

## The Influence of Psychosocial Learning Environment on HOTS in Statistic Education

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Mohd Azry Abdul Malik<sup>1,\*</sup>, Mazlini Adnan<sup>2</sup>

<sup>1</sup> Department of Statistics, Faculty of Computer Science and Mathematics, Universiti Teknologi MARA, 18500 Kelantan, Malaysia

<sup>2</sup> Department of Mathematics, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Perak, Malaysia

### ARTICLE INFO

#### Article history:

Received 10 February 2018

Received in revised form 25 February 2018

Accepted 19 March 2018

Available online 28 April 2018

### ABSTRACT

The present study investigates the relationships between psychosocial learning environment and higher order thinking skills (HOTS) ability in statistic education. Psychosocial learning environment construct were represented by five dimensions; 1) attitude toward students; 2) autonomy-power sharing; 3) student-student relationship; 4) student interest-motivation; and 5) class organization. The target population is a total of 380 students from Diploma in Statistics at one of the largest pioneer university in Malaysia. By using cluster sampling, 285 students were selected as sample for quantitative study. The study instruments were adapted from College and Classroom Environment Inventory Learning and Performance subscale from the Motivated Strategies of Learning Questionnaire for College students, and Dimension of Learning rubrics. The gathered data were analyzed using Smart Partial Least Square (SEM-PLS). The findings revealed that significant direct relationships existed between attitude towards students (ATS) and higher order thinking skills. On the other hand, the result also found that there is enough evidence to support the positive relationship between class organisation (CO) and student' higher order thinking skills.

#### Keywords:

Psychosocial learning environment,  
higher order thinking skills

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## 1. Introduction

According to Secretary's Commission on Achieving Necessary Skills [1], education only will be considered successful when each student is embedded with creative thinking, critical thinking, problem solving thinking, able to reason, making decision, and able to visualize. Education must develop students' capacities in thinking and reasoning, decision making, interpersonal competence, and problem solving [2]. Higher order thinking skills should be an integral part of teaching and learning process especially at the higher education level [3]. In reality, a real-life problem often demands complex solutions, and complex solutions require thinking process at higher level. In order to be successful, students are required to be a good thinker and an excellence problem solver [4].

\* Corresponding author.

E-mail address: [azry056@kelantan.uitm.edu.my](mailto:azry056@kelantan.uitm.edu.my) (Mohd Azry Abdul Malik)

The importance of ensuring teaching and learning process that focus more on the development of higher order thinking skill has been highlighted by many researchers [3, 5-8]. However, majority of the teaching and learning process in Malaysia education are still focusing on lower level of cognitive activities [9]. The extent to which educators understand the role of higher order thinking skills in teaching and learning process is also emerging to be an issue [10]. Effandi, Norhidayah, Mistima and Norazah [11] conducted a study to identify the level of emphasis of teaching Mathematics on the understanding of concept and high-order cognitive strategies. Their study revealed that educators were only moderately emphasis on the use of high-order cognitive strategies in teaching and learning process.

There are several factors that influence development of higher order thinking skills of a student such as teaching strategies, teaching method, support system, technology usage and others. Quality of learning environments is one of the factors that can facilitate improvement in cognitive of learner [2]. It appears from the compilation of investigations that the quality of classroom learning environment gives a significant positive effect on students' cognitive [12-19]. Therefore, this study attempts to numerically assesses the relationship between psychosocial learning environment and students' higher order thinking skills ability. This study is different from other studies in two aspects. First, the study focuses diploma level of education. In Malaysia situation, although numerous studies of education field have been conducted, study focusing on diploma level was inadequate [20]. Secondly, this study involves statistics education. MacGillivray and Mendoza [21] highlighted that research and developments in statistics education which comprises facilitating the learning of statistical thinking and reasoning is important.

## 2. Literature Review

This section discusses the literature related with psychosocial learning environment, higher order thinking skills and their relationship.

### 2.1 Psychosocial Learning Environment

Psychosocial learning environment plays a dominant part in attracting student and allowing them to be efficacious within the classroom. Psychosocial learning environment in classroom should be taken care and given attention because the atmosphere formed by the educators in teaching and learning process can either encourage or discourage students to be successful [22]. During teaching and learning process, the classroom is composed of different type of interaction and communication that lead to overall characterization of the learning environment [23].

