DEVELOPMENT OF RELATIONSHIP MODEL BETWEEN LEARNING ENVIRONMENT, PSYCHOLOGICAL CHARACTERISTICS AND HIGHER ORDER THINKING SKILLS IN STATISTICS EDUCATION

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ABSTRACT

The purpose of this study was to develop the relationship model between learning environment (physical and psychosocial environment), psychological characteristics (students' academic self-efficacy and satisfaction) and higher order thinking skills in statistics education. The study also aimed to determine if psychological characteristics mediate the relationship between learning environment and higher order thinking skills. A total of 285 students were selected as sample using cluster sampling. The study instruments were adapted from Smart Classroom Inventory, Science Laboratory Environment Inventory, College and Classroom Environment Inventory, Test of Science-Related Attitudes, Self-Efficacy in Learning and Performance for College and Dimension of Learning rubrics. The gathered data were analysed using Partial Least Square Structural Equation Modeling (PLS-SEM). The findings revealed that significant direct relationship existed between psychosocial learning environment and higher order thinking skills (β=.319, p=.000). The result also found that there is not enough proof to support the relationship between physical learning environment and higher order thinking skills (β=.070, p=.148). Mediation effect of self-efficacy and satisfaction were found in the relationship between learning environment (physical and psychosocial) and higher order thinking skills (β_1=.160, p_1=.000, β_2=.225, p_2=.000). Meanwhile, content knowledge (β_1=-.026, p_1=.593, β_2=-.021, p_2=.585) and gender of respondents (β_1=.077, p_1=.718, β_2=.029, p_2=.914) have no significant moderating effect on the relationship between exogenous and endogenous constructs. In conclusion, the relationship among learning environment, psychological characteristics and higher order thinking skills in statistics education were successfully modeled and represented as The Relationship Model between Learning Environment, Psychological Characteristics and Higher Order Thinking Skills in Statistics Education (LEPHs Model). LEPHs model provides significant and valuable contributions to theoretical, methodological, educational practice and knowledge in the area of higher order thinking research in the context of Malaysian Institution of Higher Learning. The implication of this study suggests that the LEPHs model can be used to determine the quality of the learning environment based on students' psychological characteristics and high level of thinking skills in the teaching and learning process for statistics education.

PEMBINAAN MODEL HUBUNGAN ANTARA PERSEKITARAN PEMBELAJARAN, CIRI-CIRI PSIKOLOGI DAN KEMAHIRAN BERFIKIR ARAS TINGGI DALAM PENDIDIKAN STATISTIK

ABSTRAK

Kajian ini bertujuan membina model hubungan antara persekitaran pembelajaran (persekitaran fizikal dan psikososial), ciri-ciri psikologi (efikasi kendiri akademik pelajar dan kepuasan diri pelajar) dan kemahiran berfikir aras tinggi dalam pendidikan statistik. Kajian ini juga menentukan sama ada ciri psikologi menengahkan hubungan antara persekitaran pembelajaran dan kemahiran berfikir aras tinggi. Seramai 285 pelajar telah dipilih sebagai sampel kajian menggunakan persampelan kluster. Instrumen kajian telah diadaptasi daripada *Smart Classroom Inventory, Science Laboratory Environment Inventory, College and Classroom Environment Inventory, Test of Science-Related Attitudes, Self-Efficacy in Learning and Performance for College* dan *Dimension of Learning rubrics*. Data yang dikumpulkan dianalisis dengan menggunakan Permodelan Persamaan Struktural Kuasa dua Terkecil Separa *(PLS-SEM)*. Dapatan dalam kajian mendedahkan bahawa hubungan langsung yang signifikan wujud antara persekitaran pembelajaran psikososial dan kemahiran berfikir aras tinggi (β=.319, p=.000). Kajian juga mendapati bahawa tidak ada bukti yang cukup untuk menyokong hubungan antara persekitaran pembelajaran fizikal dan kemahiran berfikir aras tinggi (β=.070, p=.148). Kesan mediasi efikasi kendiri dan kepuasan ditemui dalam hubungan antara persekitaran pembelajaran (fizikal dan psikososial) dengan kemahiran berfikir aras tinggi (β_1=.160, p_1=.000, β_2=.225, p_2=.000). Sementara itu, pengetahuan kandungan (β_1=-.026, p_1=.593, β_2=-.021, p_2=.585) dan jantina responden (β_1=.077, p_1=.718, β_2=.029, p_2=.914) tidak memberi pengaruh sederhana terhadap hubungan antara konstruk eksogen dan endogen. Sebagai kesimpulan, hubungan antara persekitaran pembelajaran, ciri-ciri psikologi dan kemahiran berfikir aras tinggi dalam pendidikan statistik berjaya dimodelkan dan diwakilkan sebagai *The Relationship Model between Learning Environment, Psychological Characteristics and Higher Order Thinking Skills in Statistics Education* (Model LEPHs). Model LEPHs memberikan sumbangan penting dan berharga kepada amalan teori, metodologi, praktikal pendidikan dan pengetahuan dalam bidang penyelidikan kemahiran berfikir aras tinggi dalam konteks Institusi Pengajian Tinggi Malaysia. Implikasinya, model LEPHs boleh digunakan bagi menentukan kualiti persekitaran pembelajaran berdasarkan ciri-ciri psikologi pelajar dan kemahiran berfikir aras tinggi secara positif dalam proses pengajaran dan pembelajaran bagi pendidikan statistik.

