The Relationship between Form 4 Students' Perceptions of Science Classroom Environment and Attitudes towards Science

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Abstract

It is essential to develop positive attitudes towards science as one of the legitimate goals of science education in Malaysia. The purpose of this study was to investigate the relationship between students' perceptions of science classroom environment and attitudes toward science. This study was a non-experimental quantitative research and employed a sample survey method to collect data. Samples were selected by using the two-stage cluster random sampling. In this study, the Test of Science-Related Attitudes (TOSRA) was adopted to measure students' attitudes towards science while students' perception towards classroom environment was measured with the 'What Is Happening In This Class' (WIHIC) instrument. Independent sample t-test, Pearson Product Moment Correlation and Multiple Regression Analysis were used to test the stated null hypotheses at a predetermined significance level, alpha = .05. Data analysis showed that gender and school locations did not have a significant effect on students' perceptions of science classroom environment. Gender also did not have a significant effect on students' attitudes toward science. However, school locations had a significant effect on students' attitudes toward science in which urban schools' students had more positive attitudes toward science than their rural peers. Correlation analysis results showed that there was positive low to moderate significant correlations between students' perceptions of science

classroom environment and attitudes toward science. Multiple regression analysis showed that students' perception of science classroom environment is a significant predictor of students' attitudes toward science in Tenom and Kota Kinabalu. Further analysis showed that WIHIC's subscale of Task Orientation is the most significant predictor to students' attitudes towards science. It is suggested that science teachers emphasize the completion of science work and activities to improve students' overall attitudes towards science. Not only that, further help is needed from school and education administrators to improve teaching and learning instruments for science teachers to make varieties of science activities to accommodate students' learning.

Keyword: Science classroom environment, attitudes toward science, gender, school locations, rural, urban, science education, interest in science

Introduction

In the 21st century, education is one of the most empowering tools to help one achieve his or her potential. Interest in science must be instilled and fostered at an early educational stage so that students will have an interest in science and technology subjects. In order to do this, students must have positive attitudes toward science. Attitudes toward science are thought to satisfy basic psychological needs, and influence future behaviors (Koballa & Crawley, 1985). Generally, the factors that are frequently found to have influence on students' attitudes towards science are gender (girls versus boys), age (primary, lower secondary, upper secondary students), schools (private versus state schools), and/or peer influences towards school science (Osborne, Simon, & Collins, 2003).

Females were found to be less confident about their ability in science despite their achievement and opportunities given for them to learn (Gömleksiz, 2012). Kahle (1983) stated that the lack of scientific experiences in the classroom, bias treatment from teachers and lack of role model contributed to female students' declining attitudes toward science. Apart from gender, school locations are also one of the most important variables in determining students' attitudes toward science. Part of it may be explained that rural students tend to have lower academic aspirations, have less value on academics and low academic motivations (Xu, 2009). Students in rural areas are also reported to have greater anxieties in learning science subjects than students in urban areas (Singh & Thukral, 2009; Woldeamanuel, Atagana, & Engida, 2013).

The main objective of this research is to investigate the relationship between students' perceptions of science classroom environment with their attitude towards science. The specific objectives of this research are to determine:

a. the level of perceptions of science classroom environment among Form 4 students.
b. the level of attitudes toward science among Form 4 students.
c. the difference in perceptions of science classroom environment based on gender and school locations.
d. the difference in attitudes toward science based on gender and school locations.
e. the association between the perceptions of science classroom environment and the attitudes towards science among Form 4 students.

Based on the research questions, the following hypotheses had been developed: -

H_{01}: There is no significant difference in the perceptions of science classroom environment between male and female students.

H_{02}: There is no significant difference in the perceptions of science classroom environment between students in rural and urban schools.

H_{03}: There is no significant difference in attitudes towards science between male and female students.

H_{04}: There is no significant difference in attitudes towards science between students in rural and urban schools.

H_{05}: There is no significant correlation between the perceptions of science classroom environment and the attitudes towards science among Form 4 students.

H_{06}: Students' perceptions of science classroom environment do not influence students' attitudes toward science.

Research Methodology

Research Design

Research method used in this study is non-experimental quantitative research because none of the variables involved will be controlled or influenced. According to Johnson and Christensen (as cited in Lay & Khoo, 2014), non-experimental quantitative research is a systematic empirical inquiry where researcher cannot control the independent variable since the manifestation of the independent variable already happened or cannot be manipulated. The overall design of this study is survey research. The instruments used to measure attitudes towards science is Test of Science-

Related Attitudes (TOSRA) while the instrument used to measure students' perceptions of classroom environment is the What Is Happening In This Class? (WIHIC) questionnaire.

Research Samples and Sampling Method

The intended population for this study would be Form 4 students from secondary schools around *Daerah* Tenom and Kota Kinabalu. By using two-stage cluster sampling, around 807 students were chosen in Tenom and around 5449 students were chosen in Kota Kinabalu with the schools functioning as the first cluster. The classes at the schools chosen would be the second cluster at the second stage. Random sampling was employed in each cluster to finally determine the final sample. Around 366 students were chosen for the final sample. The sample consisted of 167 males (45.6%) and 199 females (54.3%); 185 urban students (50.5%) and 181 rural students (49.4%).

The steps are shown in Figure 1, in which PSU stands for primary sample unit and SSU is the Secondary Sample Unit.

