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RELATIONSHIP DIMENSION IN UNIVERSITY LABORATORIES AND ITS EFFECTS ON STUDENTS' INTEREST

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Abstract

Malaysian universities are currently facing a decline of students' interest in science. It is perceived that the students' practices in laboratory activities with properly managed activities could result in positive interest in science. In that sense, it is argued that laboratory activities are less constrained, creating excellent opportunities for the interaction between instructor and students to occur. Hence, this study was aimed to examine the relationship dimension in university laboratories and its' connection towards the students' interest in a science subject. Drawing upon a survey conducted over 321 science students in four Malaysian Universities, a series of exploratory factorial, descriptive and regression analyses were applied in this study context. The results proved that in the aspects of instructor supportiveness, student cohesiveness and involvement explained 56.15% of the variations and exhibited a positive relationship with the students' interest in science. Subsequent analysis also found that both instructor supportiveness and student cohesiveness demonstrated significant contributions of 17.2%. The relationship dimension definitely showed significant contribution although in small percentages. As the laboratory objectives are ultimately important to achieve, future research should examine the best practices in laboratory to develop students' interest in science.

Keywords: Relationship dimension, interest, science subject, laboratory, university.

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1. Introduction

Globally, the continuous development of science, technology, engineering and mathematics (STEM) for undergraduate students have been a concern in national agenda (National Academies of Sciences, Engineering, & Medicine, 2016). Various issues and recommendations have been discussed among the academicians. In Malaysia, students found science subject is not a favourite subject and presumably hard to understand when compared to social science subject (Samsudin et al., 2012). This phenomenon is not something hard to observe as the same trend keeps on happening every year, from primary schools to undergraduate and postgraduate universities students. To date, government's target ratio of 60:40 for science to art students has not been achieved by Malaysian students (Samsudin et al., 2012). On the contrary, the number of science students keeps decreasing every year and it was reported that the current mass ratio is 40:60, that is only 40% of students are currently enrolled in science courses (Academy of Sciences Malaysia, 2015). Consequently, this scenario will defect the objective to achieve adequate numbers of human resource in science and technology field.

In universities, students are primarily taught about science through two ways of communications, in which through lecture courses and laboratories. According to Samsudin et al. (2012), there is a significant relationship between the teaching and learning environment outside the classroom to cultivate interest in science among the students. In this study, the context of learning outside classroom refers to the laboratory based learning (LBL) methodology. Hence, the sensorimotor experience in the laboratory is expected to help achieving science education goals such as students' interest and motivation in science (Abrahams, 2009; Chiu, Lin, & Tsai, 2016). This is due to the fact that the laboratory setting itself could encourage students working cooperatively in a small group under a cooperative mode of instruction and learning. The less formal environment creates excellent opportunities between students-instructors and students-students to promote positive constructive relationship and subsequently learning environment. This cooperative social learning represents how the students work to acquire inquiry skills as a scientist (Hofstein, Nahum, & Shore, 2001). Thus, it is important to examine the instructor and students' practices in a laboratory. Determining laboratory outcome from the aspects of laboratory psychosocial is not relatively new. To date, a lot of studies have been done over the years assessing the aspects of teaching and learning of laboratory-based science in Malaysia (Ahmad, Osman, & Halim, 2010; Fraser, 1998; Hofstein, 2004; Samsudin et al., 2012).

Since student centered paradigm is definitely a substantial component in laboratory activities, many studies have adopted five scales of Science Laboratory Environment Inventory (SLEI) to measure the psychosocial aspects of students' perception and attitudes in science (Ahmad et al., 2010; McRobbie & Fraser, 1993). The five scales in SLEI were introduced by an Australian researcher, Barry J. Fraser such as open-endedness, student cohesiveness, integration, rule clarity and material environment (Fraser, 1998). However, a role of instructor should not be neglected easily since laboratory activities are less constrained, creating excellent opportunities for the interaction between instructor and students. The original version of SLEI was also initiated and validated by Fraser together with McRobbie and Giddings to inspect into three other dimension scales, including teacher supportiveness, involvement and organization into eight scales of SLEI (Fraser, Giddings, & McRobbie, 1995; Giddings & Fraser, 1989; Hofstein, 2004; Hofstein et al.,

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Corresponding Author: Zul Ilham
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2001). Adjacent to the SLEI scales, the role of instructor in this context illustrates the role of teacher to measure the teaching and learning environment in the laboratory.

