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Predicting the Achievement of the Grade 9th Lower Secondary School Students towards Mathematics from Their Perceptions of the Classroom Learning Environment

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The data for this study was collected in 2012. The study was conducted after receiving the permission for access to the study was obtained from the principals of schools and the Departments of Education and Training in Vietnam.

Abstract

As part of a survey study on the relationship between students' perceptions of the learning environment of mathematics classroom and their attitudes as well as self-esteem towards mathematics, the mathematics achievement was investigated. It examines data from 487 grade 9th students in Vietnamese lower secondary schools to identify how students' perceptions of the learning environment variables, and the extent to which these predict the mathematics achievement. Results indicate that if students were satisfied with mathematics learning, and if they found their mathematics class as cohesive, then their self-esteem and attitudes towards mathematics would be positive. In contrast, if students perceived mathematics as difficult, and if they perceived the learning atmosphere as competitive, then their self-esteem and attitudes towards mathematics would be negative. This paper furthers that analysis by investigating students' mathematics achievement. Results indicate that students' perceptions of the classroom environment are similar for males and females. Results also show that when students perceive the environment as relatively more cohesive

and satisfied they tend to have higher mathematics achievement. In contrast, when students perceive the learning as relatively more competitive and difficult they tend to have lower mathematics achievement.

Keywords: Learning environment, Student perceptions, Achievement

1. Introduction

Constructing the classroom learning environment more stimulating for students to improve their cognitive and affective outcomes is one of the major objectives of educators. The aspects of classroom learning environment such as satisfaction, friction, competitiveness, difficulty and cohesiveness are the most important variables which may be used for the prediction of the cognitive variables (e.g. stages of mental processing such as knowledge, comprehension, application, analysis, synthesis, & evaluation; and achievement) and evaluation of affective variables (e.g. self-esteem, attitudes, motivation, and satisfaction) (Wong, Young & Fraser, 1997; LaRocque, 2008). Classroom learning environments include several characteristics which influence socio-psychological growth, intellectual development and academic achievement of students (LaRocque, 2008). The classroom climate that is perceived as safe, friendly, warm, supportive and non-threatening has been reported to improve achievement, develop higher self-esteem, and promote more positive student attitudes toward their learning (Chionh & Fraser, 2009). It has been also argued by Fraser & Fisher (1982) and LaRocque (2008) that making the aspects of classroom environment more congruent with the perceptions favoured by students may improve learning outcomes of students. In Vietnam the issues of classroom environment are rarely addressed at both the class and school levels. The classroom learning environment, as perceived by students, show that the Vietnamese classroom learning environments are likely to be passive, competitive, and difficult (Ministry of Education and Training of Vietnam [MOET], 2008). Thus, this paper further investigates associations between the classroom environment and students' achievement. The findings obtained from the possible relationships between student achievement and the classroom environment factors in the present study may provide teachers with valuable ideas for improving students' achievement in learning through altering the aspects of the classroom activities to make the classroom climate more motivating for students.

2. Literature review

As reported in our previous study (Tran, 2012), learning environment is defined as *"the interpersonal relationship among pupils, relationships between pupils and their teachers, relationships between pupils and both the subject matter studied and the method of learning, and finally, pupil perception of the structural characteristics of the class"* (Fraser, Anderson and Walberg, 1982, p.7). In recent decades, studies involving the learning environment have emerged as an internationally necessary scope of social science research among researchers (Chionh & Fraser, 2009). Several studies have been conducted in different subjects using different types of instruments for the prediction of cognitive variables and evaluation of affective variables. A series of research studies in the area of classroom climate which investigated students' perceptions of classroom activities indicated that the socio-psychological characteristics of the classroom activities measured by The My Class Inventory (MCI) developed by Fraser, Anderson, & Fraser (1982) may be used as both dependent and independent variables (Fraser & Walberg, 1995). Results of several research studies (Walberg, 1969; Hofstein, Gluzman, Ben-Zvi & Samuel, 1979; Wong & Fraser, 1996; Wong et al., 1997; Aldridge et al., 2000; Majeed et al., 2002; LaRocque, 2008; Chionh &

Fraser, 2009; Opolot-Okurut, 2010) indicated a significant relationship between the aspects of the MCI instrument and measures of cognitive and affective learning outcomes.