The studies about the psychosocial learning environment have been conducted in various ways. For example, to measure the psychosocial learning environment, Trigwell and Prosser [24] employed ten items namely creates interest, clear objectives, well prepared, clear explanations, relevance of the subject, helped understanding, chance for questions, time for consultations, clear assessment criteria, and the adequateness. In addition, Church, Elliot and Gable [25] organized a study to examine the predictor role of perception toward the psychosocial learning environment for learning goal and outcomes achievement. In their study, the perception toward the psychosocial learning environment included lecture engagement, evaluation focus, and harsh evaluation. Psychological construct covers safety aspect, respectable relationship, and autonomy in articulating ideas, feeling and thought [26-27]. The psychosocial learning environment includes social factors, such as relationship between the students, health and ability to perform in the class [28]. The

psychosocial environment also provides good exploratory information of how student perceives the quality of learning environments.

Since this study involves diploma level student, College and Classroom Environment Inventory (CCEI) is deemed as a suitable instrument to measure psychosocial learning environment construct. Therefore, psychosocial will be represented by five dimensions in College and Classroom Environment Inventory; 1) attitude toward students; 2) autonomy-power sharing; 3) student-student relationship; 4) student interest-motivation; and 5) class organization.

## 2.2 Higher Order Thinking Skills

In early study of thinking, thinking is defined as a person's behavior to solve a problem [29]. Thinking is like a sequenced chaining of events. Generally, thinking is divided into two levels which are lower order thinking and higher order thinking. By referring to Bloom's taxonomy of cognitive process, lower order thinking referred to level of knowledge and understanding, while higher order thinking starts from level of application to the evaluation's stage. Often, procedural knowledge is misinterpreted as higher order thinking skill. Indeed, procedural knowledge is a type of knowledge and might be a prerequisite to achieve higher order thinking level. Specifically, procedural knowledge can be defined as knowledge of rules [30].

In mathematics, most of the student can get the correct answer by following the procedure but only a few of them can really make reasoning with the process or procedure involved, and rarely can apply and expand the knowledge into different situation. Higher order thinking skills can be characterize as a complex cognitive process that utilizes and expands the dispensation and construction of information. According to McDavitt [31], higher order thinking skills should include analysis, evaluation, synthesis, and require mastery of lower levels thinking. Higher order thinking involves separating the complex problem into parts, identifying the relationships, combining information creatively and analyze it by using suitable cognitive level for decision making. In other word, higher order thinking involves interaction across taxonomies. Florida Department of Education [32] also agreed that higher order thinking skills demand students to utilize variety of thinking processes to manage a complex situation or task. In 2006, Tan *et al.* [33] developed a framework of Generative Learning Object Organizer and Thinking Task (GLOOTT), a pedagogically-enriched web-based learning environment designed to improve higher order thinking skills. In the study by them, authors also describe higher order thinking skills using element of analysis, synthesis and evaluation skills.

## 2.1 Relationship between Psychosocial Learning Environment and Higher Order Thinking Skills

In year 2015, Budsankom *et al.* [34] has conducted a study to identify a factor influencing higher order thinking skills of students. They applied Meta analytic structural equation modeling (MASEM) based on a database of 166 empirical studies. In their study, learning environment were described as 1) classroom climate, 2) teaching and learning methods and 3) teacher's behavior. Classroom climate consists of both physical environment such as class size, lighting quality, tidiness and psychosocial environment such as safety, relationship and freedom [35-36]. Teaching and learning methods consist of techniques or principles to manage students' learning in achieving classroom management goal [37]. Teacher's behavior consists of educators' action to motivate, encourage and facilitate students in performing a given task [38]. As a result, Meta analytic structural equation modeling confirmed that learning environment has a significant direct effect on students' higher order thinking skills development [34].

In a study conducted by Fleith [39], the factors which either stimulate or inhibit the development of higher order thinking skills in the classroom environment being explored through teachers and students' perceptions. Author applies a qualitative study to collect the data regarding the study interest. Three (3) teachers and thirty-one (31) students were involved in the interview sessions. As a result, the study found that both teachers and students believe that a good quality of learning environment able to enhance higher order thinking development. Teaching and learning process should provide students with choices, opportunity to express the ideas, develop their self-confidence, and try to manipulate students' strengths and interests. On the other hand, the result also explains that a poor quality of learning environment such as no autonomy power sharing among students and teacher, no opportunity to throw an ideas and excessive learning structure will inhibit development of higher order thinking skills.