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LIST OF ABBREVIATIONS

AKEPT	Higher Education Leadership Academy
APS	Autonomy Power Sharing
ASA	American Statistician Association
ATS	Attitude Toward Students
BLS	Bureau of Labor Statistics
CO	Class Organization
FL	Factor Loading
HOTS	Higher Order Thinking Skills
I	Indoor air, temperature and lighting
LS	Learning Space
PD	Physical Design
PLE	Physical Learning Environment
PISA	Programme for International Student Assessment
PsyLE	Psychosocial Learning Environment

SA	Student Satisfaction
SCANS	Secretary's Commission on Achieving Necessary Skills
SE	Self-Efficacy
SIM	Student Interest and Motivation
SRMR	Standardized Root Mean Square Residual
SSR	Student-student Relationship
T	Technology
TIMSS	Trends in International Mathematics and Science Study
UiTM	Univesiti Teknologi MARA
UKM	Universiti Kebangsaan Malaysia
UPSI	Universiti Pendidikan Sultan Idris
UTM	Universiti Teknologi Malaysia

CHAPTER 1

INTRODUCTION

1.1   Introduction

This chapter previews the study background and clearly underlines the problem statement. The purpose of the study is also discussed in this chapter. Moreover, the present chapter constructs three main objectives, three main research questions, and ten hypotheses to ensure the findings of the study are well supported. This chapter also describes the research framework that has been developed to represent the relationships between the variables involved in the research framework. Finally, the chapter addresses the significance, limitations, operational definitions and the structure of the study.

1.2   Background of the Study

There is a widespread concern in Malaysia about the quality of learning experienced by students (Lim, Nagendralingan, Sopia, Noor Shah, Rajendran, & Idris, 2012). According to Secretary's Commission on Achieving Necessary Skills (1991), 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. In earlier year, Devries and Kohlberg (1987) already proposed that education process should teach students suitable life skills, added value and embed them with higher order thinking skills. Education must develop students' capabilities in thinking and reasoning, decision making, interpersonal competence, and problem solving (King, Goodson, & Rohani, 2011). According to Chinedu, Olabiyi and Kamin (2015), higher order thinking skills should be embedded in teaching and learning process especially at the higher education level. 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 excellent problem solver (Tan, Aris, & Abu, 2006). Rajendran and Idris (2008) in their study also agreed that students who were taught how to develop creative insights were better suited for more complex problem solving compared to those who were not.

The importance of ensuring teaching and learning process that focuses more on the development of higher order thinking skills has been highlighted by many researchers and scholars (Azry, Mazlini, Amri, Rahimie, & Baharim, 2016; Chinedu et al., 2015; King et al., 2011; Krathwohl, 2002; López & Whittington, 2001; Lucas,

Spencer, & Claxton, 2012; Miri, David, & Uri, 2007; Pickard, 2007; Rajendran & Idris, 2008; Yee, Jailani, Razali, Widad, & Tee, 2011; Yunos, Kiong, Heong, Mohamad, & Othman, 2010). However, Mohd Ali and Shaharom (2013) highlighted that majority of the teaching and learning process for science and mathematics education in Malaysia are still focusing on lower level of cognitive activities of. In mathematics education, 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 (Nor'ain & Mohan, 2016). Effandi, Norhidayah, Mistima and Norazah (2016) 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 only moderately emphasis on the use of high-order cognitive strategies in teaching and learning process.

Shockingly, according to Malaysia Blueprint report in 2012, Higher Education Leadership Academy (AKEPT) discovered that only 12% of 125 lessons in 41 schools across Malaysia were delivered at a high standard, 38% met satisfactory standards and 50% are unsatisfactorily. The reason behind those percentages might due to most teaching and learning process conducted with no best practice pedagogies, passive lecture, lack of student engagement and was more on achieving surface level knowledge rather than developing higher order thinking skills. Those high percentages phenomena cannot be accepted as normal application because the implications of developing higher order thinking skills in student has been greatly discussed by scholars of educational field. According to Lim (2006), a good teaching and learning process in mathematics encourage conceptual understanding, students

participate actively in meaningful activities, students not only understand but able to apply what they have learned, good students' activities planning, related to students' daily life experiences, and provide a good teaching aids for students' conceptual understanding. Examination oriented culture, time constraint, educators' belief that teacher-centered approach is more practical and lack of confidence in student's ability to acquire knowledge and skills by exploring the mathematics lesson themselves becoming the challenge for educators to incorporate good teaching practice (Fatimah & Lim, 2004).