Thus, this study is focusing on the relationship dimension based on Moos category after it was introduced by Moos (1974) that includes instructor-supportiveness, student cohesiveness and involvement from the original version of SLEI (Kijkosol, 2005; Moos, 1974). The relationship dimension expresses on the degree of the people involved in the laboratory, the degree they support each other and the degree they assess openly (Ebrahimi, 2015; Kijkosol, 2005). The descriptive information for the relationship dimensions in the Science Laboratory Environment Inventory (SLEI) is demonstrated in Table 01.

Table 01. Descriptive content for relationship dimension in SLEI

Scale Name	Moos Category	Definition	Sample Item
Teacher Supportiveness	Relationship Dimension	Extent to which the teacher/instructor is helpful and concern for all students	The instructor ensures the students' safety during the laboratory session
Student Cohesiveness	Relationship Dimension	Extent to which students know, support and help each other	My friends motivate me to complete the experiment
Involvement	Relationship Dimension	Extent to which students show active participation and give full attention to laboratory activities and discussion	I prefer to conduct experiment in a group rather than individually

2. Problem Statement

Chiu et al. (2016) claimed that interaction with instructors and peers could be the factors affecting students' perceptions of learning in the laboratory. Further, it is perceived that active participation through the cooperative teamwork in laboratory activities could inculcate positive social relationship, student attitudes and cognitive skills (Hofstein et al., 2001). However, students' activities in the laboratory through constructive social interaction is not always practicing the best approach.

Somehow, ambiguous experiment objectives and insufficient simulation from instructors could give negative reaction from students, as they could not understand what they learned in the laboratory (Johnstone & Letton, 1990). In addition, students are merely guided with cookbook nature of laboratory tasks (Chiu et al., 2016), making less cooperative learning with instructors in the laboratory. Moreover, the cookbook laboratory tasks practice rote learning and repetitive experiments. As a result, students will be bored once they find the repetitive experimental results are similar as predicted by the instructors (Chiu et al., 2016; Reiner & Gilbert, 2004). If students think that the activities are boring, then the objectives of laboratory based learning (LBL) to develop students' interest in science would be a failure.

While in term of peers, it is found that some students might only become a 'passenger' without doing anything or just become an observer in some experiments (Ahmad et al., 2010). Consequently, some undergraduate students might think that individual experiments would be more effective than the passive group they have. The passive interaction could occur due to the lack of interest in the activities

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Corresponding Author: Zul Ilham
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being held (Ahmad et al., 2010; Taridi, 2007). Therefore, this study attempts to investigate on how the relationship dimension occurs via the inquiry learning in the student-centered learning process.

3. Research Questions

The research questions lie on an assumption that laboratory activities are less constrained, leading towards excellent opportunities for the interaction in the laboratory to occur. Based on the definition of relationship dimension, it comprised of the elements of teacher-supportiveness, student cohesiveness and involvement. Hence, the there are few questions need to be taken into consideration such as the following:

How the relationship dimension occurs in the laboratory?

What is the relationship between the elements in relationship dimension towards students' interest in science?

4. Purpose of the Study

In the past, some studies have examined the perceptions of teaching and learning environment in laboratory towards the students' satisfaction, interest and achievement (Ahmad et al., 2010; Beck & Blumer, 2016; Chiu et al., 2016; Samsudin et al., 2012). However, there is still no study looking into the relationship dimension and degree to predict the students' outcomes in certain extent. In this study, the relationship dimension occurs among instructor-students was discussed by referring to the definition in the SLEI (McRobbie & Fraser, 1993) and to the autonomy-supportive teachers' framework that was developed by Reeve (2006). The research conceptual framework is illustrated in Figure 01.

