Teacher-Students Interaction and Classroom Learning Environments : Its Impacts on Students' Attitude Towards Science and Math Classes

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Abstract

Research studies in education that focus on classrooms and school-level learning environments have escalated and produced promising findings that lead to enhancement of the teaching and learning process. The present study reports on the research findings on associations between students' perceptions of their teacher interaction, classroom learning environment and students' outcomes. A sample of 946 students from 43 classes in Indonesia schools completed a survey including the *Questionnaire on Teacher Interaction* (QTI), *What is Happening in This Class* (WIHIC) and a scale relating to their attitude towards science and mathematics classes. Statistical analysis shows that the reliability and validity of the WIHIC and the QTI were confirmed. Cronbach alpha coefficients ranged from 0.66 to 0.85 and from 0.62 to 0.92 for the actual and preferred versions of the Indonesian version QTI, respectively. For the Indonesian version of WIHIC, Cronbach alpha coefficients of seven scales ranged from 0.80 to 0.91 for actual version, and from 0.78 to 0.92 preferred versions. The relationships of classroom environment and interpersonal teacher behaviour with students' attitudinal outcome were identified. Finally, suggestions on the use of the two instruments for teacher professional development were offered.

Keywords: Learning environment, Students-teacher interaction, Professional

Development, Student Attitude

> *Most teachers have little control over school policy or curriculum or choice*
> *of texts or special placement of students, but most have a great deal of*
> *autonomy inside the classroom.   ~Tracy Kidder*

Introduction

Students and teachers spend a considerable amount of time in a formal school setting. The teacher's behaviour, when interacting with students, has been found to have a considerable impact on the nature of learning environment that is created (Fraser, 1989). It is believed that a positive teacher-student relationship stoutly contributes to student learning. Educators, parents and students understand that problematic relationships can be detrimental to student outcomes and development. Productive learning environments are characterised by supportive and warm interactions throughout the class: teacher-student and student-student. Similarly, teacher learning thrives when principals facilitate accommodating and safe school cultures. Researchers confirmed that a teacher-student interaction is a powerful force that can play a major role in influencing cognitive and affective development of students (Getzel & Thelen, 1960; Wubbles, Breklmans, & Hermans, 1987). Furthermore Wubbels and Levy (1993) reaffirmed the role and significance of teacher behaviour in classroom environment and in particular, how it can influence students' motivation leading to achievement.

Some reviews showed that science education researchers have led the world in the field of classroom environment since early 1980s, and that this field has contributed much to understanding and improving science education (Fraser 1998; Fraser & Walberg, 1991). For example, classroom environment assessments provide a means of monitoring, evaluating and improving science teaching and curriculum. It is highlighted that a key in improving student achievement and attitudes is to create learning environments that emphasise those characteristics that have been found to be linked empirically with student outcomes (Waldrip & Fisher, 2002).

International studies in the last four decades have firmly established classroom environment research as a thriving field of study (Fraser, 1998). Recent classroom environment research has focused on cross-national studies of science classroom environments (Fisher, Rickards, Goh, & Wong, 1997), constructivist classroom environments (Taylor, Fraser, & Fisher, 1997), science laboratory classroom environments (McRobbie & Fraser, 1993) and computer-assisted instruction classrooms (Fisher & Stolarchuk, 1997; Teh & Fraser, 1995). Most of the researchers reveal promising results of the important role of classroom learning environment on students learning in science classroom. While the area of classroom learning environment research has been internationally established, however, we noticed that only very few studies have been done in SEAMEO member countries. Therefore, it is timely to initiate such a study on this area of research in the region.

Methodology

The goals of the proposed study were to provide further cross-cultural validation information for the QTI and WIHIC questionnaires when used with a large Indonesian sample; to investigate differences in students' actual and ideal or preferred perceptions of their teacher interpersonal behavior and their classroom learning environment; and to investigate the associations between students' perceptions of teacher interaction and their learning environment with their attitudes toward science and mathematics.

More specifically, the aims were formulated in the following three research questions:

1. Are the questionnaires used in this study valid and reliable?

2. What are students' perception towards their teacher interpersonal behavior and their classroom learning environment?

3. Are there any associations between teacher interpersonal behavior and classroom learning environment with students' attitude toward science and mathematics classes?