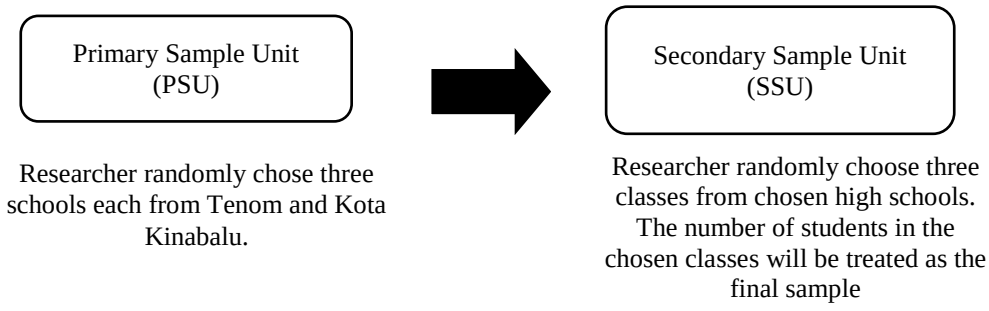

Figure 1: Steps in Two-Stage Cluster Sampling.

Instrumentations

Test of Science Related Attitude (TOSRA).

The Test of Science Related Attitudes, or more commonly known as TOSRA, had been developed according to the scheme provided by Klopfer in regard to measuring attitudes toward science (Fraser, 1981). It is a Likert scale type of instrument designed to measure seven distinct science-related attitudes among secondary school students. TOSRA subscales are: 'Social Implication of Science', 'Normality of Science', 'Attitudes towards Scientific Inquiry', 'Adoption of Science Attitudes', 'Enjoyment of Science Lessons', 'Leisure Interest in Science', and 'Career Interest in Science'. There are five responses provided for each item, which are 'Strongly Agree', 'Agree', 'Uncertain', 'Disagree', and 'Strongly Disagree'. This instrument would be used to measure students' attitudes in science. The distribution of TOSRA items are in accordance to its subscales as shown in Table 1 (Fraser, 1981):

Table 1: Distribution of TOSRA Items

Subscales	Item No.	No. of items
Social Implications of Science (S)	1, 8*, 15, 22*, 29, 36*, 43, 50*, 57, 64*	10
Normality of Scientists (N)	2*, 9, 16*, 23, 30*, 37, 44*, 51, 58*, 65	10
Attitude towards Scientific Inquiry (I)	3, 10*, 17, 24*, 31, 38*, 45, 52*, 59, 66*	10
Adoption of Scientific Attitudes (A)	4, 11*, 18, 25*, 32, 39*, 46, 53*, 60, 67*	10
Enjoyment of Science Lessons (E)	5, 12*, 19, 26*, 33, 40*, 47, 54*, 61, 68*	10
Leisure Interest in Science (L)	6, 13*, 20, 27*, 34, 41*, 48, 55*, 62, 69*	10
Career Interest in Science (C)	7* 14, 21*, 28, 35*, 42, 49*, 56, 63*, 70	10
Total		70

*****denotes negative items. Source: Fraser (1981)

Table 2 shows the description of each subscale of TOSRA.

Table 2: TOSRA Subscales

TOSRA subscale	Description
Social Implication of Science (S)	measures the attitude towards the social benefits and problems which accompany scientific progress.
Normality of Scientist (N)	measures one aspect of manifestation of favorable attitudes towards scientists given importance in science education.
Attitudes to Scientific Inquiry (I)	measures the attitude to scientific experimentation and inquiry as ways of obtaining information about the natural world.
Adoption of Scientific Attitudes (A)	measures an attitudinal aim which are attitudes like open-mindedness, willingness to revise opinions and so on are seen as being of considerable importance in
Enjoyment of Science Lessons (E)	view upon students' enjoyment of science learning lessons.
Leisure Interest in Science (L)	the development of interest in science and science-related activities.
Career Interest in Science (C)	the development of interest in pursuing a career in science.

Table 3 shows example of items from two subscales of TOSRA.

Table 3: Example of TOSRA Items

Subscale	Item
Normality of Scientists	Scientists usually like to go to their laboratories when they have a day off.
	Scientists are about as fit and healthy as other people.
Attitude to Scientific Inquiry	I would prefer to find out why something happens by doing an experiment than be being told.
	Doing experiments is not as good as finding out information from teachers.

What Is Happening In This Class (WIHIC).

The What Is Happening In This Class? (WIHIC) questionnaire is developed by Fraser, Fisher, and McRobbie (2012). WIHIC subscales are 'Student Cohesiveness', 'Teacher Support', 'Involvement', 'Investigation', 'Task Orientation', 'Cooperation', and 'Equity'. The questionnaire used Likert style system where students answer the items according to five statements which are 'Almost Never', 'Seldom', 'Sometimes', 'Often', and 'Almost Always'.