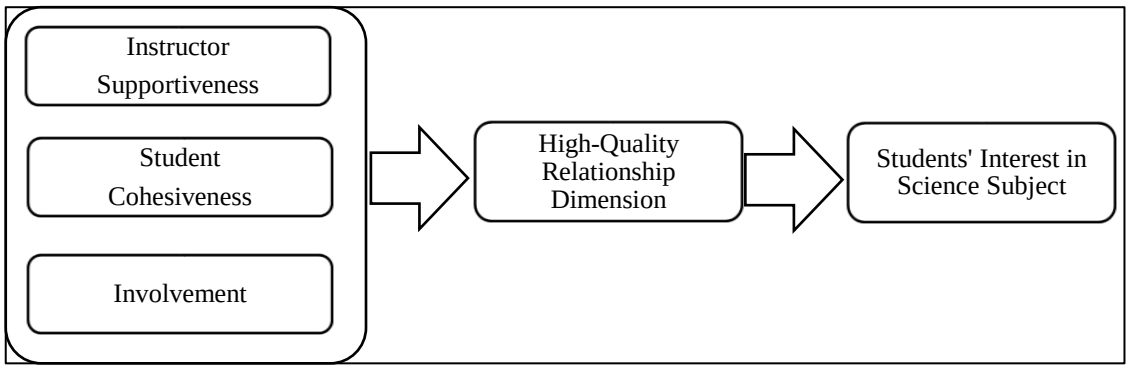

Figure 01. Research conceptual framework

5. Research Methods

5.1. Data Collection

This study employed a quantitative paradigm to investigate the pattern of relationship dimensions and its connection with the students' interest in science. 22-Likert scale questions including an open-ended question were developed to investigate the relationship between these three independent variables and a dependent variable. The survey used 5-Likert points as it could improve reliability and validity of the items used (Dawes, 2012). Before collecting data, a pilot study was conducted to test the suitability and sensitivity

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Corresponding Author: Zul Ilham
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of the instruments. 30 undergraduate science students were chosen to fill out the survey. Value of Cronbach's alpha obtained for all constructs of the survey was valid and greater than 0.7 ($\alpha = 0.827$). Then, the survey was distributed online and on paper to 330 students in 4 Malaysian universities. Since some data was out-ranged to the analysis validity, only 321 responses were used in the analysis.

This sample size was more than enough by calculating through the sample size formula, N>50+8(3), where 'N' is the sample size and '3' is the number of independent variables measured (Tabachnick, Fidell, & Osterlind, 2001). The participants were selected by using purposive random sampling method, focusing on the students who are majoring in science-based departments (e.g. physics, biology, chemistry, medicine) and currently doing experiments in laboratory-based science. Regardless of that, the participants were from different demographic areas in Malaysia with various educational backgrounds. At this extent, they could represent many Malaysian students to measure the variables needed. From the survey, 43.3% were male and 56.1% were female with another 0.6% did not respond to this demographic question. Table 02 summarizes the number of participants in this study.

Table 02. Description of Students Demographic

Category	Participants	Frequency	Percentage (%)
Sex	Male	138	43.3
	Female	179	56.1
	Missing	2	0.6
Types of University	Public University	175	54.9
	Private University	142	44.5
	Missing	2	0.6
Course	Applied Science with Islamic Studies	21	6.6
	Science	99	31.0
	Medicine	134	42.0
	Dentistry	15	4.7
	Health and Sports Science	27	8.5
	Nursing	4	1.3
	Pharmacy	16	5.0
	Science Foundation	3	0.9

5.2. Data Analysis

In order to ensure that all 20 items in the independent variables that were inter-related with each other being placed in the correct constructs, an exploratory factorial analysis was used with principal component extraction and varimax rotation. The analysis was executed twice. First was to prove the underlying three factors (i.e constructs), in which satisfy the condition of eigenvalues greater than 1 and the number of coordinates before curve is flattening out (see scree plot in Figure 02) (Costello & Osborne, 2005). To extract the 3 factors, the inter-related items were then divided into the correct factors and a double-scored item was eliminated as shown in Table 03 as according to Piaw (2014). An approach to

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Corresponding Author: Zul Ilham
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measure the scale's internal consistency is by executing reliability test. In order to achieve the test, an indicator used to satisfy the internal reliability is fixed above 0.7 as suggested by Bland and Altman (1997).