In so doing, the instruments namely, the Indonesian version of *What is Happening in this Class* (WIHIC) questionnaire and the *Questionnaire on Teacher Interaction* (QTI) were developed. As suggested by Brislin (1970), translataions of the questionnaires into Bahasa Indonesia and then back translation of both questionnaires into English were carried out. This important procedure was done to ensure that the instruments used in the study still carry the original meaning.

The sample was composed of 43 science and mathematics classes at the lower secondary levels in Indonesia. The total sample involved 946 students in 23 science classes and 20 Mathematics spread approximately equally between grades 7, 8, and 9 in 26 different schools. Each student in the sample responded to both actual and preferred versions of the QTI and the WIHIC. Attitude to class was assessed using a seven-item scale based on the Test of Science Related Attitudes (TOSRA) (Fraser, 1981; Fisher, Henderson & Fraser, 1995). The students in science classroom also responded to this scale; whereas students in mathematics classes responded to a scale of TOMRA, namely, Enjoyment toward Mathematics as school subject.

Findings and Discussions

Cross Validation of the questionnaires

Cronbach's alpha coefficient was calculated using individual scores as the units of analysis. As expected, reliability scores for preferred were higher than actual version for most of scales in both the QTI and WIHIC. Cronbach alpha reliability coefficients for both actual and preferred perceptions of QTI and WIHIC and analysis of variance (ANOVA) eta^2 results are shown in Tables 3 and 4.

On the whole, the statistics obtained were acceptable. Cronbach alpha coefficients ranged from 0.66 to 0.85 and from 0.62 to 0.92 for the actual and preferred versions of the Indonesian version QTI, respectively. For the Indonesian version of WIHIC, Cronbach alpha coefficients of seven scales ranged from 0.80 to 0.91 for actual version, and from 0.78 to 0.92 preferred versions. These results suggest that the internal consistency for the Indonesian version of QTI and WIHIC are acceptable.

Another desirable characteristic of any instrument like the QTI and WIHIC is that they are capable of differentiating between the perceptions of students in different classrooms. That is, students within the same class should perceive it relatively similarly, while mean within-class perceptions should vary from class to class. This characteristic was explored for each scale of the QTI and WIHIC using one-way ANOVA, with class membership as the main effect. It was found that each QTI and WIHIC scale differentiated significantly (p<.01) between classes and that the eta^2 statistic, representing the proportion

of variance explained by class membership, ranged from 0.13 to 0.38 for different scales of QTI and from 0.13 to 0.27 for different scales of WIHIC.

Table 3. *Internal Consistency Reliability (Cronbach Alpha Coefficient) and ANOVA Results for the Indonesian Version of QTI (n=946)*

Scale Name	Cronbach Alpha Reliability		ANOVA results (eta^2) (Actual)
	Actual	Preferred	
Leadership	0.72	0.79	0.35*
Helping/Friendly	0.76	0.62	0.38*
Understanding	0.76	0.82	0.32*
Students Responsibility	0.69	0.75	0.28*
Uncertain	0.78	0.87	0.13*
Dissatisfaction	0.84	0.92	0.22*
Admonishing	0.85	0.87	0.37*
Strict	0.66	0.69	0.28*

*p<0.01

Table 4. *Internal Consistency Reliability (Cronbach Alpha Coefficient) and ANOVA Results for the Indonesian Version of WIHIC (n=946)*

Scale Name	Cronbach Alpha Reliability		ANOVA results (eta^2)
	Actual	Preferred	
Student Cohesiveness	0.80	0.78	0.24*
Teacher Support	0.84	0.79	0.27*
Involvement	0.84	0.87	0.17*
Investigation	0.89	0.90	0.13*
Task Orientation	0.85	0.91	0.21*
Cooperation	0.83	0.82	0.14*
Equity	0.91	0.92	0.22*

*p<0.01

Differences between students' perception of the actual and preferred science classroom learning environment and interpersonal behaviour of their teacher

A summary of the average item means and average standard deviation for the two versions of the questionnaires is reported in Tables 5 and 6.