Historically, a study by Miller (1989) already found that a large number of lectures in universities typically reflected thinking at the lower levels of cognition. The above finding is consistent with Fischer and Grant (1983), who also found that regardless of the kind of subject area, course level and institution, teaching and learning process in college was still at the lowest levels of cognition. The data from their study discovered that 98% of the discourse times, conducted by lecturers were at lower levels of cognition. Again, findings from Pickford (1988) showed that 94% of lecturers conducted their discourse at lower level of cognition. Studies analyzing classroom ongoing assessment by Marso and Pigge (1993) also have found that most quizzes, tests or assignments require only recall of information. This type of practice was totally not suitable in our education system nowadays.

In real life situation, almost everything requires people to use knowledge in some ways, and most solution of a complex problem is obtained through higher level

thinking processes. Most of the educators know about this fact but only few apply it into their teaching and assessment practices. In order to counter this situation, Chabeli (2006) recommended that a study focusing on the assessment of intellectual concepts should be implemented. Moreover, in a study conducted by Effandi and Muzakkir (2017), authors showed that there was a significant difference between the Realistic Mathematics Approach and the traditional approach in terms of achievement. The realistic mathematics education approach is able to encourage students to participate actively in teaching and learning process and simultaneously improve the quality of teaching and learning process. Problem-solving activities in mathematics also help students to understand subject content, lead them in applying their knowledge in real world problems and improve teaching and learning process (Rohani, Maryam & Farzaneh, 2015).

According to Noor Azlan (2000) who traced the development of mathematics education in Malaysia, the content of the curriculum before the 1970's focused on "traditional mathematics" with major concern on computational skills. At this stage, teaching and learning process offer students with the product of mathematical thought and not the process of mathematical thought itself. Then, after the introduction of modern mathematics program that had been introduced in the late 1970s, teaching and learning procedure begin to expose students with the processes of mathematics. In 1980s, the integrated curriculum was implemented to create a balance between student skills and understanding. At this stage, teaching and learning process emphasis more on problem solving skills that related to real life experience. Compared to traditional teacher centered instruction or known as behaviourism,

problem-solving (cognitivism) and discovery (constructivism) learning produce a better learning progression and also develop students' creativity in mathematics to deal with life challenges (Abdolreza, Aida Suraya, Kamariah & Azadeh, 2016).

Furthermore, according to a study by Tan et al. (2006), the conventional education system is dominated by lecture-related or also can be called as "knowledge transmission activities". The conventional education system only produces a student that passively receiving information which only involves recall skills and simple understanding of learning. Consequently, students are more likely to become a fact-memorizer rather than a problem-solver. Nor'ain (2015) explored the practise of mathematics lecturer's in teaching and learning process at higher learning institutions and also found out that the lecturer incorporated only passive teaching method in teaching of the mathematics subject matter. Supposedly, mathematics should be the subject that trains students' mind to think logically and systematically in solving problems and making decisions (Munirah & Santi, 2014).

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. According to King et al. (2011), quality of learning environments is one of the factors that can facilitate improvement in cognitive and psychological characteristics of learner. Based on a study carried out by Che Nidzam, Kamisah and Lilia (2013), it appears from the compilation of investigations that the quality of classroom learning environment gives a significant positive effect on

students' cognitive and students' psychological characteristics (Chionh & Fraser, 2009; Fraser, Alridge & Adolphe, 2010; Fraser & Lee 2009; Goh & Fraser, 2000; Hofstein & Lunetta 2004; Majeed, Fraser & Alridge, 2002; Wolf & Fraser 2008; Kilgour, 2006). In 2015, Marzita, Che Nidzam, Noraini, Mazlini and Mohd Hairy identified the relationship between the classroom learning environment and learning comfort level. It appears that there is a highly positive association between the physical environment and learning comfort level.

Moreover, Kember, Ho and Hong (2010) and Okurut (2010) found that the quality of learning environment is also capable in motivating student to learn. Student learning outcomes are also proven to be incremented via a comfortable and enjoyable teaching and learning environment (Baek & Choi 2002; Hijazi & Naqvi 2006; Lizzio, Wilson & Simon, 2002). Khine (2002) in his study identified the learning environment as a determinant of successful teaching and learning process. In 2001, Chang and Fisher published a paper which they described a good quality of learning environment tend to increase students' achievement. Ten years earlier, McRobbie and Fraser (1993) already demonstrated that students' positive perceptions on quality of learning environment revealed a consistent relationship with learning outcomes. On a much later research, Kumar, Garimella and Nalla (2014) in their study demonstrated the positive influences of social constructivism in skill development and employability of the students.

It may be noted that most of the studies revealed that the students seem to learn better in high quality of learning environment. Combining appropriate physical facilities with positive psychosocial aspects, the learning process will enhance social contacts, intellectual activities, limit negative behaviour among students, improve student psychological characteristic and promote them to involve in learning and teaching process. A good quality environment can influence the learning atmosphere, students' attitudes and behaviour, generation of ideas, and improve students' values (Marzita et al., 2015). Thus, as observed from prior studies, there has been much discussion in educational circles that quality of learning environment and mastery of higher order thinking skills should be given special attention.

