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Assessing Science Students' Perceptions in Learning Activities Achievements in Physics Laboratory Classrooms in Udon Thani Rajabhat University

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Abstract. This research describes science student programs' perceptions of their physics laboratory classroom learning environments in Udon Thani Rajabhat University, Thailand. Associations and relationships between these perceptions and students' attitudes toward physics laboratory were also determined. The physics laboratory learning environment perceptions were obtained using the 35-item *Physics Laboratory Environment Inventory* (PLEI), which is a modified from the original *Science Laboratory Environment Inventory* (SLEI) (Fraser, McRobbie, & Giddings, 1993). This questionnaire has the 2-Actual Forms and a Preferred Form. Students' attitudes were assessed with the *Test Of Physics-Related Attitude* (TOPRA) modified from the *Test of Science-Related Attitude* (TOSRA) (Fraser, 1981). The questionnaires administered to a sample of 577 students in 13 science and technological program classes in the first semester in the academic year 2011. Using the actual-1, actual-2 and preferred forms assessed students' perceptions on the third, fourteenth and eight week, and the tenth week were also administered with the TOPRA. Statistically significant differences were found between the students' perceptions of their actual-1, actual-2 and preferred physics laboratory environments ($\rho<0.001$). The factor structures were found to have factor loading than 0.30 of the PLEI. The preferred perceptions were more favorable than actual perceptions on all scales of the PLEI. The multiple correlations *R* are significant and show that when the scales are considered the significant associations with the TOPRA ($\rho<0.001$). The R^2 values indicate that 3.35%, 43.82%, and 57.91% of the variances in students' attitudes to their physics laboratory classes were attributable to their perceptions of the actual-1, actual-2, and preferred physics laboratory classroom environments. Based on the finding, suggestions for improving the physics laboratory classroom environments with students' perceptions are provided.

Keywords: Science students' perceptions, Learning activities achievements, Physics laboratory classrooms.

1. Introduction

Education in Thailand is provided mainly by the Thai government through the Ministry of Education from pre-school to higher education level. Udon Thani Rajabhat University is one of the oldest community universities in the northeast of Thailand. UDRU is known as one of the fast growing Thai universities with more than 22,000 students, 478 teaching staff members and 310 supporting staff members and has been ranked among top ten higher education institutes of Thailand for four years. Faculty of Science continues to provide education in order to produce human resources in the field of science and applied science to serve the needs of the community. There are too many programs for study in 10 Bachelor's Degree programs; such as Mathematics, etc. Faculty of Technology is the newest and continuously growing faculty, offers Bachelor

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of Science, Technology, and Engineering through a wide range of 9 programs; such as Industrial Management, etc.

This study intended to extend this notion in order to obtain more comprehensive picture of physics laboratories for the physics foundational laboratory curriculum course of the Science Bachelor's Degree, particular at the science and technology students, by focusing on science students' perceptions about their own laboratories. Physics Department that is offered in the same management acknowledgement programs in Foundational Physics Laboratory Course. Its' course is designed carefully based on physics disciplines themselves and results of the studies to promise quality graduates with the frequency and quality of physics laboratory activities, students have changed to experience, expected to get more improvement, and supposed to get many more chances with better facilities.

Many research studies show that learning environments not only have the positive correlation with the students' outcomes, motivation, and attitudes. Furthermore, there are some research studies on learning environments which focus on student outcomes, students' and teachers' perceptions, and evaluation of the strategies ([1] Fraser, Fisher, & McRobbie, 1996). Since the laboratory classroom learning instruments were applied and adapted version from the Science Laboratory Environment Inventory (SLEI) that it was developed by [2]Fraser and his colleagues (1993) with an awareness of the importance of laboratory lessons, aspects of laboratory classroom environments have been widely investigated in various settings.

Using the SLEI, and adapted the Test Of Science-Related Attitudes (TOSRA) were associated with students' cognitive and affective outcomes were found in Australia ([3]Fisher, Henderson & Fraser, 1997), Singapore [4]Quek, Wong & Fraser (2002). The SLEI has been used in various contexts, including countries across most high schools throughout the USA, Australia, Asian and South Pacific ([5]Giddings & Waldrip, 1996), Tasmania and Australia ([6]Harrison, Fisher & Fraser, 1995, India ([7]Koul & Fisher, 2005), and Thailand ([8]Santiboon, 2008).

2. Research Aims

To describe science student programs' perceptions of their actual-1, actual-2, and preferred classroom laboratory environments in physics classes in Udon Thani Rajabhat University.

To investigate associations correlations and relationships between the science student programs' perceptions of their actual-1, actual-2, and preferred classroom laboratory environments in physics classes in Udon Thani Rajabhat University.