Results from t-tests for paired samples as displayed at Table 5 show that there are significant differences (p<0.01) between students' perceptions of their actual and preferred teacher interpersonal behavior as represented on all scales of the Indonesian version of QTI. Similarly, Table 6 shows the differences that are statistically significant (p<0.01) between students' perceptions of their actual and preferred learning environment on all scales of the Indonesian version WIHIC.

Table 5. *Average Item Mean, Average Standard Deviation, and t Value from t-tests with Paired Samples for Differences between the Actual and Preferred Perceptions of QTI (n=946)*

Scale	Average Item Mean		Average Standard Deviation		t value
	A	P	A	P	
Leadership	3.86	4.48	0.56	0.42	-33.80**
Helping/Friendly	3.44	4.28	0.69	0.62	-34.97**
Understanding	3.91	4.50	0.62	0.55	-30.58**
Students Responsibility	2.53	3.11	0.66	0.83	-24.91**
Uncertain	1.58	1.92	0.61	0.95	-8.61**
Dissatisfaction	1.55	1.48	0.63	0.82	3.05*
Admonishing	1.75	1.60	0.73	0.80	6.53**
Strict	2.78	2.68	0.64	0.73	4.88**

**p<0.01; *p<0.05

Table 6. *Average Item Mean, Average Standard Deviation (SD), and t Value from t-tests with Paired Samples for Differences between the Actual and Preferred Perceptions of WIHIC (n=946)*

Scale	Average Item Mean		Average SD		t value
	A	P	A	P	
Student Cohesiveness	4.04	4.60	0.50	0.52	-34.99**
Teacher Support	3.28	4.10	0.65	0.71	-39.74**
Involvement	3.11	3.94	0.61	0.65	-45.56**
Investigation	2.99	3.81	0.73	0.78	-40.66**
Task Orientation	3.84	4.54	0.55	0.54	-44.54**
Cooperation	3.60	4.17	0.60	0.65	-34.52**
Equity	3.83	4.44	0.71	0.62	-31.45**

**p<0.01

The results, which are consistent with previous study, suggest that most students would prefer a learning environment which is characterised by having more teachers' support, enhancing students' cohesiveness, providing clearer task orientation, doing more investigations, and ensuring greater cooperation as well as more equity during class sessions. These differences in both actual and preferred scales can be used by teachers or principals as a focus for improving the classroom learning environment in keeping with Fraser's (1989) five stages for learning environment enhancement.

Differences between male and female students' perception of the actual science classroom learning environment and interpersonal behaviour of their teacher

Gender differences in teacher-student interpersonal behaviour and in their classroom learning environment were examined using Independent-Sample T-test with the eight QTI scales and seven scales of WIHIC as variables. Table 7 presents the scale means and standard deviations for male and female students' scores on the eight scales of the QTI. Statistically significant gender differences were apparent in students' responses to five of the eight scales of the QTI, with females perceiving greater understanding behaviours in their teachers and males perceiving their teachers as being more uncertain, dissatisfied, admonishing and experience more freedom. The magnitude of these differences is not large but the differences consistently show that females perceive their teachers in a more positive way than do males.

Table 7. *Average Item Mean, Average Standard Deviation (SD), and t Value from t-tests with Independent-Samples T-tests for Differences between Male (n=387) and Female (n=559) Perceptions of QTI*

Scale	Average Item Mean		Average SD		t value
	Male	Female	Male	Female	
Leadership	3.82	3.88	0.57	0.54	-1.74
Helping/Friendly	3.39	3.48	0.73	0.66	-1.86
Understanding	3.81	3.98	0.67	0.56	-4.05**
Students Responsibility	2.59	2.48	0.69	0.63	2.54*
Uncertain	1.66	1.54	0.68	0.55	3.08*
Dissatisfaction	1.63	1.49	0.68	0.58	3.35**
Admonishing	1.81	1.71	0.77	0.69	2.05*
Strict	2.82	2.75	0.59	0.67	1.85

**p<0.01; *p<0.05

Regarding students' perception of their learning environment as assessed using the Indonesian version of WIHIC, the results of this study maintain the assertions yielded from the previous studies (Goh & Fraser, 1995; Goh, Young, & Fraser, 1995; Riah, 1998; Riah & Fraser, 1998; Wong, 1994), in which females hold better perceptions of the classroom-learning environment than do males. Table 8 suggests that generally females have perceptions slightly more favourable than the males on the actual science classroom-learning environment. While the magnitudes of the differences between male and female students' views of the classroom learning environment are relatively small, statistically significant differences occur on all scales, except on *Involvement* and *Investigation*.