The distribution of WIHIC's items based on the subscales is as shown in Table 4:

Table 4: Distribution of WIHIC Items According to its Subscales

Subscales	Item No.	No. of Items
Student Cohesiveness	1, 2, 3, 4, 5, 6, 7, 8	8
Teacher Support	9, 10, 11, 12, 13, 14, 15, 16	8
Involvement	17, 18, 19, 20, 21, 22, 23, 24	8
Investigation	25, 26, 27, 28, 29, 30, 31, 32	8
Task Orientation	33, 34, 35, 36, 37, 38, 39, 40	8
Cooperation	41, 42, 43, 44, 45, 46, 47, 48	8
Equity	49, 50, 51, 52, 53, 54, 55, 56	8
Total		56

Due to the questions in WIHIC encompassing a more general view on classroom environment, it has been modified so that the questions will be more specific towards science classroom environment. For instance, the item “I build friendship with other students in this class” is changed into “I build friendship with other students in Science class”. Another example is the item “I ask the teacher questions” is changed into “I ask the Science teacher questions”.

Table 5 shows the description of each WIHIC subscale.

Table 5: WIHIC Subscales

Subscales	Description
Student Cohesiveness	The degree to which students know, help, and are supportive of one another.
Teacher Support	The degree to which the teacher helps, befriends, trusts, and is interested in students.
Involvement	The degree to which students have attentive interest, participate in discussions, do additional work, and enjoy the class.
Investigation	The degree to which the emphasis is on the skills and process of inquiry and their use in problem solving and investigation.
Task Orientation	The degree to which it is important to complete activities planned and to stay on the subject matter.
Cooperation	The degree to which students cooperate rather than compete with one another on learning tasks.
Equity	The degree to which students are treated equally by the teacher.

TOSRA and WIHIC Translation

In order to minimize language limitations as students in Sabah predominantly speak and read in Malay, TOSRA and WIHIC would be presented in bilingual form including both English and Malay languages. The author translated the instruments into Malay. *Bahasa Melayu* teachers helped in proofreading and in editing the Malay version of TOSRA and WIHIC. Help from TESL teachers who have credibility in the English

language would be sought to back-translate the Malay version instruments back into English to avoid error and to double check for meaning. The translators are professionals in the languages (*Bahasa Melayu* and English) involved as it is within their career knowledge and have been teaching the languages for more than ten years. Any discrepancies that will appear is discussed before conducting the study.

Research Findings

The Level of Perceptions of Science Classroom Environment among Students

The What Is Happening In this Class? (WIHIC) has 7 subscales that determine students' perception towards their classroom environment. Each of these subscales contained 8 items, in which overall there are 56 items. The subscales are Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity.

Table 7 showed that Student Cohesiveness had the highest mean (M = 29.48, SD = 4.916), while the subscale Investigation had the lowest mean (M = 22.94, SD = 6.568).

Table 7: Descriptive Statistics for All Subscales of WIHIC

	Student Cohesiveness	Teacher Support	Involvement	Investigation	Task Orientation	Cooperation	Equity
M	29.48	26.19	23.75	22.94	28.48	28.98	28.22
SD	4.916	5.937	5.343	6.568	5.843	6.410	6.665

This implies that students' perceptions of their science classroom environment is very favourable in terms of students' cohesiveness in class. The ascending order for the mean of each subscale is as following; Investigation (M = 22.94, SD = 6.568), Involvement (M = 23.75, SD = 5.343), Teacher Support (M = 26.19, SD = 5.937), Equity (M = 28.22, SD = 6.665), Task Orientation (M = 28.48, SD = 5.843), Cooperation (M = 28.98, SD = 6.410), and Student Cohesiveness (M = 29.48, SD = 4.916). The finding implies that students generally have good perceptions of science classroom environment.

The Level of Attitudes toward Science among Students

The Test of Science Related Attitudes (TOSRA) has 7 subscales that determine the aspects of students' attitudes towards science. Each subscale contained 10 items where there are positive and negative items. These subscales are Social Implications of Science (S), Normality of Scientists (N), Attitude to Scientific Inquiry (I), Adoption of Scientific Attitudes (A), Enjoyment of Science Lessons (E), Leisure Interest in Science (L), and Career Interest in Science (C).

According to Table 8, the highest mean obtained for overall sample was Attitude to Scientific Inquiry (M = 32.41, SD = 5.252), which showed that out of 7 aspects, students' attitudes towards science is very positive in the aspect of scientific inquiry.

Table 8: Descriptive Statistics for All Subscales of TOSRA

	Social Implication of Science	Normality of Scientists	Attitude to Scientific Inquiry	Adoption of Scientific Attitudes	Enjoyment of Science Lessons	Leisure Interest in Science	Career Interest in Science
M	31.68	31.74	32.41	32.09	31.52	31.44	30.50
SD	4.667	3.649	5.252	4.868	5.774	5.429	5.099

Career Interest in Science subscale obtained the lowest mean (M = 30.50, SD = 5.099) which implied that out of all subscales, students' have poor attitudes toward science in terms of having a career in science. The ascending order of the mean for subscales is as following; Career Interest in Science (M = 30.50, SD = 5.099), Leisure Interest in Science (M = 31.44, SD = 5.429), Enjoyment of Science Lessons (M = 31.52, SD = 5.774), Social Implication of Science (M = 31.68, SD = 4.667), Normality of Scientists (M = 31.74, SD = 3.649), Adoption of Scientific Attitudes (M = 32.09, SD = 4.868), and Attitude to Scientific Inquiry (M = 32.41, SD = 5.252). The finding implies that students have generally positive attitudes toward science.

Difference in the Perceptions of Science Classroom Environment based on Gender and School Locations

H_{01}: There is no significant difference in the perceptions of science classroom environment between male and female students.