Various studies reviewed by Anderson (1973) provide credible evidence that the aspects of classroom environment may account for 13% to 46% of significant variance in learning outcomes. Accordingly, students learn more when they perceived their classroom activities as positive (e.g. satisfaction, cohesiveness), and that students learn less when they perceived their classroom activities as negative (e.g. difficulty, friction, competitiveness). The findings of these associations show that the classroom environment has the predictive ability for student cognitive and affective learning outcomes (Fraser, 1998). The results of a meta-analysis conducted by Haertel, Walberg & Haertel (1981) involving 17,805 students in four countries found that student outcomes are positively correlated with some classroom environment factors such as satisfaction and cohesiveness, and negatively correlated with others such as difficulty and friction. Furthermore, Fraser & Fisher's (1982) study involving a sample of 116 grade 8th and 9th science classes, and Wong et al.'s (1997) study involving the use of multilevel analysis with 1592 mathematics students showed that student perception of the learning environment appears to correlate to student outcomes. Additionally, the results obtained by Fraser's (1994) tabulation of 40 past studies in science education, using a variety of classroom environment instruments and samples ranging across numerous countries and grade levels, confirmed that associations between measures of cognitive and affective outcomes and student perceptions of the learning environment have been replicated.

In addition to the established influence of the classroom environment on student outcomes, some aspects of classroom environment have been found to be predictors of a number of students' cognitive and affective outcomes (Majeed et al., 2002; Webster & Fisher, 2003; LaRocque, 2008; Chionh & Fraser, 2009; Opolot-Okurut, 2010). For example, Majeed et al. (2002) reported a study of mathematics classroom learning environment in Brunei Darussalam and its association with students' satisfaction among a sample of 1565 students from 81 classes in 15 government secondary schools. Results showed that students generally perceived a positive learning environment in mathematics classes, and associations between satisfaction and all of the MCI scales were statistically significant both at student and class levels. Moreover, an investigation on associations between school-level environment and student outcomes among 620 teachers and 4645 students from 57 Australian secondary schools conducted by Webster & Fisher (2003) showed the existence of outcome-environment relationships. Similarly, LaRocque (2008) examines students' perceptions of their classroom activities and the possible effect of these perceptions on academic learning outcomes among 2387 students from 22 American elementary schools. The results obtained from correlation analyses and multivariate analysis of variance indicated that the perceptions of the general classroom activities were significantly related to both math and reading achievement. Furthermore, a recent analysis of associations between the classroom environment and several student outcomes among 2310 Singaporean grade 10th students in 75 geography and mathematics classes in 38 schools conducted by Chionh & Fraser (2009) revealed that greater achievement scores were found in classrooms with more student cohesiveness, while attitudes and self-esteem were more favorable in classrooms with

more teacher support, task orientation and equity. Similarly, Opolot-Okurut (2010) reports a study of 81 Ugandan secondary students' perceptions of mathematics classroom learning environment and their associations with their motivation towards mathematics. The results of the t-tests for independent samples indicated a statistically significant difference in student perceptions between different school types. The study also indicated that student perceptions on some of the modified classroom environment scales were statistically significantly associated with student motivation.

The review of literature shows that the classroom environment appears to have a greater predictive ability of cognitive and affective outcomes. The review also shows that almost all studies which supported the importance of the classroom environment for the prediction of achievement were conducted in the setting of western education (Fisher & Khine, 2006; Fraser, 2007). The issues of classroom environment have only been studied and addressed in the settings of Asian education in recent years (Goh & Khine, 2002). This paper adds to the literature by reporting the results of an investigation to determine if students' perceptions of the learning environment of the mathematics classroom in Vietnamese lower secondary schools may predict their mathematics achievement.