To analyze the Physics Laboratory Environment Inventory (PLEI) and the Test of Science-Related Attitude (TOSRA) a valid and reliable instruments for use in this study.

To develop and improve learning activities of science student programs' achievement in physics laboratory classes in Udon Thani Rajabhat University.

3. Research Methodology

3.1. Sample:

The main study involved science and technological programs' students who were freshly enrolled at the Foundational Physics Laboratory Course (4011308) in the first semester in the academic year 2011, Udon Thani Rajabhat University, Thailand with a sample of 577 students in 13 science and technological groups from 5 physics' lecturers.

3.2. Research Instruments:

3.1.1 Physics Laboratory Environment Inventory (PLEI)

The physics laboratory classroom environments on the actual and the preferred versions, adapt the Personal Form of the Science Laboratory Environment Inventory (SLEI) ([2]Fraser, McRobbie & Giddings, 1993) for use in the present study, to ensure renamed as Physics Laboratory Environment Inventory (PLEI), the word *science* was replace with *physics*. Thus, the final version of the PLEI contained 35 items and five scales which are Student Cohesiveness (SC), Open-Endness (OE), Integration (I), Rule Clarity (RC), and Material Environment (ME). The PLEI has five responses which are Almost Never, Seldom, Sometimes,

Often, and Very Often which have scores 1, 2, 3, 4, and 5 respectively for positive items and revised scores for the negative items.

3.1.2 The Test of Physics-Related Attitude (TOPRA)

The Test of Physics-Related Attitude (TOPRA) was adapted version from the original of the Test of Science-Related Attitude (TOSRA) ([10]Fraser, 1981) and intended to measure students' attitudes in all subjects, the wording of the items was modified by replacing the word *This Subject* with *Physics*.

3.1.3 Steps on Assessing Students' Perceptions with the PLEI and TOPRA Questionnaires

Using the PLEI was followed as for assessing students' perceptions of their actual-1 form on the 3rd week, actual-2 form on the 14th week, and preferred form on the 8th week and the TOPRA on the 10th week for associating physics classroom laboratory environments in physics classes in Udon Thani Rajabhat University.

3.1.4 Data Analysis:

Quantitative data were obtained using the two questionnaires (PLEI and TOPRA). Appropriate statistical procedures were selected to determine whether the Thai versions of the questionnaires are valid and reliable. These were those tests traditionally used with learning environment questionnaires: factor analysis, internal consistency reliability, and ability to differentiate between students in different classrooms. Simple and multiple correlation analyses were used with the actual and preferred versions. A *t*-test for correlated samples was used for each individual PLEI scale to investigate whether students have significant different perceptions of their actual and preferred classrooms.

4. Results

4.1. Validation of the PLEI

Description of quantitative data of analyzing responses for science students' assessments is reported in Table 1. Internal consistency (Cronbach alpha coefficient) and the mean correlation of each scale with the other scales were obtained for the sample in this present study as indices of scale reliability and descriminant validity for the actual-1, actual-2 and preferred forms of the PLEI. The scale means ranged from 24.50 to 27.83 on the actual-1 form, from 26.02 to 28.51 on the actual 2 form, and from 29.87 to 30.52 on the preferred form, and reveals that the differences between the actual-1, actual-2 and preferred forms of the PLEI scales were statistically significant at the 0.001 level for all of the five scales. On the whole, it appears that the items had factor loadings greater than 0.30 with their a priori scales, and hence, the results lend support to the factorial
validity of the PLEI.

Table 1. Scale Means' score, Means, Variance, Standard Deviations, Ability to Differences between Classrooms (ANOVA) for Pair Sample of Actual and Preferred Forms, and Associations between PLEI Scales and Attitudes to Physics Laboratory Classes in Term of Simple and Multiple Correlations (R) and Standardized Regression Coefficient.

Scale	Form	Means' score	Mean (μ)	Std. (σ)	Alpha reliability	Discriminant validity	Pair Sample	eta^2	*t*-test	Standard Regress Weight Attitude (β)		
										Actual-1 Form	Actual-2 Form	Preferred Form
Student Cohesiveness	Actual 1	27.83	3.98	4.45	0.75*	0.72*	Actual 2-Actual 1	0.06*	2.96*	0.07	0.21*	0.22*
	Actual 2	28.51	4.07	4.36	0.79*	0.79*	Pref.-Actual 1	0.07*	12.03*			
	Preferred	30.52	4.36	3.51	0.84*	0.82*	Pref.-Actual 2	0.63*	16.63*			
Open-Endedness	Actual 1	27.13	3.88	4.03	0.74*	0.72*	Actual 2-Actual 1	0.07*	4.14*	0.04	0.18*	0.19*
	Actual 2	28.05	4.01	4.22	0.80*	0.79*	Pref.-Actual 1	0.04*	12.67*			
	Preferred	29.87	4.27	3.49	0.82*	0.83*	Pref.-Actual 2	0.56*	14.81*			
Integration	Actual 1	26.89	3.84	5.03	0.79*	0.71*	Actual 2-Actual 1	0.07*	4.75*	0.02	0.15*	0.22*
	Actual 2	28.18	4.03	5.05	0.82*	0.78*	Pref.-Actual 1	0.05*	15.38*			