The first null hypothesis is tested using the independent sample *t*-test at a specified significance level, alpha = .05. Table 9 shows the statistic information of WIHIC result based on gender.

Table 9: Descriptive Statistics for WIHIC Result based on Gender

	Gender	N	Mean	SD
Student Cohesiveness	Male	166	29.47	4.807
	Female	197	29.48	5.018
Teacher Support	Male	166	25.86	5.848
	Female	197	26.47	6.012
Involvement	Male	166	23.32	5.537
	Female	197	24.11	5.160
Investigation	Male	166	22.75	6.272
	Female	197	23.10	6.819
Task Orientation	Male	166	27.95	5.860
	Female	197	28.92	5.808
Cooperation	Male	166	27.81	6.420
	Female	197	29.96	6.250
Equity	Male	166	28.07	6.841
	Female	197	28.34	6.528
Overall	Male	166	161.94	27.10
	Female	197	166.29	26.37

Generally, female students are more positive in their perceptions of science classroom environment than male students in all aspects of WIHIC. Both male and female students scored highest in the subscale Student Cohesiveness (male= 29.47, female= 29.48), with female having higher cohesiveness than male students.

As shown in Table 10, the overall independent sample t-test results showed that there was no significant difference in perceptions of science classroom environment between male and female students (t = -1.547, p = .123). All WIHIC subscales are also statistically insignificant, except for the subscale Cooperation which had a significant value of $p< 0.05$. According to Table 5, female students cooperate more with their peers in science class than male students (male = 27.81, female = 29.97).

Table 10: Independent Sample *t*-Test Result of WIHIC According to Gender

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference
Student Cohesiveness	1.098	.295	-.022	361	.982	-.011
Teacher Support	.482	.488	-.966	361	.334	-.604
Involvement	.970	.325	-1.399	361	.163	-.786
Investigation	2.381	.124	-.503	361	.615	-.348
Task Orientation	.285	.594	-1.572	361	.117	-.966
Cooperation	.683	.409	-3.234	361	.001	-2.156
Equity	.499	.480	-.380	361	.704	-.266
Overall	1.186	.277	-1.547	361	.123	-4.353

However, the mean differences for all subscales of WIHIC are not statistically significant. Thus, this finding failed to reject the first null hypothesis. There is no significant difference in the perceptions of science classroom environment between male and female students.

H_{02}: There is no significant difference in the perceptions of science classroom environment between students in rural and urban schools.

The second null hypothesis is tested using the independent sample *t*-test at a specified significance level, alpha = .05. Table 11 shows the statistic information of WIHIC result based on school locations.

Table 11: Descriptive Statistic for WIHIC Result Based on School Locations

	School Location	N	Mean	SD
Student Cohesiveness	rural	180	29.10	5.066
	urban	183	29.85	4.749
Teacher Support	rural	180	26.16	5.590
	urban	183	26.22	6.275
Involvement	rural	180	23.77	5.353
	urban	183	23.73	5.348
Investigation	rural	180	22.07	6.520
	urban	183	23.79	6.520
Task Orientation	rural	180	28.20	6.158
	urban	183	28.75	5.519
Cooperation	rural	180	28.15	6.523
	urban	183	29.80	6.207
Equity	rural	180	28.86	6.475
	urban	183	27.59	6.805
Overall	rural	180	162.55	27.876
	urban	183	166.03	25.579

Generally, urban students are more positive in their perceptions of science classroom environment than rural students in most aspects of WIHIC. Rural students showed a little higher mean value for the subscales Involvement and Equity than urban students. Both rural and urban students scored highest in the subscale Student Cohesiveness (rural = 29.10, urban = 29.84).

As shown in Table 12, the overall independent sample *t*-test results showed that there was no significant difference in perceptions of science classroom environment between rural and urban students (t = -1.239, p = .216). All WIHIC subscales are also statistically insignificant, except for the subscale of Investigation (p = .012) and Cooperation (p = .014). According to Table 9, urban students have more positive perception both in

investigation (rural = 22.07, urban = 23.79) and cooperation (rural = 28.15, urban = 29.80) in science class than rural students. Except for Investigation and Cooperation, the mean differences for the other subscales are not statistically significant. Thus, this finding failed to reject the second null hypothesis. There is no significant difference in the perceptions of science classroom environment between urban and rural students.

Table 12: Independent Sample *t*-Test Result of WIHIC According to School Locations

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference
Student Cohesiveness	.512	.475	-1.449	361	.148	-.746
Teacher Support	.374	.541	-.110	361	.913	-.068
Involvement	.000	.998	.071	361	.943	.039
Investigation	.808	.369	-2.521	361	.012	-1.725
Task	4.880	.028	-.911	355.402	.363	-.559
Cooperation	2.059	.152	-2.474	361	.014	-1.653
Equity	.683	.409	1.830	361	.068	1.276
Overall	2.827	.094	-1.239	361	.216	-3.477

Difference in the Attitudes towards Science based on Gender and School Locations

H_{03}: There is no significant difference in attitudes towards science between male and female students.

The third null hypothesis is tested using the independent sample t-test at a specified significance level, alpha = .05. Table 13 shows the statistic information of TOSRA result based on gender.