For the descriptive analysis, mean and standard deviation for each factor was calculated and interpreted into five levels (i.e very low, low, moderate, high and very high) after the 5-Likert scales were divided into 5 ranges proportionally. To get the broader interpretation, frequency and percentage for scores of each factor were then divided into three categories. This was done by dividing 5-Likert scales equally into three categories (i.e low, moderate and high). According to the central limit theorem, the large number of independent samples would give approximately normal (Ruxton, Wilkinson & Neuhäuser, 2015). Hence, to find the relationship between dependent variable and independent variables, a parametric statistic was used in this analysis. Satisfying the condition of interval/ratio, the Pearson product moment correlation coefficient was applied to measure the strength of association (linear relationship) between independent and dependent variables. The relationship dimension was shown statistically and scatter plot in Table 03 and Figure 02 respectively. After that, the relationship between these variables was predicted according to intervals interpretation as proposed by Cohen (1988). However, the correlation did not appear to measure the causal-effect concerning the intent of the current study. In relation to that, the sophisticated relationship between one continuous dependent variable and three independent variables was explored deeper by using stepwise multiple regression. This helps to tell how well set of variables able to predict an outcome in particular order.

Finally, an open-ended together with 5-Likert scale points was also included at the end of the survey for their response. The purpose of this question was to explore the other investigated factors that contribute towards the students' interest in science. Nevertheless, this study reports only the response related to the relationship dimension occurs in the laboratory.

6. Findings

6.1. Exploratory Factor Analysis and Reliability

Three factors exhibited eigenvalues above than 1 as predicted, referring to the relationship dimension in Moos category. These factors also were supported by the acceptable internal reliabilities (Cronbach's alpha > 0.7). The first factor had high internal reliabilities (Cronbach's alpha = 0.920) due to the higher number of items for the instructor supportiveness and all other factors are still accepted for exceeding the optimum internal reliability value. Resulting from the factorial analysis, the factors were divided into three themes; instructor supportiveness, involvement and student cohesiveness. Moreover, the coordination of scree plots has suggested to include these three factors model that explained 56.15% of the variation with each of instructor supportiveness, pattern of involvement and student cohesiveness represent 34.10%, 14.91% and 7.14% respectively to the percentage variation for student perceptions of laboratory learning (see Figure 02 and Table 03). These three factors model then were made as the basis for the constructs development in this study and subsequent analysis.

http://dx.doi.org/10.15405/epsbs.2018.05.13
Corresponding Author: Zul Ilham
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