3. Methodology

3.1 Sample

As noted in our previous report (Tran, 2012), a correlational design was undertaken to test the relationship between correlations between the learning environment factors of the mathematics classroom and both the scales of self-esteem and attitudes towards mathematics, although the outcomes of relevance to this paper are students' perceptions of learning environment factors between males and females, and their mathematics achievement. This study used a sample of 487 final-year mathematics students comprising 212 females and 275 males from 14 mathematics classes in 7 Vietnamese government lower secondary schools.

3.2 Instrumentation

The My Class Inventory

As described in our previous paper (Tran, 2012), the My Class Inventory (MCI) developed by Anderson, Walberg & Fraser (1982) was utilized to investigate students' perceptions of their mathematics environment. The first component of MCI, called **Satisfaction** (S), contained 9 items (*The pupils enjoy their schoolwork in my class [+]; Most pupils are pleased with the class [+]; Some pupils don't like the class [-]; Most of children in my class enjoy school [+]; Most of children say the class is fun [+]; Some pupils are not happy in the class [-]; Children seem to like the class [+]; Some of the pupils don't like the class [-]; The class is fun [+]*). The second component combining 9 items was called **Friction** (F), comprised 8 items (*Children are always fighting with each other [+]; Some of the children in our class are mean [+]; Many children in our class like to fight [+]; Some pupils don't like other pupils [+]; Some children don't like other children [+]; Certain pupils always want to have their own way [+]; Children in our class fight a lot [+]; Certain pupils don't like what other pupils do [+]*). The third component, **Competitiveness** (CM), comprised 7 items (*Children*

often race to see who can finish first [+]; Most children want their work to be better than their friend's work [+]; Some pupils feels bad when they do not do as well as the others [+]; Most children don't care who finishes first [-]; Some pupils always try to do their work better than the others [+]; In our class some pupils always want to do best [+]; A few children in my class want to be first all of the time [+]). The fourth component comprised 8 items (*In our class the work is hard to do [+]; Most children can do their schoolwork without help [-]; Only the smart people can do the work in our class [+]; Children often find their work hard [+]; Only the mart pupils can do their work [+]; Many pupils in our class say school is easy [-]; Schoolwork is hard to do [+]; Most of the pupils in my class know how to do their work [-]*) was called **Difficulty** (D). The last component, **Cohesion** (CH), comprised 6 items (*In my class everybody is my friend [+]; Some people in my class are not my friends [-]; All of the children know each other well [+]; All pupils in my class are close friends [+]; All of the pupils in my class like one another [+]; Children in our class like each other as friends [+]*). For each item, respondents indicated on a five point scale. Items designated (+) are scored 1, 2, 3, 4 and 5, respectively, for the responses SD (Strongly Disagree), D (Disagree), U (Undecided), A (Agree), SA (Strongly Agree). Items designated (-) are scored in the reserve way. The students' responses (n = 212 [males]; n = 275 [females]) to the five components were checked for internal consistency by computing respective Cronbach Alpha coefficients. Table 1 below reports the means, standard deviations, and Cronbach Alpha coefficient of internal consistency for the components.

Table 1. Learning Environment Components

Variable	No of Items	Boys (n = 275)			Girls (n = 212)		
		Mean	S.D.	Alpha	Mean	S.D.	Alpha
Satisfaction	9	3.71	.841	.81	3.77	.779	.85
Friction	8	3.50	.942	.77	3.58	.911	.76
Competitiveness	7	3.71	.501	.75	3.69	.407	.78
Difficulty	8	3.67	.512	.79	3.69	.519	.83
Cohesion	6	3.72	.749	.84	3.70	.698	.80

Achievement test

A post-achievement test comprised 40 items, focusing on the content of the mathematics knowledge was used to measure achievement immediately after the academic year ended. All items in post-test were presented in a multiple-choice format. Each item had four alternative choices for the correct answer. The maximum mean score of each test is 10. Using a KR 20 coefficient, the reliability of the post-test was .76.