Table 13: Descriptive Statistic for TOSRA Based on Gender

	Gender	N	Mean	SD
Social Implications of Science (S)	Male	166	31.34	4.535
	Female	197	31.97	4.768
Normality of Scientists (N)	Male	166	31.74	3.735
	Female	197	31.75	3.584
Attitude to Scientific Inquiry (I)	Male	166	32.45	4.736
	Female	197	32.38	5.662
Adoption of Scientific Attitudes (A)	Male	166	31.86	4.920
	Female	197	32.28	4.827
Enjoyment of Science Lessons (E)	Male	166	31.61	5.879
	Female	197	31.45	5.698
Leisure Interest in Science (L)	Male	166	31.28	5.511
	Female	197	31.58	5.369
Career Interest in Science (C)	Male	166	30.59	4.815
	Female	197	30.43	5.338
Overall	Male	166	220.90	25.653
	Female	197	221.86	24.219

Further test showed non-significant values for Levene's Test for Equality of Variances, therefore, the result interpreted will be based on equal variances assumed. The independent sample t-test result for the third

null hypothesis is shown in Table 14. Generally, in Table 13, male students are more positive in the subscales Attitude to Scientific Inquiry, Enjoyment of Science Lessons and Career Interest in Science. On the other hand, female students are more positive in Social Implications of Science, Normality of Scientists, Adoption of Scientific Attitudes and Leisure Interest in Science.

Table 14: Independent *Sample t*-Test Result for TOSRA According to Gender

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference
Social Implications of Science (S)	.189	.664	-1.295	361	.196	-.636
Normality of Scientists (N)	.105	.746	-.027	361	.979	-.010
Attitude to Scientific Inquiry (I)	.723	.396	.128	361	.898	.071
Adoption of Scientific Attitudes (A)	.201	.654	-.812	361	.417	-.416
Enjoyment of Science Lessons (E)	.009	.925	.267	361	.790	.162
Leisure Interest in Science (L)	.003	.958	-.514	361	.607	-.294
Career Interest in Science (C)	.021	.884	.297	361	.767	.159
Overall	.336	.563	-.368	361	.713	-.964

As shown in Table 14, the overall independent sample t-test results showed that there was no significant difference in attitudes toward science between male and female students (t = -.368, p = .713). The mean differences for all subscales of TOSRA are not statistically significant. Thus, this finding failed to reject the third null hypothesis. There is no significant difference in attitudes toward science between male and female students.

H_{04}: There is no significant difference in attitudes towards science between students in rural and urban schools

The fourth null hypothesis is tested using the independent sample t-test at a specified significance level, alpha = .05. Table 15 shows the statistic information of TOSRA result based on school locations.

Table 15: Descriptive Statistics for TOSRA Based on School Locations

	Area	N	Mean	SD
Social Implications of Science (S)	Rural	180	30.38	4.128
	Urban	183	32.97	4.819
Normality of Scientists (N)	Rural	180	31.69	3.072
	Urban	183	31.79	4.146
Attitude to Scientific Inquiry (I)	Rural	180	32.77	6.097
	Urban	183	32.06	4.248
Adoption of Scientific Attitudes (A)	Rural	180	30.25	3.720
	Urban	183	33.90	5.185
Enjoyment of Science Lessons (E)	Rural	180	29.43	3.637
	Urban	183	33.57	6.690
Leisure Interest in Science (L)	Rural	180	30.32	3.530
	Urban	183	32.55	6.624
Career Interest in Science (C)	Rural	180	30.17	3.929
	Urban	183	30.83	6.026
Overall	Rural	180	215.0	19.712
	Urban	183	227.7	27.690

Further test showed Levene's Test for Equality of Variances as significant for all subscales, therefore, the result interpreted will be based on equal variances not assumed. The independent sample t-test result for the first null hypothesis is shown in Table 16. Generally, students in urban schools are a lot more positive in all attitudes subscales, except for the subscale Attitude to Scientific Inquiry, in which rural schools' students display more positive attitude.

Table 16: Independent Sample *t*-Test Result for TOSRA According to School Locations

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference
Social Implications of Science (S)	13.296	.000	-5.501	354.335	.000	-2.589
Normality of Scientists (N)	17.265	.000	-.270	335.591	.787	-.103
Attitude to Scientific Inquiry (I)	7.931	.005	1.289	319.159	.198	.712
Adoption of Scientific Attitudes (A)	19.623	.000	-7.706	330.363	.000	-3.646
Enjoyment of Science Lessons (E)	63.864	.000	-7.341	281.935	.000	-4.140
Leisure Interest in Science (L)	53.644	.000	-4.021	278.665	.000	-2.235
Career Interest in Science (C)	13.511	.000	-1.235	313.737	.218	-.658
Overall	24.126	.000	-5.025	329.045	.000	-12.660

As shown in Table 16, the overall independent sample *t*-test results showed that there is significant difference in attitudes toward science

between students in rural and urban schools (t = -5.025, p = .000). The TOSRA subscales that are statistically significant are Social Implications of Science, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, and Leisure Interest in Science.

In Table 15 urban schools showed more positive attitude in the subscales Social Implications of Science, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, and Leisure Interest in Science stated. However, it was not statistically significant. Thus, this finding rejects the fourth null hypothesis. There is a significant difference in attitudes toward science between students in rural and urban schools.

Association between the Perceptions of Science Classroom Environment with Attitudes towards Science among Form 4 Students

> H_{05}: There is no significant correlation between the perceptions of science classroom environment and the attitudes towards science among Form 4 students.