1.3   Problem Statement

The Malaysian government has been planning for the development of intellectual capital in the country in which education is placed as the utmost important asset. The higher education main objective is to create "World Class Universities" in Malaysia. Even though there are so many great deals have been done to achieve it, the employability rate of undergraduate is still an issue. In relation to the study, it is a surprise to see the statistics of graduates' unemployment in the country despite their education and training obtained at the university. Department of Statistics graphically shows an increasing trend of unemployment rate in Malaysia from 2014 to 2015, as in Figure 1.1. The pattern of the inclining trend for the unemployment rate is something that needs to be worried.
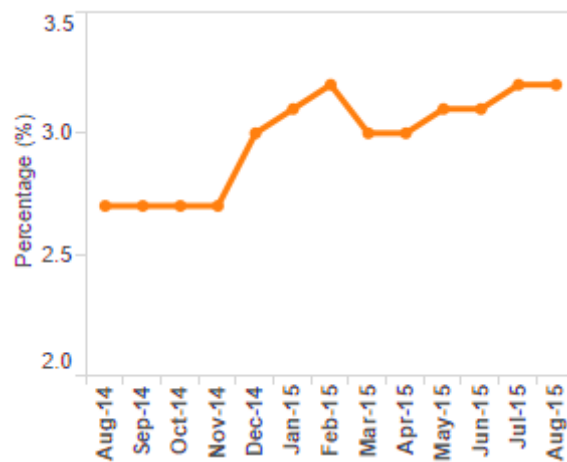
Figure 1.1. Unemployment Rate Trend. Adapted from Department of Statistics, 2015

There are several reasons that associated with high unemployment rate issues such as social status, political status, economical status, job opportunity and others. In education point of view, providing a graduate with a criterion that fulfil industry or employer requirement is one of the features that influence the unemployment rate. The universities are expected to be the manufacturer of competent work force for the country, and the graduates are considered as "output" of the university system. Due to that reason, marketability of the graduates in the job market should be the priority of the universities. They must put in mind that the marketability of graduates also relies on the requirement of potential employers.

Based on the employability skills framework set by Department of Education Science and Training, there are eight employability skills required by students namely; problem solving, planning and organizing, teamwork, lifelong learning,

initiative, communication, technology, self- management, and enterprise as well as other several individual characteristics (Curtin, 2004). Chinedu, Libunao, Kamen, and Saud (2014) agreed that preparing student with higher order thinking skills is very essential to solve employability problem where they highlighted that the best way to prepare future employees is to teach students how to think instead of what to think. Most companies demand workers with decent level of English proficiency, good soft skills and also higher order thinking skills, such as problem solving, creative thinking and critical thinking. Being aware of those employment requirements, university should produce students with the qualities and skills based on the requirements set by the potential employers or industries and give specific attention on student higher order thinking skills development. Hence, the quality of teaching and learning process at the university, quality of the learning environment, the support systems and programs offered by the university need to be excellent.

However, the quality of Malaysia education system has once again been questioned when Organization for Economic Cooperation and Development (OECD) has reported that Malaysia is ranked 52 out of 65 countries in terms of education quality (Krishnan & Noraini, 2014). Furthermore, according to Malaysia former minister of education Tan Sri Muhyiddin Yasin, test report at the international level such as Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) has proven that our student's achievement is still at average level. For instance, Malaysia scored only 421 in mathematics in PISA 2012, whereas the global average score was 494 (Krishnan & Noraini, 2014).

In order to be excellent in education, the development of students' higher order thinking skills in teaching and learning process becoming necessity to be fortified. Students are expected to have higher order thinking skill in order to face a continuous rapid change in Malaysia development. According to Malaysia education blueprint 2013-2025, there is a high concern over to what extent does students being fortified with the proper skills to endure in today society. Looking back to the history, the formal and systematic teaching of higher order thinking skills in Malaysia classroom begin in the early 1990s (Rajendran, 2001) or equal to 16 years old experience. In term of experiences, Malaysia education is still considered as 'immature' or 'young' in higher order thinking skill development. There are still a lot of opportunities and aspects need to be investigated and improved. Moreover, both higher education and secondary education in Malaysia are lag sufficient utilization of higher order thinking skills (Chinedu et al., 2015; Yee et al., 2011; Yee, Jailani, Razali, Widad, & Tee, 2010). Additionally, according to Yee et al. (2011), higher order thinking skills are learnable and teachable, and all students have the right to apply and learn this type of higher level thinking.

Therefore, in line with Malaysia Education Blueprint 2013-2025, this study attempts to fill the gaps by studying the factors influence higher order thinking skills development in statistics education. This study numerically assesses the relationship between learning environment, psychological characteristics and students' higher order thinking skills. Even though physical learning environment gives a great influence to the development of an individual, Chism (2006) reported that studies relating to physical environment are still relatively scanty and suggest conducting

further study about the impact of physical environment on learning. Veal and Jackson (2006) also claimed that research on the interrelationship of physical learning environment design and education practice is still not sufficient. Moreover, Higgins, Hall, Wall, Woolner, and McCaughey (2005) agreed that more research is needed to assess learning environment especially on the effects of the design or physical aspects on educators and learners. Thus, in this study, learning environment is represented by physical and psychosocial learning environment.