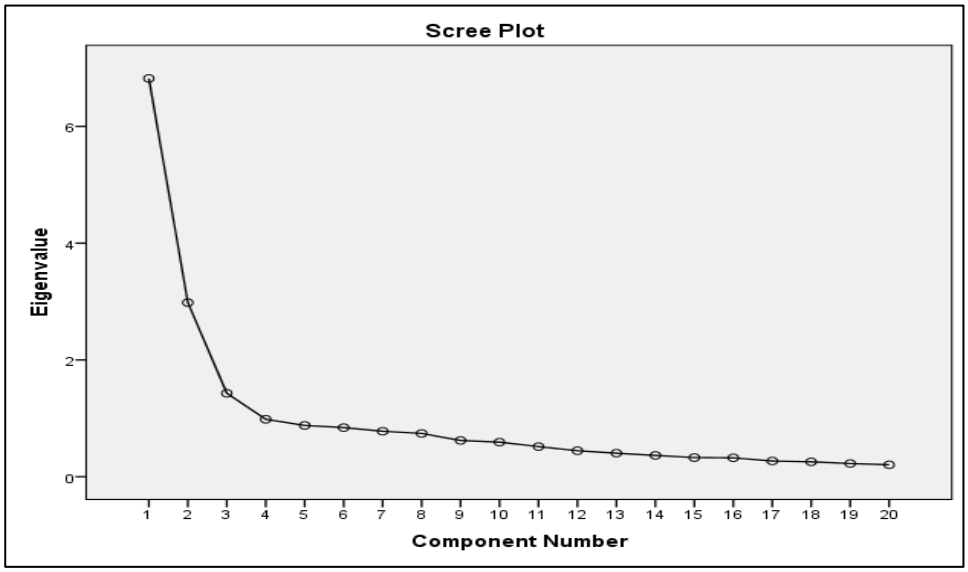

Figure 02. Scree plot from exploratory analysis

In this study, the reliability test shows all excellent values of 'Cronbach's Alpha' for instructor supportiveness, involvement and student cohesiveness, which are 0.920, 0.726 and 0.745 respectively. Furthermore, the cumulative value of 'Cronbach's Alpha' between dependent and independent variable was also calculated and obtained as 0.883 (Table 04). Since all values are above of 0.7, so the scale can be considered reliable in the sample (Piaw, 2014). All the twenty items exhibited reliable factor loadings with the lowest in the student cohesiveness factor (SC1 = 0.431) but still acceptable for the related synthesis of information in this study. While the highest factor loading was in the pattern of involvement (IV2 = 0.867). However, one item on SC5 ("I can understand something easier when interacting with friends") had two loading factors value, shared with 0.494 and 0.515 derived from the factor of involvement and student cohesiveness. According to Piaw (2014), this item must be removed and yet has increased the internal reliability of the factor (Cronbach's alpha = 0.745). Although the remaining eight items from both factors of student cohesiveness and involvement might be related to each other underlying same construct, the items are more easily understood as two separate constructs as proposed by Moos category in SLEI. Both constructs are composed of four items each and have high internal reliability (Cronbach's alpha = 0.726 and 0.712 for involvement and student cohesiveness respectively).

Table 03. Factor loadings for three constructs

Construct	Code	Questions	Factor		
			1	2	3
Instructor Supportiveness (Cronbach's alpha = 0.920)	IS3	Instructor delivers instruction that can be easily understood	0.801		
	IS8	Instructor guides me to carry out experiments successfully	0.800		
	IS9	Instructor motivates me to carry out experiments successfully	0.786		
	IS11	Instructor encourages me and friends in problem-solving	0.757		

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	IS1	Instructor is able to explain an experimental procedure wisely	0.746		
	IS2	Instructor monitors experimental activities in laboratory session	0.736		
	IS6	Instructor uses allocated time effectively	0.732		
	IS10	Instructor gives an opportunity for me to ask questions	0.723		
	IS5	Instructor concerns on the students' safety in the laboratory	0.705		
	IS4	Instructor ensures student obeys the rule in laboratory	0.678		
	IS7	Instructor ensures me to submit laboratory report on time	0.585		
Involvement (Cronbach's alpha = 0.726)	IV2	I prefer to discuss with friends compared with instructor		0.867	
	IV3	I prefer to share an information with friends compared with instructor		0.856	
	IV4	I interact frequently with friends rather than instructor		0.652	
	IV1	I prefer to conduct experiments in a group compared with individually		0.489	
Student Cohesiveness (Cronbach's alpha = 0.712)	SC4	My friends and I cooperate to keep all the equipment neatly after used			0.779
	SC3	My friends motivate me to complete the experiments			0.758
	SC2	My friends and I give full attention to the instructors' explanation			0.658
	SC5	I can understand easier when communicating with friends (removed)		0.502	0.515
	SC1	I become motivated when my friends manage to finish their experiments			0.445
Eigenvalue			6.82	2.98	1.43
% of variance			34.10	14.91	7.14

Table 04. Reliability Test

Predictive Variable		**Cronbach's Alpha**
Reliability scale of Independent Variable (IV)	Instructor supportiveness	0.920
	Involvement	0.726
	Student cohesiveness	0.745
Reliability IV-DV (Students' interest in science)		0.883

By using these three constructs, the data were analyzed by using Pearson correlation analysis and highlighted in Table 05. In term of students' interest in science, these three factors are distinctly correlated. The relationship strength between the dependent variable and independent variables is explained as suggested by Cohen (1988) in the Table 05. The relationship measured is found positively and moderately correlated for both factors of teacher supportiveness (r = 0.375) and student cohesiveness (r = 0.317) with

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Corresponding Author: Zul Ilham
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the students' interest in science. However, the factor of involvement implies weak correlation with the value less than 0.3. The results verify that the both factors with moderate correlation have adequate correlation coefficients (r > 0.3), showing a sufficient convergent validity (Chiu et al., 2016; Netemeyer, Bearden, & Sharma, 2003).