Table 8. *Average Item Mean, Average Standard Deviation, and t Value from t-tests with Paired Samples for Differences Between (n=387) and Female (n=559) Perceptions of WIHIC*

Scale	Average Item Mean		Average Standard Deviation		t value
	Male	Female	Male	Female	
Student Cohesiveness	3.98	4.08	0.53	0.48	-3.01**
Teacher Support	3.19	3.34	0.69	0.62	-3.57**
Involvement	3.07	3.14	0.64	0.59	-1.67
Investigation	3.03	2.96	0.76	0.70	1.46
Task Orientation	3.77	3.90	0.58	0.52	-3.44**
Cooperation	3.56	3.64	0.58	0.61	-2.12*
Equity	3.72	3.92	0.70	0.72	-4.39**

**$p<0.01$; *$p<0.05$

Association between Students' Outcomes and Classroom Learning Environments

Correlations between students' perceptions of the science classroom learning environment, their teacher interpersonal behavior and students' outcomes were investigated. Simple and multiple correlations between each scale of the Indonesian WIHIC and QTI and attitudinal outcomes using individual scores as the unit of analysis (n=946) were conducted. Simple correlations indicated the bivariate association between students' outcomes and each of the scales of the Indonesian WIHIC and QTI. On the other hand, multiple correlations or multiple regression analysis offer the joint and unique influence of each scale in the Indonesian WIHIC and QTI on students' outcomes. A significant beta weight confirms if a scale of the Indonesian WIHIC or QTI is related to students' outcomes when the six scales of WIHIC or seven scale of QTI are mutually controlled. A summary of simple correlation (r), multiple correlations (R) and standardised regression coefficient (β) for the association between the QTI and WIHIC and students' outcomes are presented in Tables 9 and 10, respectively.

Simple correlation figures (r) in Table 9 shows that four scales of the Indonesian QTI, *namely, Leadership, Helping/Friendly, Understanding and Dissatisfaction* are statistically significantly ($p<0.05$) associated with students enjoyment in science classroom. On the other hand, all scales of the Indonesian QTI except *Students Responsibility* are statistically significantly ($p<0.05$) correlated with students enjoyment in mathematics subjects. The multiple regression analysis produced a significant multiple correlation (R) of 0.21 ($p<0.05$) for students' enjoyment in science classes, of 0.37 ($p<0.01$) for students' enjoyment mathematics classes. Furthermore, investigations of the value of β reveal that the value of *Dissatisfaction* (β =0.14, p<0.05) scales of the Indonesian QTI is a strong predictor of students' enjoyment in science classrooms. On the other hand, *Admonishing* scale is strong predictor of students' enjoyment during mathematics lessons. Students become less enjoy mathematics lesson when the teachers display more admonishing attitude in the classroom.

Table 9. *Simple Correlation (r), Multiple Correlation (R) and Standardised Regression*

Coefficient (β) for Association between Teacher Interpersonal Behaviour as measured by the Indonesian version of QTI and Student Attitudes towards the Subjects

QTI Scales	Strength of Students Outcomes-Environment Association			
	Attitudinal Outcomes (Enjoyment)			
	Science Classes		Mathematics Classes	
	r	β	r	β
Leadership	0.16**	0.10	0.20**	0.06
Helping/Friendly	0.11**	-0.03	0.22**	0.03
Understanding	0.17**	0.11	0.28**	0.11
Students Responsibility	0.05	0.04	0.07	0.03
Uncertain	-0.04	0.04	-0.12**	-0.08
Dissatisfaction	-0.12**	-0.14*	-0.19**	-0.07
Admonishing	-0.04	0.06	-0.32**	-0.28*
Strict	-0.01	-0.02	-0.14**	-0.01
Multiple Correlations (R)	0.21*		0.37**	