In short, there are tremendous studies conducted in the past found that learning environment construct can affect student's psychological characteristic significantly and simultaneously giving significant influence on learning [40-42]. Rutter [43] claimed that a student working condition was positively related to exam success. Learning environment is an important teaching device for educators [44]. Sanoff [45] agreed with the statement and proved it to be true in his study. The result of Sanoff's study revealed that learning environment did significantly affect learning, ideas, values, attitudes and culture. Table 1 compiles the recent supporting literatures of the relationship between learning environment, psychological characteristic and higher order thinking skills.

**Table 1**

The recent supporting literature

Relationship	Supporting literature
Learning environment positively influences higher order thinking skills.	Budsankom et al., [34]; Loes et al., [64]; Pascarella et al., [65] Fraser & Kahle [13]; Chism, [40]; Monahan, [41]; Strange & Banning, [42]; Fleith, [39]; Sanoff, [45]

### 3. Methodology

This section discusses the research design, population of the study, target sample, sampling technique, data collection, instrumentation and technique of analysis.

#### 3.1 Research Design

The study mainly focuses on quantitative approach in order to achieve the study objectives. The presents study used survey method in collecting the data. Survey can be described as structured way to collect information from the respondents using questionnaires. This study employed a structured questionnaire consisted of closed-ended questions in the data collection. Moreover, this study employed a cross-sectional design since taking measurements at one point of time was already adequate for the study. The study utilized self-administered questionnaires to obtain quantitative data. The respondents were given the questionnaire to be completed at their own convenient time. The study captured student perceived on quality concerning psychosocial learning environment and assessed the extent of student higher order thinking skills ability resulting from the performance of the independent constructs.

### 3.2 Population and Sample

The target population for this study was the diploma students from 'Faculty A' at one of the pioneer and largest university in Malaysia. The study focused on specific faculty in order to stay focus on students who had experienced the teaching and learning lesson in statistics subject only. The study was also restricted to only Regression Analysis subject which involved two programs from this faculty. Regression analysis I subject seems to be a suitable focus subject to represent statistics because the subject contains tremendous fundamental concepts of statistic such as the concept of correlation, parameter, ordinary least square method, model adequacy, error term, hypothesis testing, test statistic, multicollinearity and others. Once the students can master the knowledge and concept in Regression analysis, it will be easier for them to learn other type of statistics subjects because of the relatedness [20]. The details information about the population available for this study is as Table 2.

**Table 2**

Target population

Campus	Total Student	Population (N)
Campus A	94	
Campus B	191	380
Campus C	95	

### 3.3 Sampling and Data Collection

This study employed probability sampling and focused on cluster and simple random sampling. Probability sampling is a process that assures every individual in population has an equal chance of being selected as sample. Since the target population was clustered together in different campuses geographically, cluster sampling was considered as the most appropriate sampling design for this study which resulted 2 campuses were selected. Randomly, Campus A and Campus B were chosen for data collection whereas Campus C was then automatically used for pilot study. The study obtained only the list of students from Diploma in Statistic and Diploma in Actuarial Science since those students were in the position to provide their opinion for items under the respective construct of the study. Therefore, 94 students from Campus A and 191 students from Campus B with a total equal to 285 students became the respondent for quantitative study. This 285 sample was more than enough to fulfil the rule of thumbs for SEM which is sample size should be at least 10 times the largest number of structural paths directed at a particular construct in the structural model. By 95% confidence level and standard deviation as .5, the target sample gives only 5% margin of error. The calculation of margin of error is as below;

$$\text{margin of error} = \sqrt{\frac{(z\text{-score}^2)(\text{StdDev})(1-\text{StdDev})}{\text{number of sample}}} \quad (1)$$

$$= \sqrt{\frac{(1.96^2)(.50)(1-.50)}{285}} = 0.05 \quad (2)$$

### 3.4 Instrumentation

The questionnaire for present study consisted of six sections. Section A covered information on demographic profiles while Section B, and C covered on psychosocial learning environment, and

higher order thinking skill variables respectively. According to Bryman and Bell [46] and Straub [47] pre-testing of an instrument is important to give an indication of how well the questions flow and improve instrument comprehension. Instruments pre-test also allows the researcher to check the adequacy of instructions to respondents. Each of the items should be representative of the construct and comprehensively cover all aspects of the construct. By follows the suggestions of Lewis, Templeton and Byrd [48] on establishing content validity, conducting pre-test and a pilot-test are necessary.