Table 05. Correlation of relationship dimension (N=321)

Predictive Variables		**Students' interest in science**	**Interpretation according to Cohen (1988)**
Pearson Correlation	Instructor supportiveness	0.375	Moderate
	Involvement	0.100	Small
	Student cohesiveness	0.317	Moderate

Table 06. Descriptive Analysis (N=321)

Predictive Variables	**Frequency** and **Percentage**			**Mean**	**S.D**	**Interpretation**
	Score 1.00-2.33 (Low)	Score 2.34-3.66 (Moderate)	Score 3.67-5.00 (High)			
Instructor supportiveness	2 0.6%	53 16.5%	266 82.9%	4.180	0.599	High
Involvement	8 2.5%	79 24.6%	234 72.9%	3.980	0.703	High
Student cohesiveness	4 1.2%	60 18.7%	257 80.1%	4.083	0.624	High
Students' interest in science	2 0.6%	44 13.7%	275 85.7%	4.327	0.633	Very High

Table 06 describes the behavioural pattern of four variables studied. The statistics indicate that majority of Malaysian students in science course scored high in each variable. The score is divided into three interpretations; low, moderate and high. For instructor supportiveness, more than 80% of the total students think that the instructor is helpful and highly motivated. In the pattern of involvement, it shows that students would interact more with friends rather than their instructor. To sum up, the overall result indicates that in student-centered learning, both students-students and instructor-students' interaction still play an important role towards the successful laboratory teaching and learning. The variable of students' interest in science scored the highest among all variables with 85.7% as most students think that laboratory activities boosted up their interest in science. In order to get the broader description on the mean score for each variable, five interpretations for mean are divided equally from the 5-Likert points (1.0-1.8 = Very low, 1.8-2.6 = Low, 2.6-3.4 = Medium, 3.4-4.2 = High, 4.3-5.0 = Very high). All the relationship variables scored averagely high and the interest in science is averagely very high. Thus, there is still a considerable gap worth to be studied in order to equalize both the dependent and independent variables.

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Corresponding Author: Zul Ilham
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eISSN: 2357-1330

6.2. Regression analysis

To look whether there is a significant relationship and contribution percentages for each relationship dimension variables in laboratory with the students' interest in science, multiple regression test was executed and presented in Table 07. Student perceptions on the three relationship dimension (instructor supportiveness, pattern of involvement and student cohesiveness) in laboratory significantly contribute towards their interest in science subject [$F(2, 318) = 31.69$, $p = 0.000$] ($p < 0.05$). Through the stepwise regression, the highest contribution is generated by the instructor supportiveness ($\beta = 0.303$, $t = 5.191$, $p < 0.05$) in laboratory with $R^2 = 14\%$ towards the students' interest from the facet of relationship dimension. Following the second contributor with $R^2 = 3.2\%$ is resulted from student cohesiveness ($\beta = 0.175$, $t = 3.441$, $p < 0.05$). On the other hand, even though involvement of students in laboratory has a significant relationship, but is not a factor that contributes towards the students' interest and is considered constant in this analysis.

Table 07. Multiple Regression (Stepwise)

Predictive Variable (X)	B	Std. Error	Beta (β)	t-Value	t-Sig.	R^2	Contribution (%)
Constant	2.264	0.263		8.284	0.000		
Instructor supportiveness	0.320	0.059	0.303	5.191	0.000	0.140	14.0
Student cohesiveness	0.178	0.057	0.175	3.441	0.002	0.172	3.2

Multiple R	0.408
Square R	0.172
Adjusted R Square	0.166
Standard Error	0.580
Contribution	17.2%

The data in Table 07 indicates that students would have more interest to learn science if there is an excellent interaction occurs between instructor-students and students-students. In relation to that, the contribution of both factors in relationship dimension towards the students' interest could be formed through the following regression equation:

$$Y = 2.264 + 0.320 X_1 + 0.178 X_2$$

where:

Y = Students' interest in science
X_1 = Instructor supportiveness
X_2 = Student cohesiveness
Constant = 2.264
Error = 0.379

http://dx.doi.org/10.15405/epsbs.2018.05.13
Corresponding Author: Zul Ilham
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6.3. Open-ended Questions.

The result of participants' verbal comments revealed that interaction in the laboratory also affects the students' interest in science. The following question was asked to the respondents at the end of the survey:

- Learning in the laboratory could enhance my interest towards science subjects. Why?

Out of 321 respondents, 24 of them left the answer blanks. Thus, after refining 297 responses, only 2.4% respond on this question based on the relationship dimension factor in laboratory. There are few positive and negative responses depict the interaction occurs in Malaysian universities laboratories and how it greatly influences their interest in science.

Some of the positive responses:

"As in lab, there will be more interaction between students and lecturers. Besides, we can relate the theory and experiment, thus, lead to more understanding about the subject."

"Because there is more interaction in the lab compare to in the classroom."