Budsankom, Sawangboon, Damrongpanit, and Chuensirimongkol (2015) suggested that the psychological factor also must be considered and exerted to the classroom learning environment study. Therefore, in the present study, psychological characteristics will be a mediating construct linking the relationship between learning environment and higher order thinking skills construct. Occurrence of gender and content knowledge as moderating variables between quality of learning environment and higher order thinking skills also will be investigated. Previous researches revealed that there occurred a significant difference in higher order thinking skills among difference gender (Hyde, Fennema, & Lamon 1990; Galagher, Holst, McGillicuddy, Morely & Cahalan, 2000; Royer & Garofoli, 1999) and content knowledge (Tanujaya, Mumu & Margono, 2017) in mathematics education.

The presents study is different from other studies in three aspects. First, the study focuses diploma level of education. In Malaysia situation, although numerous studies of educational field have been conducted among students in primary,

secondary schools, undergraduate and even in the level of postgraduate, study focusing on diploma level was inadequate (Azry, Mazlini, Norafefah, Amri and Jasrul, 2017). Secondly, this study also investigates the relationship between the quality of learning environment and higher order thinking skills with the occurrence of psychological characteristic as mediating variables. In accordance to that, this study attempts to assess both physical and psychosocial learning environment set up in teaching and learning process that can give a direct and/or indirect effect to higher order thinking skills.

Statistician is projected to be one of the fastest-growing jobs (American Statistical Association, 2016). According to the Bureau of Labour Statistics (BLS) forecasts, the employment of statisticians will increase by 34% from 2014 to 2024, compared to 28% for mathematical science occupations. If we were to look from education perspective, statistics courses or subjects, as compared to science and mathematics are still lack of attention (Azry et al., 2017). From year 2000 to 2012, only 20 published research papers related with statistics education were found in an electronic search in Malaysia (Reston, Krishnan, & Noraini, 2015). Moreover, MacGillivray and Pereira-Mendoza (2011) highlighted that research and developments in statistics education which comprises facilitating the learning of statistical thinking and reasoning is important. Thus, thirdly, this study involves statistics education. Regression analysis I subject seems to be a suitable focus subject to represent statistics education for the diploma level 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 (Azry et al., 2017).

1.4   Purpose of the Study

The study assesses the opportunity to improve learning's outcomes in term of psychological characteristics and higher order thinking skills in statistics education via learning environment which is relevance with the government policy on education development plan. Historically in Malaysian education system, the development of strong content knowledge is main priority of the system (Malaysia Education Blueprint, 2012). There is however, theoretical knowledge only is no longer enough for a student to face complex real life. This situation forces the system to emphasis more on developing student higher order thinking skills while preparing them with adequate knowledge in facing life challenges.

Via Malaysia Education Blueprint 2013-2025, the Malaysia education system has highlighted the needs to meet the Quality of a High International Standard. The governments try to reinforce the system by promoting education that focus on core skills. One of the skills is remodel the examination style to include greater attention on higher order thinking skills. To face that challenge, students must be furnished and trained to master the higher order thinking skills. In line with the government policy, this study assesses the direct and indirect contribution of quality of learning

environment in the aspect of physical and psychosocial environment toward students' higher order thinking skills ability. The study also examines the psychological characteristics of a student in term of academic self-efficacy, and satisfaction as intervening variables linking learning environment and higher order thinking skills. In addition, the study also examines the moderating effect of gender and study program on the relationship between learning environment and student's higher order thinking skills.

1.5   Objectives of the Study

The general objective of this study is to identify the significance of learning environment and psychological characteristics constructs in influencing students' higher order thinking skills. The study also wants to examine the moderating effects of certain variable on the constructs leading to development of students' higher order thinking skills. Specifically, the construction of the following objectives is to ensure the findings of the study are well supported. The study is designed to achieve the following main objectives:

1. To determine the significant relationship between quality of learning environment (physical learning environment and psychosocial learning environment) and students' higher order thinking skills.

2. To examine the mediating effect of psychological characteristics (academic self-efficacy and student's satisfaction) on the relationship between quality of learning environment and students' higher order thinking skills.

3. To examine the moderating effect of content knowledge and gender on the relationship between quality of learning environment and students' higher order thinking skills.

1.6   Research Questions and the Corresponding Hypotheses

Figure 1.2 shows the main hypotheses among constructs in the study. In order to achieve the above objectives, the study needs to address the following research questions and to test their corresponding hypotheses as in Table 1.1.

Table 1.1

The summary of research questions and the main hypotheses

Research Question 1: Is there a significant and direct relationship between quality of learning environment (physical learning environment and psychosocial learning environment) and students' higher order thinking skills?

Main Hypothesis 1
H1   Physical learning environment has a significant and direct influence on students' higher order thinking skills.
H2   Psychosocial learning environment has a significant and direct influence on students' higher order thinking skills.