For pre-test, the experts were approached for their opinions relating to questionnaire design. Through the pre-testing phase, experts are allowed to identify items that could be added or deleted from the instrument, and make suggestions for enhancements, if necessary [48]. Thus, pre-test for this study's instrumentation validation was performed by three persons in different field and from different university. Person '1' is an expert of learning environment study from Universiti Pendidikan Sultan Idris. Person '2' from Universiti Teknologi MARA is an expert in statistics field while person '3' from Universti Teknologi Malaysia is an expert in higher order thinking skills area. They were approached for their expertise in the related research and practice.

The experts were asked to comment on the questionnaire design and each of the items was reviewed by the experts for its content, scope, and purpose. Experts were also asked to comment on various aspects of the questions such as the clarity or ambiguity, item representativeness, appropriateness of the scale, and clarity of instructions. Then, five former students of Diploma in Statistics were chosen in instruments pre-test to make sure questionnaire are understandable and not confusing for diploma level students.

**Table 3**

The summary of instruments used in questionnaire after pre-test

Construct	Items	Source	Expert Validation
Psychosocial leaning environment	33	College and Classroom Environment Inventory, CCEI,	Validated
Higher order thinking skills	8	Marzano Higher Order Thinking, Dimension of learning Rubrics	Validated

After the pre-testing phase, the instrument was pilot-tested using respondents that are similar to the real survey sample. A pilot study is normally conducted to enhance particular research instruments [50]. The main objective of pilot study is to determine the extent of how reliable was the items from inventory in measuring the intended latent construct. The reliability test is conducted during the pilot to find out whether the data collecting means prove their accuracy, stability, and consistency level. Indicator reliability and internal consistency reliability were used by the researcher to measure the reliability. Indicator reliability can be assessed through the indicator loadings (factor loadings) and the values should be higher than 0.7 [51]. Internal consistency reliability can be assessed through measuring the Cronbach alpha. If the Cronbach alpha is more than 0.70, the questions will be admitted as reliable. As claimed by Gay, Mills and Airasian [52], a pilot test is considered as a test in which a small-scale trial of the study is conducted prior to the full-scale study. Therefore, preliminary study that involved 30 students from Faculty A, Campus C. was conducted to pilot the extent of how reliable was the items from inventory in measuring the intended latent construct.

The result of pre-test and pilot test concluded that items in questionnaire were understandable to read and statistically, all construct give an acceptable internal consistency reliability (Cronbach alpha above 0.7). All the items in the construct also achieve a good indicator reliability with factor

loading values greater than 0.6. Only three items were deleted due to low factor loading. The result of pilot study and the summary of final instruments used are as shown in Table 4.

**Table 4**  
 Summary of preliminary results on reliability of instruments

Construct	Sub-construct	Cronbach alpha		No. of final items
		Before CFA	After CFA	
Psychosocial Learning environment	Attitude toward students	0.946	0.946	32
	Autonomy-power sharing	0.747	0.879	
	Student-student relationships	0.921	0.921	
	Student interest-motivation	0.947	0.947	
	Class organization	0.917	0.917	
Higher order thinking skills	Higher order thinking skills	0.983	0.983	8

### 3.5 Techniques of Data Analysis

Data screening was performed to identify data entry errors and to examine the statistical assumptions of analysis which involve checking for missing data, outlier, and normality. After screening, data cleaning was performed. The data was then analysed using Partial Least Square-Structural Equation Modelling (PLS-SEM).

## 4. Results and Discussion

This section presents the description of respondent demographic profile, assessment of measurement and structural model, and finally model fit.

### 4.1 The Descriptive Analysis of Respondent Demographic Profile

Most of the respondents were mainly females which constituted 76.5 percent compared to 23.5 percent of male respondents. 7.6 percent of respondent age were below 20 years old and 92.4 percent were age 20 to 22 years old. The allocation of the respondents are 65.9 percent from Campus B and 34.1 percent from Campus A and majority of the respondent 90.2 percent were from semester 5 students. In term of study program, 44.3 percent of respondent were from Diploma of Actuarial Science and 55.7 percent were from Diploma in Statistic.