The fifth null hypothesis is tested using the Pearson's Product Moment Correlation at a significance level alpha = .05. The overall result for simple correlation obtained on Table 17 showed that there is a weak positive linear relationship between students' attitudes towards science and their perception towards classroom environment (r = .267, p< .05). The probability value was less than the predetermined significance value (alpha = .05), therefore the fifth null hypothesis was rejected.

Table 17: Pearson's Product Moment Correlation

		WIHIC	TOSRA
WIHIC	Pearson Correlation	1	.267**
	Sig. (2-tailed)		.000

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

There is a significant weak positive linear relationship between students' attitudes towards science and their perception of science classroom environment. This conclusion was made at the confidence level of 95%. In other words, if students have positive perception of their science classroom environment, they will have positive attitudes towards science.

In Table 18, it was shown that the WIHIC's subscale of Task Orientation and TOSRA's subscale of Leisure Interest in Science had the significant highest positive correlation of (r = .264), while the significant lowest positive correlation was observed between WIHIC's Student Cohesiveness subscale and TOSRA's Social Implications of Science (p = .107). There are weak negative correlations as well between the subscales of Equity and Social Implications of Science as well as between Equity and Adoption of Scientific Attitudes. However, both subscales did not have significant values.

Table 18: Pearson's Correlations of WIHIC and TOSRA Subscales

		S	N	I	A	E	L	C
Student Cohesiveness	Pearson Correlation	.107*	.055	.142**	.138**	.158**	.126*	.029
	Sig. (2-tailed)	.042	.296	.007	.008	.002	.016	.588
Teacher Support	Pearson Correlation	.111*	.212**	.156**	.110*	.089	.131*	.140**
	Sig. (2-tailed)	.034	.000	.003	.036	.091	.012	.008
Involvement	Pearson Correlation	.022	.195**	.132*	.053	.076	.040	.102
	Sig. (2-tailed)	.669	.000	.012	.312	.148	.452	.052
Investigation	Pearson Correlation	.178**	.207**	.126*	.173**	.185**	.159**	.154**
	Sig. (2-tailed)	.001	.000	.016	.001	.000	.002	.003
Task Orientation	Pearson Correlation	.227**	.231**	.235**	.224**	.244**	.264**	.176**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.001
Cooperation	Pearson Correlation	.117*	.096	.168**	.172**	.243**	.166**	.049
	Sig. (2-tailed)	.025	.067	.001	.001	.000	.002	.355
Equity	Pearson Correlation	-.020	.197**	.154**	-.009	.049	.026	.041
	Sig. (2-tailed)	.702	.000	.003	.862	.348	.619	.439

**S= Social Implications of Science, N= Normality of Scientists, I= Attitudes to Scientific Inquiry, A= Adoption of Scientific Attitudes, E= Enjoyment of Science Lesson, L= Leisure Interest in Science, C= Career Interest in Science*

For the first TOSRA's subscale of Social Implications of Science, the highest correlation is with the WIHIC's subscale of Task Orientation (r = .227). The second TOSRA's subscale of Normality of Scientists has highest

correlation with WIHIC's subscale of Task Orientation (r = .231). The third TOSRA's subscale of Attitudes to Scientific Inquiry has highest correlation with WIHIC's subscale of Task Orientation (r = .235). The fourth TOSRA's subscale of Adoption of Scientific Attitudes has the highest correlation with WIHIC's subscale of Task Orientation (r = .224). The fifth TOSRA's subscale of Enjoyment of Science Lessons has the highest correlation with WIHIC's subscale of Task Orientation (r = .244). The sixth TOSRA's subscale of Leisure Interest in Science has the highest correlation with WIHIC's subscale of Task Orientation (r = .264). The last TOSRA's subscale of Career Interest in Science has the highest correlation with WIHIC's subscale of Task Orientation (r = .176). It seems that Task Orientation, which means the degree to which it is important to complete activities planned and to stay on the subject matter is the most important aspect for students' overall positive attitudes toward science.

> H_{06}: Students' perceptions of science classroom environment do not influence students' attitudes toward science.

The sixth null hypothesis is tested using the Multiple Linear Regression at a significance level, alpha = .05. The subscales of WIHIC would be the focus of this test to determine which of the seven subscales of WIHIC can best predict the outcome of TOSRA. In Table 19, the R Square value for dependent variable TOSRA to the independent variable WIHIC's subscales is at .128 or 12.8%. The ANOVA result which is represented in Table 16 showed that this model with the R Square value at 12.8% is significant, $p < .05$.

Table 19: Model Summary of All Subscales of WIHIC to TOSRA

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.358[a]	.128	.111	23.43536

a. Predictors: (Constant), Equity, Investigation, Student Cohesive, Teacher Support, Task Orientation, Cooperation, Involvement

Table 20 showed the ANOVA result between subscales of WIHIC and TOSRA.