(continue)

Table 1.1 *(continued)*

Research Question 2: Does psychological characteristic (academic self-efficacy and student satisfaction) mediate the relationship between quality of physical learning environment and students' higher order thinking skills?

	Main Hypothesis 2 (1)
H3	Self-efficacy mediates the relationship between physical learning environment and higher order thinking skills.
H4	Students' satisfaction mediates the relationship between physical learning environment and higher order thinking skills.

Research Question 3: Does psychological characteristic (academic self-efficacy and student satisfaction) mediate the relationship between quality of psychosocial learning environment and students' higher order thinking skills?

	Main Hypothesis 2 (2)
H5	Self-efficacy mediates the relationship between psychosocial learning environment and higher order thinking skills.
H6	Students' satisfaction mediates the relationship between Psychosocial learning environment and higher order thinking skills.

Research Question 4: Does content knowledge and gender moderate the relationship between physical learning environment and students' higher order thinking skills?

	Main Hypothesis 3 (1)
H7	Content knowledge moderates the relationship between physical learning environment and higher order thinking skills.

(continue)

Table 1.1 *(continued)*

H8	Gender moderates the relationship between psychosocial learning environment and higher order thinking skills.

Research Question 5: Does content knowledge and gender moderate the relationship between psychosocial learning environment and higher order thinking skills?

Main Hypothesis 3 (2)

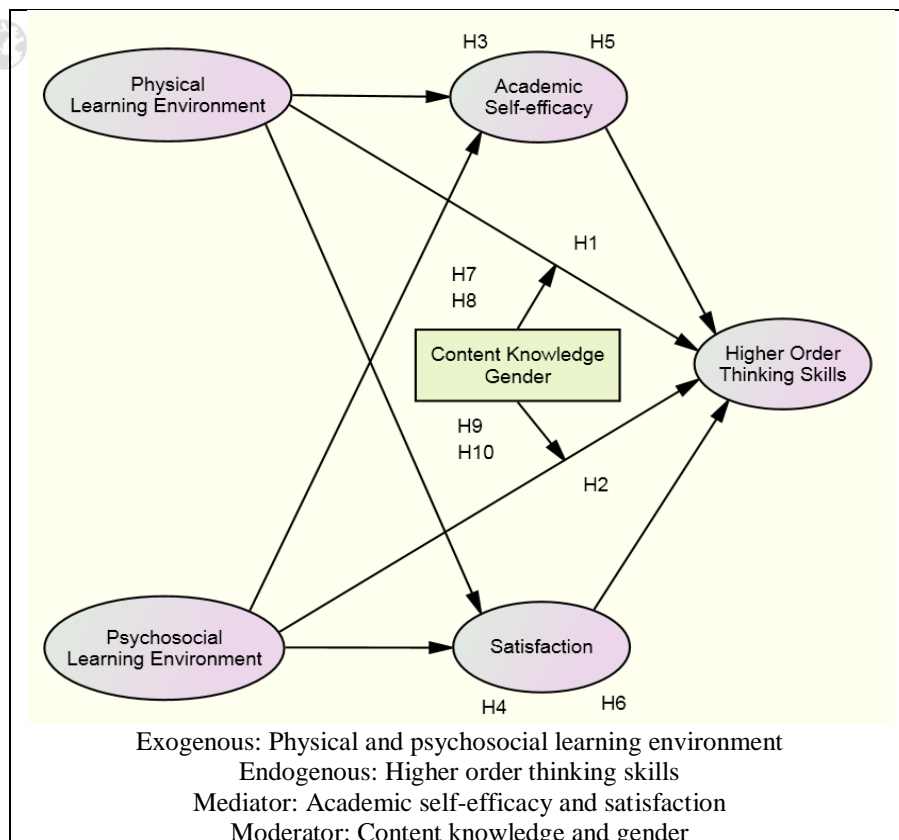|	
H9	Content knowledge moderates the relationship between psychosocial learning environment and higher order thinking skills.
H10	Gender moderates the relationship between physical learning environment and higher order thinking skills.

Figure 1.2. The Main Hypotheses among Constructs in the Study.

1.7   The Conceptual Framework

Based on the review of literature, the conceptual framework has been developed to represent the relationships between learning environment and higher order thinking skills with the existence of psychological characteristics as mediating variable. The proposed model is adapted from the Productivity Model by Walberg (1981), Learning Environment Model by Zandvliet (1999), Self-efficacy Model by Bandura (1977), and Meta analytic structural modelling of factors affecting higher order thinking skills (MASEM) by Budsakom et al. (2015).