### 4.2 Assessment of Measurement Model for the Study

In order to evaluate the measurement model, reliability and validity tests were used. Reliability is to test how consistently a measuring instrument measures whatever concept it is measuring, while validity is a test of how well an instrument that is developed measures the particular concept it is intended to measure. In assessing the reflective measurement items, it is recommended to achieved satisfaction in reliability (indicator reliability, and internal consistency reliability), convergent and discriminant validity [51].

#### 4.2.1 Indicator and internal consistency reliability

Reliability is the extent of how reliable is the said measurement model in measuring the intended latent construct. For indicator reliability, indicator loadings (factor loadings) should be



higher than 0.7 [51]. The loadings of variables showed more strongly on their own constructs in the model where greater than 0.7 are considered adequate [55]. During the deletion stage, all of the outer loadings are above the minimum requirement of 0.7, with the exception of APS1, APS2 and CO6. Therefore, these three items were deleted. The values of all the acceptable outer loading after deletion process is shown in Table 5.

Another assessment need to put a consideration is the assessment of internal consistency reliability. It can be asses through measuring the composite reliability (CR) and Cronbach alpha. Composite reliability values reflect the level to which construct indicators reveal the latent variables and they should be greater than 0.70. Cronbach's alpha coefficient was developed in this study along the composite reliability values to examine the inter-item consistency of the measurement items. The Cronbach alpha (CA) and composite reliability (CR) should be higher than 0.7 [51].

**Table 5**  
 Result of the Factor loading, Composite reliability and Cronbach alpha

Construct	Factor loading FL	Composite reliability CR	Cronbach alpha CA
<b>Attitude towards Student (ATS)</b>		<b>.939</b>	<b>.922</b>
ATS1	0.797		
ATS2	0.848		
ATS3	0.884		
ATS4	0.886		
ATS5	0.828		
ATS6	0.845		
<b>Autonomy power sharing (APS)</b>		<b>.91</b>	<b>.85</b>
APS3	0.761		
APS4	0.941		
APS5	0.923		
<b>Student-student relationship (SSR)</b>		<b>.927</b>	<b>.908</b>
SSR1	0.711		
SSR2	0.836		
SSR3	0.804		
SSR4	0.845		
SSR5	0.8		
SSR6	0.833		
SSR7	0.791		
<b>Student interest and motivation (SIM)</b>		<b>.952</b>	<b>.950</b>
SIM1	0.807		



SIM2	0.875		
SIM3	0.9		
SIM4	0.899		
SIM5	0.878		
SIM6	0.891		
SIM7	0.883		
<b>Class organization (CO)</b>		<b>.946</b>	<b>.931</b>
CO1	0.82		
CO2	0.874		
CO3	0.897		
CO4	0.893		
CO5	0.89		
CO7	0.803		
<b>Higher order thinking skills (HOTS)</b>		<b>.952</b>	<b>.950</b>
H1	0.877		
H2	0.866		
H3	0.866		
H4	0.899		
H5	0.857		
H6	0.861		
H7	0.826		
H8	0.825		

Based on the Table 5, all the composite reliability values and the cronbach alpha values ranged from 0.850 to 0.980 which depicts the degree to which the construct indicators indicate the latent, and construct ranged which exceeded the recommended value of 0.7 [51]. All the cronbach's alpha (CA) and composite reliability (CR) exceeded the recommended value of 0.70, indicating that the measurement scale used in this study had high internal consistency [55].

#### 4.2.2 Convergent validity

Convergent validity is described as the extent to which items measuring the same concept in construct. Convergent validity is asses using average variance extracted (AVE). Average variance extracted (AVE) measures the variance captured by the indicators relative to measurement error

should be higher than 0.50 in orders to justify the use of the construct [51]. In this study, the AVEs ranged from 0.656 to 0.736, which were all within the suggested range as in Table 6.