	Preferred	30.65	4.38	3.53	0.83*	0.82*	Pref.-Actual 2	0.57*	17.10*			
Rule Clarity	Actual 1	26.71	3.82	3.97	0.69*	0.74*	Actual 2-Actual 1	0.09*	4.44*			
	Actual 2	27.69	3.96	4.21	0.77*	0.80*	Pref.-Actual 1	0.04*	15.49*	0.06	0.18*	0.33*
	Preferred	29.98	4.28	3.43	0.82*	0.83*	Pref.-Actual 2	0.53*	18.29*			
Material Environment	Actual 1	24.50	3.50	4.58	0.66*	0.74*	Actual 2-Actual 1	0.06*	5.58*			
	Actual 2	26.02	3.72	5.06	0.77*	0.80*	Pref.-Actual 1	0.04*	22.85*	0.02	0.12*	0.14*
	Preferred	30.07	4.30	3.48	0.81*	0.83*	Pref.-Actual 2	0.44*	24.06*			
Multiple Correlation (R)										0.18	0.66*	0.76*
R^2										0.0335	0.4382	0.5791

N = 557, *ρ < .001

* Correlation is significant at the 0.001 level (2-tailed)

4.2. Comparisons between Science Students' Perceptions of Their Actual 1, Actual 2 and Preferred Forms in Physics Laboratory Classroom Environments

Figure 1 illustrates the differences between the Actual 1, Actual 2 and Preferred Forms and indicates that students would prefer more than actual and enhanced in all of scales in the laboratories. The PLEI data for the 13 groups for statistical significant with *t*-test analysis is reported in the Table 1. The 35-item PLEI was also subjected to a series of one-way analyses of variance, the *eta*^{2} statistic ranged from 0.06 to 0.84, from 0.04 to 1.03, and from 0.04 to 1.03 for different between actual-2 and actual-1 forms, preferred and actual-1 forms, and preferred and actual 2 forms. They were confirmed that each scale differentiated significantly (ρ <0.001) between perceptions of science students in different classrooms. As reported in Figure 1, the reliability coefficients for different PLEI scales, this figured suggest that the scales of the PLEI measure district although somewhat overlapping aspects of the physics laboratory classes.

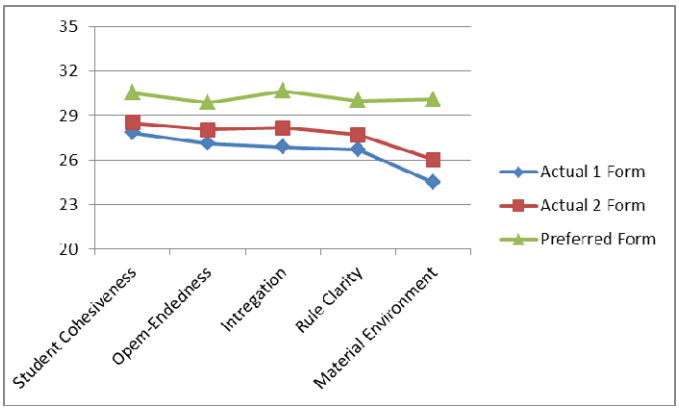

Fig 1. Significant differences between science students' perceptions of their actual-1, actual-2 and preferred scores on the PLEI.

4.3. Validation of the TOPRA

To measure science students' attitudes towards physics laboratory studies, using internal consistency reliability the TOPRA had a value of 0.83 which was considered satisfactory for further use in this study.

4.4. Associations between Science students' Perceptions of Physics Laboratory Learning Environment with the TOPRA

In this study, it was also considered important to investigate associations between science students' perceptions of their physics laboratory classroom learning environments with their attitude toward physics. In Table 1, the sample correlation values (r) are reported which show statistically significant correlations (p<0.05) between students attitudinal outcomes and their physics laboratory classroom environment on all scales. These associations are positive for all scales of the actual-2 and preferred forms in their classes where the students perceived greater student cohesiveness, open-endness, integration, clear rules and a satisfactory material environment there was a more favourable attitude towards their physics laboratory classes. In the

other hand, the sample correlation values (r) are reported which does not show statistically significant correlations on all scales of the actual-1 form.