Table 20: ANOVA between Subscales of WIHIC and TOSRA

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	28673.096	7	4096.157	7.458	.000[b]
	Residual	194971.719	355	549.216		
	Total	223644.815	362			

a. Dependent Variable: TOSRA
b. Predictors: (Constant), Equity, Investigation, Student Cohesive, Teacher Support, Task Orientation, Cooperation, Involvement

Table 21 showed the coefficients between subscales of WIHIC and TOSRA. The highest standardized coefficient is Task Orientation (.279) and the lowest is Equity (-.141). This means that Task Orientation contributed highest to students' attitudes toward science at 27.9%, followed by Investigation which contributed 11.8%, Teacher Support at 9%, Cooperation at 6.2%, Student Cohesiveness at 2.6%, Involvement at -9.1%, and Equity at -14.1%. Based on the magnitude of standardized coefficients, WIHIC's subscale of Task Orientation is the best statistically significant predictor of students' attitudes toward science (ß= .279). This conclusion is made at the

significance level, α = .05 (5%) with confidence level at 95%. Thus, the sixth null hypothesis was rejected.

Table 21: Coefficients between Subscales of WIHIC and TOSRA

Model		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	(Constant)	181.572	8.437		21.522	.000
	Student Cohesiveness	.132	.307	.026	.430	.667
	Teacher Support	.376	.262	.090	1.433	.153
	Involvement	-.421	.346	-.091	-1.218	.224
	Investigation	.447	.262	.118	1.704	.089
	Task Orientation	1.187	.299	.279	3.970	.000
	Cooperation	.238	.273	.062	.875	.382
	Equity	-.526	.244	-.141	-2.155	.032

a. Dependent Variable: TOSRA

Discussion

Perceptions of Science Classroom Environment among Students

The finding showed that students perceived their science learning environment positive in all aspects in WIHIC's subscales. Students perceived a high cohesiveness in which they know, help and are supportive of one another. They also perceived that they cooperate rather than compete with one another on learning tasks. Apart from that, students understood the importance of completing planned activities. They also perceived that they

are treated equally by the teacher in the classroom. This is supported by Wahyudi and Treagust (2003) in which students were found to favour classroom environment characterised with more student cohesiveness, task orientation, cooperation and equity.

Brok, Fisher, Rickards, and Bull (2006) showed that students viewed their classroom more positively on student cohesiveness, task orientation and cooperation. Since students perceived high cohesiveness (Student Cohesiveness, M = 29.48), this finding showed that students in Tenom and Kota Kinabalu were friendly, helpful and supportive of one another. This is supported in a study done by Anderson, Hamilton and Hattie (2004), where students were found to have high affiliation with one another. This finding showed that the science classroom environment Tenom and Kota Kinabalu encouraged support and cooperation rather than competition.

The Level of Attitudes toward Science among Students

Student in Tenom and Kota Kinabalu have favorable attitude to scientific experimentation and inquiry to obtain information about the natural world. This shows that students like to perform experiments to understand their surroundings, and they inquire about their surroundings actively. Furthermore, students in Tenom and Kota Kinabalu showed that they are open-minded and are willing to revise their opinions when they found evidences contrary to their original opinions. This means that students are encouraged to have opinions that are based on evidences and to be willing to think about possibilities other than what they know. Apart from that, students have an unbiased view towards scientists and thought of them as the same as any other people in different professions.

This may due to Malaysian society respecting and giving high values to people in science professions. Students in Tenom and Kota Kinabalu also understand the impact of scientific works on benefiting the social world, but they are also aware of the problems that come with scientific progress. This may be because Science textbook syllabus used in schools contained facts regarding the advantages and disadvantages of scientific progress. Students also showed that they enjoy science lessons and develop interest in science-related activities. Basically, this means that students love science lessons and view the subject favorably.

Perceptions of Science Classroom Environment According to Students' Gender and School Locations

This finding was supported by Anderson, et al. (2004) who found no significant difference in classroom climate between male and female students. This could be because science classroom environment in Tenom and Kota Kinabalu provide the same opportunities for students despite their genders. If subtle differences are to be considered, it can be said that female students have more favorable perceptions of science classroom environment than boys. Nonetheless, the values presented were not significant and thus can be ignored.

The only WIHIC subscale that had significant value was the subscale Cooperation (p= .001). It was perceived that female students scored higher than male students on the subscale Cooperation (male, M = 27.81, female, M = 29.97). The result of this research is related to Brok, et al. (2006) and Yang (2015), in which female students were found to be more cooperative than male students. This result showed female students in Tenom and Kota Kinabalu prefer to cooperate rather than compete with their friends or work in group to finish a task or solve a problem.

The result obtained for this test showed that there is no significant difference between rural and urban schools students' perceptions of science classroom environment. Thus, the second null hypothesis is not rejected. The means for all subscales of WIHIC showed non-significant statistical difference between rural and urban schools students.

This finding is related to Wahyudi and Treagust (2004). The two subscales that were significant were Investigation (p = .012) and Cooperation (p = .014) where it showed that urban students displayed better perception of science classroom environment than rural students for both Investigation and Cooperation. This finding is related to Wahyudi and Treagust (2004) finding in which urban students cooperate better than rural students. The reason for the difference in urban and rural students' perceptions of science classroom environment can be attributed to the different teaching techniques and social relationship with their teachers or peers. Apart from that, the difference in environment settings may play a part in the students' perceptions too.

Attitudes toward Science According to Students' Gender and School Locations

The result obtained for this test showed no significant difference between male and female students' attitudes toward science. Thus, the third null hypothesis is also failed to be rejected. This was supported by Cokadar and Kulce (2008), Orbay, Gokdere, Tereci and Aydin (2010), and Nasr and Soltani (2011). This could be because the current society in Tenom and Kota Kinabalu does not treat male and female students differently as education is imposed by the government to all students regardless of their gender. Parents and teachers also encouraged both genders to strive for

success and stressed on education as a guarantee for good future for both boys and girls.