**Table 6**  
 Summary of average variance extracted values

Construct	Average variance extracted (AVE)
Attitude towards student (ATS)	0.72
Autonomy power sharing (APS)	0.772
Student-student relationship (SSR)	0.646
Student interest and motivation (SIM)	0.769
Class organization (CO)	0.746
Higher order thinking skills (HOTS)	0.739

#### 4.2.3 Discriminant validity

Discriminant validity is the extent to which a construct is different from other constructs. The discriminant validity specifies that each latent constructs' AVE should be higher than the construct's highest squared correlation with other latent construct and the indicator's loadings should be greater than all its cross loadings [56]. Another way to asses' discriminant validity is by using Heterotrait-Monotrait ratio of correlations (HTMT) where HTMT below 0.9 means that the discriminant validity is establish.

Table 7 shows the results of convergent and discriminant validity analyses by Fornell and Larcker's criterion. All constructs had the values of AVE square root in diagonal were greater than the squared correlation with other constructs in off diagonal, showing that all constructs met the acceptable standard of discriminant validity [55]. The value of Heterotrait-Monotrait ratio of correlations for each construct also shows the value below 0.9 which indicate discriminant validity achieved as in Table 8.

**Table 7**  
 Discriminant validity using Fornell and Larcker's criterion

	APS	ATS	CO	HOTS	SIM	SSR
APS	0.878					
ATS	0.617	0.849				
CO	0.624	0.696	0.864			
HOTS	0.508	0.623	0.606	0.86		
SIM	0.621	0.691	0.813	0.59	0.877	
SSR	0.49	0.594	0.578	0.494	0.659	0.804

**Table 8**  
 Discriminant validity using Heterotrait-Monotrait ratio of correlations

	APS	ATS	CO	HOTS	SIM	SSR
APS						
ATS	0.69					
CO	0.697	0.748				
HOTS	0.557	0.659	0.64			
SIM	0.687	0.736	0.863	0.616		
SSR	0.548	0.644	0.619	0.523	0.704	

In sum, all the constructs have achieved good reliability and strong validity. Once the measurement model has been confirmed as reliable and valid, the next step is to assess the structural model results.

### 4.3 The Structural Model Assessment

Before assessing the structural model, collinearity for the structural model construct need to be examined. Estimation of path coefficients in the structural model is based on ordinary least square (OLS) regressions of each endogenous latent variable on its corresponding predecessor constructs and the result might be biased if the estimation involves multicollinearity problem. After checking for collinearity, assessment continues with the level or the coefficient of determination  $R^2$  values, the  $f^2$  effect size, the predictive relevance and the significant of the path coefficient.

#### 4.3.1 Assessment of collinearity

Before examining the significance of the structural model, collinearity of the model constructs must be checked by calculating the variance inflation factor (VIF) values and it should be less than 5. The results of these analyses may be biased if collinearity is present. Therefore, in this study, the results for VIF were all less than 5 as suggested by Hair et al., [51] as in table 9. Thus, this study can proceed to the next analysis assessment of structural model.

**Table 9**

VIF values for independent constructs

Construct	HOTS
Attitude towards student (ATS)	2.412
Autonomy power sharing (APS)	1.89
Student-student relationship (SSR)	1.897
Student interest and motivation (SIM)	3.722
Class organization (CO)	3.386

#### 4.3.2 Assessment of effect size ( $f^2$ ) and coefficient of determination ( $R^2$ )

Coefficient of determination revealed the percentage of variation in endogenous construct is explained by exogenous construct. While, the  $f^2$  effect size measures the individual contribution of exogenous construct toward the endogenous construct. Based on Chin [57], it is good to determine the effect sizes of specific latent variables' impact upon the dependent variables with the help of  $f^2$  analysis which is complementary to  $R^2$ .

According to Hair *et al.*, [51],  $R^2$  values of 0.75, 0.50 or 0.25 for endogenous latent variables in the structural model can be described as substantial, moderate or weak, respectively. Based on Table 10, the  $R^2$  values of higher order thinking skills (0.461) is considered moderate and is in the substantial range. Based on Cohen [58], the  $f^2$  values of 0.02, 0.15 and 0.35, were used to interpret small, medium and large effects sizes of the predictive variables, respectively. The result of effect size shows that Attitude towards student (ATS) Class organization (CO) and has a moderate effect in producing the  $R^2$  for HOTS (0.07,0.025). For Autonomy power sharing (APS), Student-student relationship (SSR) and Student interest and motivation (SIM), these constructs has small effect size on HOTS (0.007, 0.007 and 0.005).

