisons between Relations of F-test Analysis for the SLEI*

Scale		SS	df	MS	F-test	Sig.
Student Cohesiveness	Between Group	57.71	2	28.85	155.93	.00
	Within Group	64.37	348	0.18		
	Total	122.09	350			
Opened-Endedness	Between Group	74.06	2	37.03	144.71	.00
	Within Group	89.04	348	2.25		
	Total	163.10	350			
Integration	Between Group	54.43	2	27.21	293.533	.00
	Within Group	32.26	348	0.09		
	Total	86.70	350			
Rule Clarity	Between	10.36	2	5.18	28.26	

	Group					.00
	Within Group	63.79	348	0.18		
	Total	74.15	350			
Material Environment	Between Group	5.20	2	2.60	11.40	.00
	Within Group	79.46	348	0.22		
	Total	84.67	350			

Table 2 shows the relationships between each scale of the SLEI, which compared of between and within groups, and total all of five scales. Statistically significant was related with F-test at evidence of 0.05 level.

Table 3. *Scale Science Attitudes of the Relationships between Multiple Efficiency of Pre and Post of Actual 1 and Actual 2 forms for the SLEI.*

Science-Related Attitude		Student Cohesiveness	Opened-Endedness	Integration	Rule Clarity	Material Environment
Pre-Science-Related Attitude and Actual-1 Form	Efficiency of Multiple Correlation	0.05	0.05	0.24	0.24	0.32
	Sig.	0.53	0.53	0.00***	0.00***	0.00***
Post-Science-Related Attitude and Actual-2 Form	Efficiency of Multiple Correlation	0.08	0.05	0.41	0.20	0.06
	Sig.	0.39	0.57	0.00***	0.02*	0.51

*N = 117, *ρ < 0.05, **ρ < 0.01, ***ρ < 0.001,*

These involved: simple correlation and multiple regression analyses of relationships between the set of actual environment scales as a whole and the TOSRA that it's reported in Table 4. In Table 4, a main method of data analysis was used to investigate this environment-attitude relationship. The sample correlation values (r) are reported which show statistically significant correlations (p<0.05) between students attitudinal outcomes and their science laboratory classroom learning environments on all scales.

Table 4. *Scale Science Attitudes of the Relationships between Multiple Efficiency of Pre and Post of Preferred forms for the SLEI.*

Science-Related Attitude	Student Cohesiveness	Opened-Endedness	Integration	Rule Clarity	Material Environment

Pre-Science-Related Attitude and Preferred Form	Efficiency of Multiple Correlation	0.08	0.03	0.49	0.21	0.37
	Sig.	0.33	0.67	0.00	0.02	0.69
Post-Science-Related Attitude and Preferred Form	Efficiency of Multiple Correlation	0.11	0.04	0.50	0.20	0.05
	Sig.	0.23	0.66	0.00	0.02	0.54

*N = 117, *ρ < 0.05, **ρ < 0.01, ***ρ < 0.001,*

These associations are positive for all scales of the Actual and Preferred Forms in their classes where the students perceived greater environment there was a more Student Cohesiveness, Opened-Endedness, Rule Clarity, and Material Environment scales which favourable attitude towards their science laboratory classes. In the other hand, the multiple correlation values (R) are reported which does not show statistically significant correlations between students' attitudinal outcomes and their science laboratory classroom learning environments on all scales of the Actual Form.

4. CONCLUSIONS AND DISCUSSION

Table 3 and Table 4 are compared to investigate associations between science students' perceptions of their science laboratory classroom learning environments with their attitude toward science laboratory classes. Using the SLEI instrument in the higher education level, of 117 secondary educational students in 3 classes at Grade 8th level in BorabuWittayakhan School, Thailand, will help teachers to evaluate their learning environments in science laboratory classroom learning environments in order to improve their education process. Furthermore, the information from the SLEI could be useful as the guide to enhance the effectiveness of science laboratory classes. The effectiveness in science laboratory classroom learning environments is very important because the improving work is high cost and time consuming. Therefore, evaluation of science laboratory classroom learning environments teaching is important for improving and developing students' learning achievement successfully.

The actual and preferred perceptions of 117 students of their science laboratory classroom learning environments were measured with the SLEI. The comparisons of the Actual Forms with the Preferred Form indicated that students would prefer more cohesiveness, friction, difficulty, satisfaction, and competitiveness in their science laboratory classroom learning environments. In general, students' perceptions of their preferred science laboratory classroom learning environments were to be greater than what they actually perceive to be provided. The results of this study also indicate that using the SLEI helps science teachers in their educational institutes to gain a better picture of learning environment and the perceived learning needs of their students.

An investigation of the association between students' perceptions of learning environments with their attitudes to their science laboratory classroom learning environments with regard to the SLEI, it was found that all of five scales were positively associated with students' attitude

to science laboratory classroom learning environments. The multiple correlation *R* is significant for the SLEI and shows that when the scales are considered together there are significant associations with the Attitude Scale.

Learning environment is an important aspect in education process. It not only influences the students' outcomes, but also instructor performances. Instructor could use the information from learning environment assessments to improve their education process. Furthermore, one instrument which could evaluate learning environments My Class Inventory (SLEI).This instrument provides the information of students' perceptions on actual and preferred learning environment. The information from this instrument could be used for improvement and effectiveness teaching in science laboratory classroom learning environments.

Overall, this study replicated previous studies using the SLEI, with the findings being consistent with the situation in Borabu Wittayakhan Schoolin Thailand. It is also noteworthy that this study showed distinctive and more positive learning environment perceptions among students from the science laboratory classroom learning environments, interestingly.

The SLEI could be used as either a predictor or an outcome variable depending upon the research questions being asked. It may also be a useful evaluation tool. For example, if one was testing a new type of laboratory course, the SLEI could be used to see not only what students would prefer in the course, but also to see how they felt about the course after it was implemented.

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