This is supported by Cokadar and Kulce (2008) and Orbay, et al. (2010) as both studies presented no significant difference between male and female students' attitudes toward science. Both studies were conducted in Turkey in which society and science-related images are a lot more neutral on genders than the one being presented in Western countries (Cokadar & Külce, 2008). In Western society, the context of science was heavily male-based such as the depictions of male scientists and little to almost none female scientists' images (FORTH/IACM, 2011). However, in Malaysia, there are a lot more female in the professional fields, including in the Science, Technology, Engineering and Mathematics field (United Nations Educational, Scientific and Cultural Organizations, 2015), which may contribute to the non-significant difference between male and female students' attitudes toward science.

There were four subscales with significant result; Social Implications of Science, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, and Leisure Interest in Science. This finding was supported by Etuk, Etuk, Etudor-Eyo and Samuel (2011) and Muhammad, Muhammad and Harrison (2012). Urban students showed more positive attitudes toward science in these subscales than rural students.

Rural students displayed poorer on adopting scientific attitudes than their urban peers. This was supported by Muhammad, Muhammad and Harrison (2012) in which rural students scored lower on TOSRA's Adoption of Scientific Attitudes. The reasons for rural students having less positive attitudes toward science can be attributed to poorer science facilities (Etuk et al., 2011) and difference in socio-economics standard

(Muhammad et al., 2012). Most rural schools in Tenom and Kota Kinabalu have poor facilities which made it hard for students to experience conducive experimenting condition. This could explain the lack of adoption of scientific attitudes among rural students as they were less exposed to the process hands-on scientific experiments that require scientific skills as well as scientific attitudes.

Association between the Perceptions of Science Classroom Environment with Attitudes toward Science among Form 4 Students

The analysis result showed that there was a weak linear positive correlation between WIHIC and TOSRA. This meant that the better students perceived their science classroom environment, the more positive their attitudes toward science is. Through the analysis, it was found that there is a weak positive correlation between students' perceptions of science classroom environment and their attitudes toward science (r = .264). This result was supported by several previous studies (Koul & Fisher, 2004; Akinbobola, 2009; Özkal et al., 2009; Kaya & Geban, 2011; Logan & Skamp, 2013; Ovute & Ovute, 2015). Further analysis showed that the highest positive correlation between WIHIC and TOSRA subscale was between WIHIC's Task Orientation and TOSRA's Leisure Interest in Science. It is also interesting to note that the WIHIC subscale Task Orientation has the highest correlation with all subscales of TOSRA. Both WIHIC subscales Investigation and Task Orientation has significant positive correlation with all of TOSRA's subscales.

This means that the more students are able to finish any science activities in class and are able to learn as much about the subject matter, the more they are interested in science as well as in science-related activities. Sener, Turk, and Tas (2015) had stated that students displayed positive

attitudes toward science when they have a chance to learn by themselves and do more hands-on or students-centered activities. Apart from that, another WIHIC's subscale had all significant positive correlation with all TOSRA's subscales was Investigation. This subscale is also related to more positive attitudes toward science as a whole. This is supported by Kaya and Geban (2011), where students who were given opportunities to inquire develop more positive attitudes toward science.

The result obtained showed that WIHIC is a significant predictor of TOSRA. Thus, the sixth null hypothesis was successfully rejected. This result is supported by several studies (Koul & Fisher, 2004; Akinbobola, 2009; Ozkal et al., 2009; Kaya & Geban, 2011; Logan & Skamp, 2013; Ovute & Ovute, 2015).

This result showed that learning environment does influence students' attitudes toward science. The reason for this might be because students' perceptions of their science classroom environment shaped how they would behave in classroom. For instance, students might develop poor attitudes towards science if they dislike the science teacher or if they do not have good relationship with other students. Furthermore, students develop more positive attitude towards science in terms of spending their leisure time with science activities or science-related activities if they have higher Task Orientation in science class. Apart from that, students also have positive social implications of science if they have higher cohesiveness during science class.

Conclusion

In conclusion, students in Tenom and Kota Kinabalu both have favorable perceptions of science classroom environment and positive attitudes toward science. There is a certain equality between male and female students and this showed in the result as both male and female view their science classroom environment favorably. Male and female students also display positive attitudes toward science. However, rural students seemed to display less positive attitudes toward science when compared to urban students. Rural students do not enjoy their science lesson or spend their time doing science activities as much as urban students do. They also tend to consider careers in science much less than urban students, and this is despite their ability to adopt scientific attitudes much better than urban students. Apart from that, students' perceptions of their science classroom environment affect students' attitudes toward science in a sense that they appreciate their science teachers to help them to finish their science works or tasks. Therefore, it is suggested that science teachers emphasize on the importance of turning up any works and work on class discussions to further help students to understand science lessons. Other suggestions extend to education administrators and school administrators to provide useful tools to help science teachers to conduct better lessons, as well as to promote positive attitudes toward science among students. The research can be improved further by getting a bigger sample from a wider population which was not restricted to Kota Kinabalu and Tenom. Getting more data can help give a better view on students' perceptions of science classroom environment and their attitudes toward science.

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