In short, environment construct in Productivity Model is recognized as a potential factor to manipulate psychological characteristics and student's higher order thinking skills. The Learning Environment Model suggested that by manipulating the environment, the productivity in education output can be enhanced. Based on Self-Efficacy Model, the present study recognized self-efficacy constructs as a potential factor to influence student's higher order thinking skills. In the MASEM model, learning environment construct is identified as a potential factor to influence student's higher order thinking skills with intervening of mediating effect by psychological characteristics. Details explanation about the models involved is discussed in literature review and model development sections. The framework for this study is represented in Figure 1.3. The constructs involved are learning environment (physical and psychosocial learning environment) as exogenous constructs, higher order thinking skills as endogenous construct, and psychological characteristic (students' self-efficacy and satisfaction) as mediating construct. Content knowledge and gender

are the variables that moderate the relationship between quality of learning environment and student higher order thinking skills ability.
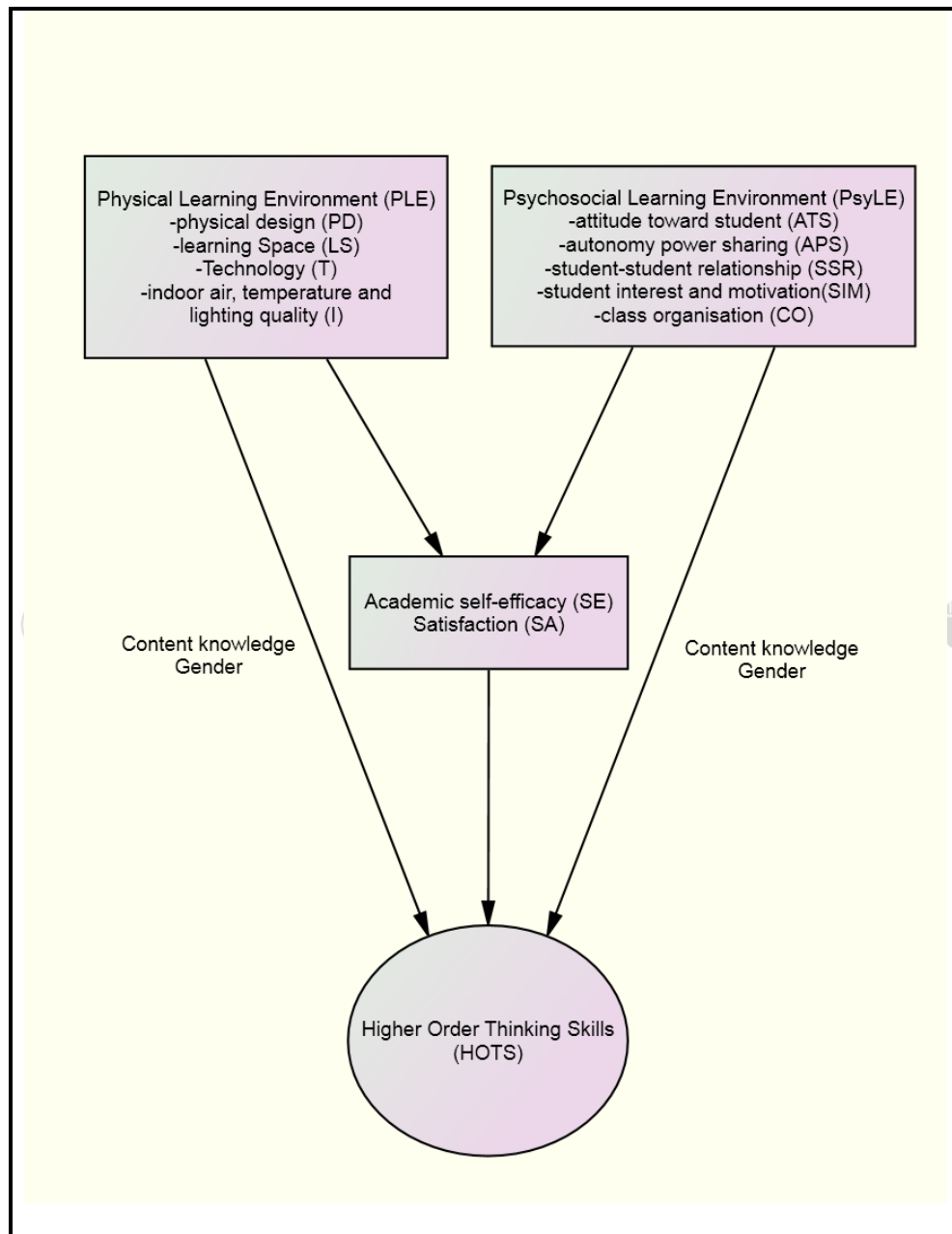

Figure 1.3. The Conceptual Framework

1.8 Significance of the Study

Firstly, this study give an important and valuable contribution to knowledge in the area of higher order thinking skills research in the context of Malaysian Institution of Higher Learning. This study helps to examine various interacting variables with the higher order thinking skills in statistics education. Thus, by understanding the relationships between learning environment and higher order thinking skills, strategies could be developed to enhance teaching and learning performance and consequently will lead the statistics education in Malaysia to become more competitive and dynamic in higher education level. Secondly, this study will assimilate psychological characteristics of students represented by academic self-efficacy and satisfaction as a mediators, gender and content knowledge as a moderators, and these variables have not yet been tested in higher order thinking skills research for the statistics education perspective. Therefore, the findings of the study will be meaningfully and extending the existing literature in these particular areas.