**Table 10**  
 R<sup>2</sup> and f<sup>2</sup> effect size of latent constructs result

Construct	R <sup>2</sup>	f <sup>2</sup> effect size HOTS
Higher order thinking skills (HOTS)	0.461	
Attitude towards student (ATS)		0.071**
Autonomy power sharing (APS)		0.007*
Student-student relationship (SSR)		0.007*
Student interest and motivation (SIM)		0.005*
Class organization (CO)		0.025**

Note: \*small effect, \*\*medium effect, \*\*\*large effect

#### 4.3.3 Assessment of predictive relevance

Another criterion for the evaluation of the structural model is the predictive relevance  $Q^2$ , which is a measure that reflects how well observed values are reconstructed by the model and its parameter estimates [51,57].  $Q^2$  values are obtained using a blindfolding procedure. As claimed by Hair *et al.*, [51], the model will have predictive quality if the cross-redundancy value is more than zero or otherwise the predictive relevance of the model cannot be concluded.

**Table 11**  
 Prediction Relevance of the Model

Total	SSO	SSE	Q <sup>2</sup> (=1-SSE/SSO)
Higher order thinking skills (HOTS)	2,112.00	1450.73	0.313

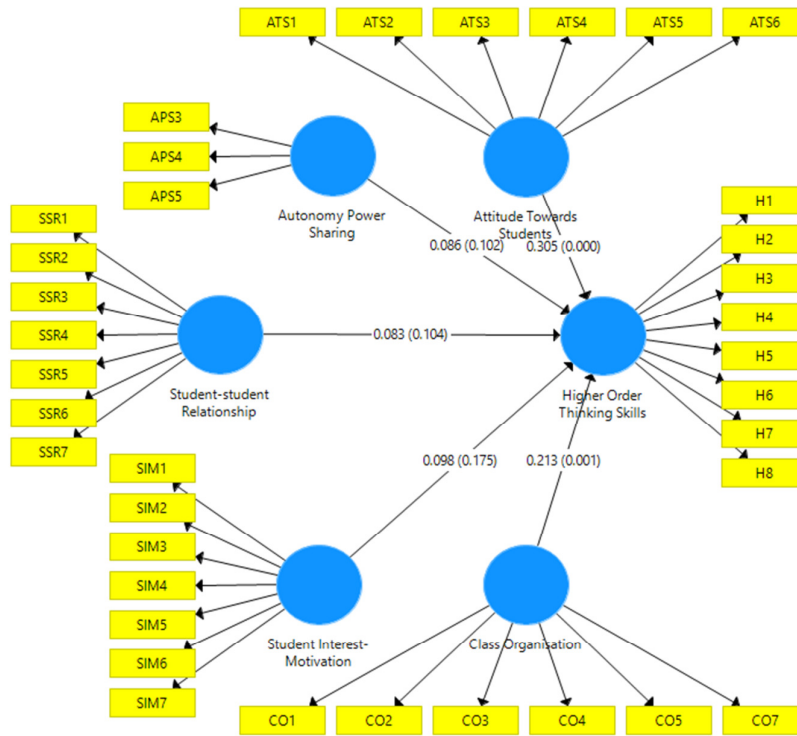
The results in Table 1 show that the obtained cross validated redundancy values for higher order thinking skills construct was found to be 0.313. According to Hair *et al.*, [51], a relative measure of predictive relevance  $Q^2$  values of 0.02, 0.15 and 0.35 indicate that an exogenous construct has a small, medium or large predictive relevance. These results show a value of  $Q^2$  that support the suggestion that the model has an adequate prediction quality. Therefore, the final structural equation modeling is as Figure 1.

#### 4.4 Model Fit

Model fit indices enable judging how well a hypothesized model structure fits the empirical data and, thus, help to identify model misspecifications. In 2013, Henseler and Sarstedt [59] stressed out that the usefulness of the goodness of fit index both conceptually and empirically in PLS-SEM are still not satisfying. However, in a simulation study conducted by Dijkstra and Henseler [60] and Henseler *et al.*, [61], authors suggested that Standardized Root Mean Square Residual (SRMR), RMSttheta, and exact fit test are capable of identifying model misspecifications. For this study, SRMR is used to represent model fit criterion implemented for PLS path modelling. In order to have some frame of reference, it has become customary to determine the model fit both for the estimated model and for the saturated model. Saturation refers to the structural model, which means that in the saturated model all constructs correlate freely. A cut-off less than 0.10 or of 0.08 for standardized root mean square residual appears to be more adequate for PLS path models [62]. The result of the standardized root mean square residual (SRMR) indicated that the model is well fitted as in Table 12.