*p<0.05; **p<0.01

Table 10. *Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for Association between Science Classroom Learning Environments as measured by the Indonesian version of WIHIC and Student Attitudes towards the Subjects*

WIHIC Scales	Strength of Students Outcomes-Environment Association			
	Attitudinal Outcomes (Enjoyment)			
	Science Classes		Mathematics Classes	
	r	β	r	β
Student Cohesiveness	0.11*	-0.4	0.25**	0.04
Teacher Support	0.15**	-0.6	0.36**	0.21**
Involvement	0.25**	0.16*	0.25**	-0.01
Investigation	0.21**	0.01	0.17**	-0.09
Task Orientation	0.30**	0.23**	0.39**	0.40**
Cooperation	0.16**	-0.2	0.15**	-0.15*
Equity	0.20**	0.07	0.24**	-0.01
Multiple Correlations (R)	0.33**		0.43**	

*p<0.05; **p<0.01; ***p<0.001

Table 10 shows that all scales of the Indonesian WIHIC are statistically significantly

($p<0.05$) associated with students attitude toward science and mathematics subjects. The multiple regression analysis produced a significant multiple correlation (R) of 0.33 ($p<0.01$) for students' enjoyment in science classes, of 0.43 ($p<0.01$) for students' enjoyment mathematics classes. Furthermore, investigations of the value of β reveal that the value of *Involvement* (β =0.16, p<0.05) and *Task Orientation* (β =0.23, p<0.01) scales of the Indonesian WIHIC are strong predictors of students' enjoyment in science classrooms. Furthermore, students' enjoyment during mathematics lessons is statistically significantly ($p<0.05$ and $p<0.01$) influenced by three scales, namely *Teacher Support, Task Orientation* and *Cooperation*, of the Indonesian WIHIC. Inspection of the β sign indicates some negative relationships exits between some scales of the Indonesian WIHIC and students' enjoyment in mathematics classrooms. Table 10 indicates that students' enjoyment during mathematics are greater in classrooms that have less cooperation but have a good teacher support and clear task direction.

Conclusions and Recommendations

This study has explored associations between students' perceptions of their teacher interpersonal behavior, classroom learning environment and their attitude toward science and mathematics classes.

This study confirmed the reliability and validity of the QTI and WIHIC when used in lower secondary science and mathematics classes in Indonesian school context. It is found in this study that there are differences on students' perceptions toward their teacher interpersonal behavior and their classroom learning environment based on actual and preferred version as well as based on students' gender. As expected, eventhough to such extent students are contented with their actual perceptions on both the QTI and WIHIC scales. However, they would like to have more positive experience of teacher interaction and to have more conducive classroom learning environment. This study also found gender differences that consistently showed that females perceive their teachers in a more positive way than males do. Female students also consistently perceive their science and mathematics classroom environment more favorable than their male counterparts.

Regarding the association between students' perception of learning environment and their attitude toward science and mathematics, generally the dimensions or scales of the QTI and WIHIC were found to be significantly associated with student attitudes. In particular, the study showed that there was a positive correlation between student attitude toward science and mathematics classes and the teachers' leadership, helping/friendly and understanding behaviours. Students had a more positive attitude to their science and mathematics classes when their teacher exhibited more of these behaviours and less admonishing, dissatisfied, uncertain and strict behaviours. If science and mathematics teachers want to promote favourable student attitudes to their class, they should ensure the presence of these interpersonal behaviours.

This research is of practical significance in that it has drawn a link between student attitudes and the nature of the teacher-student behaviour in the classroom. The study could be of significance for teacher educators and policy makers in that it provides a way of improving student outcomes by changing the nature of classroom learning environment and the existence of interpersonal relationships between students and teachers in classrooms.

Future research should be planned to help teachers in using these two instruments

for improving their teaching performance. A study on better or exemplary teachers as suggested by Waldrip and Fisher (2002) would be advised to be done in SEAMEO member countries so that the teachers from this region may share and learn from each other through the best practices found from the research.

It is also advisable for teacher training centre or the university to take into consideration the importance of knowledge of teacher interpersonal behaviour and learning environment. To provide student teachers with adequate knowledge, therefore, learning environments can be included as mandatory unit course in the university or teacher training centre.

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