Thirdly, by applying PLS-SEM, this research is able to demonstrate the simultaneous effects of these multiple variables to the endogenous constructs and it would benefit the academicians in enhancing their knowledge relating to the variables under investigation within the Malaysian and statistics education context. Fourthly, the result of this research will be beneficial to several bodies such as the Malaysia higher institutions, Malaysia Education Department and as well as the agencies involved in Malaysia's policy making process. In line with Malaysia education blueprint 2013-2025, whereas, the government want to emphasis and strengthen the higher order thinking skills development in teaching and learning process, the

findings will be significance to the government's needs to adopt the best strategies to improve the Malaysia education quality and to make decisions in government planning on the educational development.

1.9 Limitations of the Study

Similar to other studies, this particular study also bound with limitations, both in scope and methodology. First of all, the study has been carried out in the 'Faculty A' at the one of the pioneer university in Malaysia. Thus, the result might only be generalizable to the above population. In other words, the findings might be different if the scope was increased to include more faculties since different faculties might pose different characteristics. Another limitation is this study employs the cross-sectional design whereby the students' perception score is only measured once throughout the study. Since higher education is a long-term commitment, and this study found the length of time in a university has a significant effect on the students' perception score, the result would be more informative if the longitudinal design is employed. In longitudinal design, the perception score of the respondents is assessed at different time interval throughout their study. Using this method, the management of a university could monitor how their students' perception changes against time when they are consuming more service from the university.

1.10 Operational Definitions

There are several key terms used in this study. The following are definitions of main terms used in this study based on previous researches conducted.

- *Learning environment*: Learning environment can be categorized into psychosocial learning environment and physical learning environment (Fraser, 1998; Kilgour, 2006; Zandvliet & Straker, 2001).

- *Physical learning environment*: Physical learning environment is related to the classroom component, seating positions, classroom design, furniture arrangement, density and crowd, privacy, noise, and design (Weinstein, 1979). The present study described physical learning environment (PLE) as a formation of physical design (PD), learning space (LS), technology (T), indoor air, temperature and lighting quality (I). The present study employed Smart classroom inventory (SCI) and-Science Laboratory Environment Inventory (PSLEI) to measure the quality of physical learning environment.

- *Psychosocial learning environment*: Psychosocial learning environment is related to the type of interaction between students, teachers and environment where teaching and learning process was taking place (Moos, 1979; Weishen, Chang & Guo, 2007). The present study described psychosocial learning environment (PsyLE) as a formation of attitude toward students (ATS), autonomy power sharing (APS), student-student relationship (SSR), student interest and motivation (SIM) and class organization (CO). The present study employed College and Classroom Environment Inventory (CCEI) to measure the quality of psychosocial learning environment.

- *Psychological characteristic*: Santrock (2009) and Woolfolk (2004) commonly referred psychological characteristic as personality trait or behavioural characteristic of individuals. This study reviews the psychological characteristic construct using two major psychological variables; students' academic self-efficacy and satisfaction.

- *Academic self-efficacy*: Bandura (1986) defined self-efficacy as an individual's belief in their capability to achieve the given task or goal in specific or general. The present study described students' self-efficacy as a student's belief in their capability to achieve the academic task or goal in regression analysis course. This construct was measured using Self-efficacy in Learning and Performance for College Inventory.

- *Students' satisfaction*: Student satisfaction represent the subjective student's perceptions related with attitude, feeling and hopes about quality of service or product received (Wu, Tennyson & Hsia, 2010). In this study, students' satisfaction is defined as student perceptions regarding their feeling and attitude towards regression analysis course. This construct is measured using Test of Science-Related Attitudes Inventory (TOSRA).

- *Content knowledge*: Content knowledge is referred to student knowledge related to subject/course which can be measured using cumulative grade pointer average (Badaruddin Ibrahim, 2012). In the present study, content knowledge is referring to student knowledge related to statistics course.

- *Higher order thinking skills*: Higher order thinking skills involved critical thinking, problem solving and transfer skills (Brookhart, 2010). Critical

thinking is a type of thinking that is focused on deciding what to do (Brookhart, 2010). Overcoming constraints that are in the way of pursuing goals referred to problem solving thinking (Brookhart, 2010). Transfer skill train student should learn not only to remember but able to use what they have learned (Brookhart, 2010). The present study measured students' higher order thinking skills in Regression Analysis course by using Dimension of Learning Rubrics (Marzano et al., 1997).

1.11   Summary of the Study

The present study is organized into six chapters. Following is the introductory chapter. Chapter two provides an intensive review of literatures related to this study. The discussion covers the concept of all constructs in the study including their development, application debates by previous researchers and the theoretical perspectives of the constructs involves in the present study. Chapter three explains the development of the present study model and hypothesis leading to the influence of learning environment on higher order thinking skills, and psychological characteristics as a mediating construct, the main themes of this study. The fourth chapter details out the research methodology used in this study. Details discussion on the data analysis and research findings are laid out in chapter five. In addition, this chapter also summarizes the conclusions in empirical aspects. The theoretical as well as implications of this study will be presented in chapter six, the last chapter of the report. The chapter also presents suggestions on the direction for future researches in this particular area.