4.5. Improvement and Development on Science Students' Learning Achievements with the PLEI

Table 1 is compared to investigate associations between science students' perceptions of their physics classroom environments with their attitude toward physics laboratory. Using the PLEI instrument in the higher education level, will help lecturers to evaluate their learning environments in order to improve their education process. Furthermore, the information from the PLEI could be useful as the guide to enhance the effectiveness of physics laboratory. Therefore, evaluation of the physics laboratory teaching is important for improving and developing students' learning achievement successfully.

5. Conclusion

The actual and preferred perceptions of 557 science program students of their physics laboratory classroom environments were measured with the PLEI. The comparisons of the Actual Forms with the Preferred Form indicated that students would prefer more student cohesiveness, open-endness, integration, rule clarity, and an enhanced material environment in their laboratories. The results of this study also indicate that using the PLEI helps Thai physics lecturers 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 physics classes, with regard to the PLEI, it was found that all of five scales were positively associated with students' attitude to physics laboratory classes. The multiple correlation R is significant for the PLEI and shows that when the scales are considered together that are significant associations with the TOPRA. The R^2 values indicate that 3.35%, 43.82% and 57.91% with actual 1, actual 2 and preferred forms of the valiance in students' attitudes to their physics class was attributable to their perceptions of their physics laboratory classroom environments. The beta weights (β) show that in classes where the students perceived greater than all scales in their physics laboratory lessons.

6. Discussion

As described in the results section, Udon Thani Rajabhat University's students show similar answering patterns to those from other countries as reported in previous studies when they are asked to reply to the PLEI questionnaire. Overall, Udon Thani Rajabhat University's students show relatively favourable perceptions of their laboratory lessons, with the lowest score occurring for the Material Environment scale. It seems that laboratory lessons or practical activities related to physics lessons are operated rather as supplementary to theory classes rather than being independently important in their own right. The lower score on Material Environment scale has been also reported in several previous studies. Internationally, it is most likely that physics teachers or lecturers are not convinced about the practical value of laboratory activities. This can be also applied to the Udon Thani Rajabhat University situation, where an examination-driven curriculum is normally prescribed and delivered. In other words, Thai physics lectures or teachers usually do not place much value to laboratory activities, because laboratory lessons guarantee satisfactory student achievement.

Overall, this study replicated previous studies using the PLEI, with the findings being consistent with the situation in Udon Thani Rajabhat University in Thailand. It is also noteworthy that this study showed distinctive and more positive learning environment perceptions among students from the science and technology program students, Faculty of Science and Faculty of Technology.

7. Reference

[1] Fraser, B. J., Fisher, D. L., and McRobbie, C. J. *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. 1996.

[2] Fraser, B., McRobbie, C. J. and Giddings, G. J. (1993). Development and cross-national validation of a laboratory classroom instrument for senior high school students. *Science Education*, 77, 1-24. 1993.

[3] Fisher, D. L. Henderson, D. and Fraser, B. L. Laboratory environment and student outcomes in senior high school biology classes. *American Biology Teacher*, 1997. **59**, 214-219.

[4] Quek, C. L., Wong, A. F. L. and Fraser, B. J. (2002). Teacher-student interaction and gifted students' attitudes toward chemistry in laboratory classrooms in Singapore. *Journal of Classroom Interaction,* **40**(1): 18-28.

[5] Giddings, G.J. and Waldrip, B. *A comparison of science laboratory classrooms in Asia, Australia, South Pacific and USA: An international study.* Paper presented at the annual meeting of the American Educational Research Association, New York, NY. 1996.

[6] Henderson, D., Fisher, D.L.and Fraser, B. J. *Gender Differences in Biology Students' Perceptions of Actual and Preferred Learning Environments.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco. 1995.

[7] Koul, P. and Fisher, D. *Science classroom learning environments in India*. Paper presented at the International Educational Research Conference of the Australian Association for Research in Education (AARE), Brisbane, Australia. 2005.

[8] Santiboon, T. *Classroom learning environments in science laboratory classes in "ONE DISTRICT: ONE LAB SCHOOL PROJECT" in Thailand*. Proceedings of the 5th International Conference in Science, Mathematics and Technology Education: Science Mathematics and Technology Education: Beyond Cultural Boundaries. Udon Thani Rajabhat University & Curtin University of Technology, Udon Thani, Thailand. 2008.

[9] Fraser, B. L. and McRobbie, C. J. (1995). Science laboratory classroom environments at schools and universities: a cross-national study. Educational Research and Evaluation, 1, 289-317.

[10] Fraser, B. J. TOSRA*:* Test of science-related attitudes, Melbourne. *Australian Council for Educational Research.* 1981.