"Because I could try equipment and conduct experiments with friends. Other than that, laboratory is more comfortable and suitable for me when compare sitting in the bored classroom"

"Practicing group works and strengthen my understanding in the science subjects taken"

Some of the negative responses:

"Sometimes, lecturer (instructor) did not monitor each student."

"Sometimes, lecturers (instructors) are too emotional and this condition causes me not interested to study"

7. Conclusion

To assess university students' perception of the relationship dimension in laboratory, this quantitative study is developed following the procedure to achieve reliability and validity of the instrument used. The result from exploratory factor analysis reveals that three variables are manipulating around the relationship dimension in laboratory. Since this study is focusing on the interaction, so the pattern of involvement factor is projecting towards the active communication occurs in the student-centered learning. In contrast to other factors, active involvement of student exhibits weak correlation and did not correlate directly towards the interest in science, even though it is eventually correlated significantly towards the favorable science learning environment (Ahmad, Osman, & Halim, 2013). Further on the data, in term of student-centered and active learning, the undergraduate students already verify that they prefer to carry out laboratory activities with friends in a cooperative group. In all cases, the relationships were moderately

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varied, explaining <60% of the variation in student perceptions. Similarly, Konak, Clark, and Nasereddin (2014) also found that interaction in laboratory is positively correlated to the increased interest but not as high as competency factor in laboratory learning. Therefore, future study is suggested to explore into other multiple variables to relate between the relationship dimension, the interest in science and competency or understanding.

In addition, as student-centered learning is commonly practiced in the laboratory activities, students-students' interaction is expected to be higher. However, the perception of Malaysian students is that instructor gives higher support and concerns in the laboratory learning when compared to peers. This finding is consistent to those proposed by Hofstein et al. (2001). Apparently, most students also pointed out that their instructor has given clear instruction, helpful and encouraging, and understanding but strict in completing the laboratory task. In spite of that, some students claimed that instructors should monitor students more often to give encouragement and motivation to them. The continuous motivation would be able to generate a situational interest although the arguments between these two terms still exist (Abrahams, 2009).

The regression analysis also found instructor supportiveness contributes the highest relationship dimension towards their interest in science. The result from instructor supportiveness is quite similar and replicate prior findings as values of leadership and helping of teacher affect greatly on the students' attitudes (Kijkosol, 2005; Koul & Fisher, 2003). However, in terms of correlation, the finding from student cohesiveness replies distinctly as there is a moderate correlation towards the students' interest in science. Previous study yields no correlation exist for this factor with the student attitudes in class (Henderson, 1995; Kijkosol, 2005) and the students' interest in science (Uk, 2001). The following discussion suggests the variation between results with the previous study. At first, this might be the factor of demographic area. A specific study by Uk (2001) was done in a classroom, which is more teacher-oriented. His study also was done in Korea that practicing different study culture when compared to Malaysia. Secondly, this study used survey responses from diverse science fields whereas the study by Kijkosol (2005) and Henderson (1995) was only conducted for the use of undergraduate biology courses. For these reasons, this study is more appropriate to represent science laboratory at diverse institutions.

Besides that, both instructor and students' cohesiveness contribute of 17.2% and yet significant to the students' interest in science. The open-ended question attested that only 2.4% of 297 students' responses would concern that interaction occurs in laboratory has greatly influenced their positive interest in science. They pointed out that cooperative works in laboratory task really help them to learn science and only a few feels demotivated due to unsatisfactory condition with less interactive practices in laboratory. This open-ended question affirms the small percentages contributed from the relationship dimension. In the same reason, most of the students reveal that understanding and integration of theory are among the highest criteria that could develop their positive interest in science. A good level of all these factors are likely to increase motivation and interest of students in science and could be quantified for future studies.

Finally, several aspects are suggested to be improved in the future study. For example, it is suggested to synchronize seven items for each three factors as suggested by McRobbie and Fraser (1993) in SLEI items. For broader definition, future study might integrate and takes into account other validated instruments to measure the relationship dimensions such as Questionnaire on Teacher Interaction (QTI),

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Teacher Communication Behaviour Questionnaire (TCBQ), Learning Environment Inventory (LEI) and Classroom Environment Inventory (CEI). By incorporating these factors, wider relationship dimension from instructor, students and materials perspectives is hoped to be achieved.

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