4. Procedure

As described in our previous report (Tran, 2012), all of 487 grade 9th students were invited to participate in this study after the permission for access to the study was obtained from the principals of schools and the Department of Education and Training. All participants were

clearly explained that they were free to withdraw from the research at any time. The privacy of participants was ensured concerning the information they supplied in the questionnaires. No questions or statements required the participants to provide their names or schools where they are studying. After students completed the 9th grade mathematics program in the second semester at the end of the academic year, the researcher administered the MCI questionnaire to the head teachers of mathematics classes in each school, who delivered the questionnaires to the students. Participants completed the three questionnaires in 60 minutes. A post-achievement test was also administered to students after the academic year ended. The researcher personally collected the completed data from the head teachers of classes in each school.

5. Data Analysis

The relationships among the variables of learning environments were investigated using Pearson product-moment correlation coefficient. Independent-samples t-tests were conducted to compare the learning environment component scores for males and females. Multiple regression analyses were also conducted to find out if there were any achievement-environment associations. All analyses were tested for significance at the .05 level.

6. Results and Discussions

An analysis using Pearson's correlation coefficient (Table 2) indicates that correlations among the five variables of the learning environment were statistically significant at the .01 and .05 levels (2-tailed). The smallest relationship was r (487) = .122, p = .007 between Friction scale and Cohesion scale. The largest relationship was r (487) = .595, p = .004 between Cohesion scale and Difficulty scale.

Table 2. Correlations between Variables of Learning Environment

Variable	Friction	Cohesion	Satisfaction	Difficulty	Competitiveness
Friction	1	.122**	.210**	.197*	.154**
		.007	.002	.037	.001
		487	487	487	487
Cohesion		1	.157**	.595**	.553*
			.000	.004	.047
			487	487	487
Satisfaction			1	.345**	.247**
				.000	.019
				487	487
Difficulty				1	.585**
					.000
					487
Competitiveness					1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 reports the results of the five independent-samples t-tests on the learning environment components. The results shows that there were not statistically significant different between perceptions of males and females on the learning environment variables. An inspection of mean scores in Table 2 indicates that students' perceptions of the mathematics classrooms are similar for males and females. The magnitude of differences in the two mean scores between males and females on the five variables was very small, .02 scale point for the *Competitiveness, Difficulty, and Cohesion* components,.06 for the *Satisfaction* component and .08 for the *Friction* component. Results of this study suggest that the sample under study was evenly distributed by gender (56.4% versus 43.6%) so that it could be assumed that the results of non-significant main effects for gender are reliable. Results of this study are consistent with the finding of the previous research (LaRocque, 2008) which indicates a non-significant main effect for gender.

Table 3. Results for 5 independent-samples t-tests

Variable	Boys (n = 275)		Girls (n = 212)				
	Mean	S.D.	Mean	S.D.	t-value	Mean difference	p-value
Satisfaction	3.71	.841	3.77	.779	1.72	.06	.613*
Friction	3.50	.942	3.58	.911	1.60	.08	.547*
Competitiveness	3.71	.501	3.69	.407	1.12	.02	.423*
Difficulty	3.67	.512	3.69	.519	1.11	.02	.974*
Cohesion	3.72	.749	3.70	.698	0.97	.02	.654*