**Table 12**  
 Standardized root mean square residual (SRMR) value for model fit

	Standardized root mean square residual	Result
Saturated model	0.052	Model is fit
Estimated model	0.052	



**Fig. 1.** Final structural model

#### 4.5 Hypotheses Testing

The hypotheses of this study were tested by examining the path coefficients ( $\beta$ ) through structural equation modeling using the PLS approach. The path coefficients generated by PLS provide an indication of the relationships and can be used similar to the traditional regression coefficients. The bootstrapping technique was used to obtain the t-values of each coefficient whereas the t-values of the parameter indicate the strength of the relationship the parameter represents. Therefore, the higher the t-value, the stronger the relationship is [63]. Path models as in figure 1 are diagrams used to visually display the hypotheses and variable relationships that are examined when SEM is applied [51].

**Table 13**  
 Direct Relationship Result

Path	Path coefficient	p-values	Result
APS → HOTS	0.086	0.106	Not significant
ATS → HOTS	0.305	0.000	Significant
CO → HOTS	0.213	0.001	Significant
SIM → HOTS	0.098	0.176	Not significant
SSR → HOTS	0.083	0.100	Not significant

\*Significant at  $p < .05$ . APS= Autonomy power sharing, ATS= attitudes toward student, CO= class organisation, SIM=student-interest motivation, SSR= Student-student relationship, HOTS = higher order thinking skills ability

There were five exogenous construct (IV) in this study; 1) Attitude towards student 2) Class organization, 3) Autonomy power sharing, 4) Student-student relationship and 5) Student interest and motivation. These exogenous constructs were hypothesized to have a significant direct relationship with higher order thinking skills ability constructs (DV). To determine these relationships, PLS algorithm and bootstrapping algorithm were conducted. The results in Table 4.9 showed that the Attitude towards students ( $\beta = 0.305$ ,  $p$ -value = 0.000) and Class organization ( $\beta = 0.213$ ,  $p$ -value = 0.001) constructs have a significant positive relationship with higher order thinking skills ability constructs ( $\beta = 0.319$ ,  $p$ -value = 0.00). Moreover, there is not enough evidence to support the relationship between Autonomy power sharing, Student interest-motivation, and student-student relationship with students' higher order thinking skills.

#### 4. Conclusion

The present study found that quality of psychosocial learning environment (Attitude towards students ( $\beta = 0.305$ ,  $p$ -value = 0.000) and Class organization ( $\beta = 0.213$ ,  $p$ -value = 0.001)) has a significant and direct influence on students' higher order thinking skills ability. The result asserts that psychosocial learning environment is an important factor in students' higher order thinking skills development. This finding is consistent with the result obtained by Budsankom et al. [34]. In the study, based on the result of meta analytic structural equation modeling, the authors conclude that the quality of classroom climate is one of the factors contribute to the development of higher order thinking skills ability. Furthermore, the finding obtained in this study is also consistent with the result of the study done by Loes *et al.* [64] and Pascarella *et al.* [65]. In both studies, the authors concluded that a good quality of psychosocial learning environment gives a positive significant impact on the growth of students' higher order thinking skills ability. Last but not least, this hypothesis also in line with Azry *et al.* [5] in chemistry education setting, Morris and Maisto [66], and Fleith [39], where they emphasize that the elements of psychosocial environment are significantly affiliated students' higher order thinking skills development.

The present study attempts to make several contributions. Firstly, the empirical findings of this study will help to clarify the impact of psychosocial learning environment on the cognitive development focusing on higher order thinking skills. Thus, by understanding the relationship, strategies could be developed to enhance quality of the learning environment in universities and consequently will lead the universities to become more competitive in producing high quality output with good higher order thinking skills ability. Secondly, the findings of the study will be meaningfully and extending the existing literature in these particular areas. This study would be of benefit to academicians in enhancing their knowledge and thoughts relating to the variables under investigation within the Malaysian context.

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