*p >.05

An inspection of mean scores indicates that the post-achievement test scores of males (M = 7.41, S.D. = .76) and females (M = 7.62, S.D. = .79) are nearly similar. To examine the relationships between students' perceptions of the learning environment variables and their mathematics achievement, the two multiple regression analyses on the predicted measures and dependent variable were conducted. Table 4 reports the results of the two multiple regression analyses on the predicted measures and dependent variable. The first multiple regression model with all five predictors explained 39.1% of the variance in boys' achievement scores (R^2 = .391), F (5, 481) = 41.212, $p < .05$. The two variables were positively and statistically significant, with the value of Cohesion (β = .193, t = 2.956, $p < .05$), and Satisfaction (β = .207, t = 3.011, $p < .05$). The Difficulty and Competitiveness variables of the learning environment were negatively significantly related to boys' achievement scores, with the beta value of Difficulty (β = -.401, t = -6.412, $p < .05$), Competitiveness (β = -.376, t = -.4.971, $p < .05$). The only Friction scale (β = .152, t = 2.541, $p > .05$) was not statistically significant with boys' achievement scores. The second multiple

regression model with all five predictors produced 37.6% of the variance in girls' achievement scores (R^2 = .376), F (5, 481) = 39.871, p < .05. The Difficulty and Competitiveness variables of the learning environment were negatively significantly related to girls' achievement scores, with the beta value of Difficulty (β = -.576, t = -5.913, p < .05), Competitiveness (β = -.457, t = -5.214, p < .05). The two variables were positively and statistically significant, with the value of Cohesion (β = .189, t = 2.852, p < .05), and Satisfaction (β = .272, t = 3.412, p < .05). The Friction scale (β = .157, t = 2.764, p > .05) was not a statistically significant predictor in this model.

Table 4. Results from Multiple Regression Analyses

Variable	Model 1 – Boys' achievement			Model 2 – Girls' achievement		
	R^2	F	p	R^2	F	p
	.273	36.100	.000	.690	214.003	.011
	β	t	p	β	t	p
Friction	.152	2.541	.062	.157	2.764	.071
Cohesion	.193	2.956	.004	.189	2.852	.002
Satisfaction	.207	3.011	.001	.272	3.412	.007
Difficulty	-.401	-6.412	.000	-.576	-.5.913	.004
Competitiveness	-.376	-.4.971	.005	-.457	-.5.212	.000

a. Predictors: Friction, Cohesion, Satisfaction, Difficulty, and Competitiveness

b. Dependent variables: Mathematics achievement

The findings obtained from the two models indicated that when both male and female students perceive the environment as more difficult and competitive they tend to have lower mathematics achievement. Conversely, students tend to have higher mathematics achievement when they find the environment more satisfied and cohesive. The results of this study are consistent with the findings of previous research (Hofstein et al., 1979; Wong & Fraser, 1996; Wong et al., 1997; Aldridge et al., 2000; Majeed et al., 2002; LaRocque, 2008; Chionh & Fraser, 2009) which indicates a significant relationship between the classroom environment and student achievement.

7. Conclusion

The results shows that there were not statistically significant different between perceptions of males and females on the learning environment variables. Results also indicate that some aspects of the classroom learning environment significantly influence the mathematics achievement of a group of Vietnamese secondary school students. The correlation and multiple regression analyses obtained support the hypothesis that students' perceptions of the learning environment of the mathematics classroom may predict their mathematics achievement. The findings reveal that if students are more satisfied with mathematics learning, and if they find their mathematics classroom atmosphere more cohesive, then their

mathematics achievement would be high. In contrast, if students perceived mathematics as difficult, and if students perceived the learning atmosphere as competitive, then their mathematics achievement would be low. Only the friction factor was not statistically significant with students' achievement scores. All of the five factors such as friction, cohesiveness, satisfaction, difficulty and competitiveness are major components of the classroom environment, which may be affected by the secondary school teachers. In the classroom level, mathematics teachers should pay more attention to all aspects of the classroom learning environment because these aspects may provide valuable ideas to help teachers to become more reflective and improve their teaching practice (Yarrow, 1977, p.68). It seems that, from the results obtained in this study, fostering students' mathematics achievement is the most necessary mandate of teachers. Therefore, a positive learning environment should be created to promote the achievement of students in Vietnamese secondary schools.

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