CONCEPTUAL MODEL OF TACIT KNOWLEDGE TRANSFER FOR PBL TEACHING METHOD IN SYSTEM ANALYSIS AND DESIGN COURSE

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Abstrak

Pembelajaran Berasaskan Masalah (PBL) merupakan satu kaedah pengajaran yang mampu memindahkan pengetahuan tasit daripada pensyarah kepada pelajar berdasarkan proses Sosialisasi, Pensuratan, Kombinasi, dan Pensiratan (SECI). Walau bagaimanapun, model SECI ini tidak mengandungi faktor prestasi pelajar, yang merupakan petunjuk untuk mengukur keberkesanan proses pengajaran dan pembelajaran. Oleh itu, kajian ini mencadangkan sebuah model konsep bagi menilai keberkesanan menggunakan kaedah PBL sebagai kaedah pengajaran untuk memindahkan pengetahuan tasit dengan menambaik model SECI. Kajian ini menggunakan kutipan data secara tinjauan, bermula dengan membina soal selidik kajian untuk meninjau proses SECI dan Prestasi dalam memindahkan pengetahuan tasit daripada pensyarah kepada pelajar. Responden kajian adalah pelajar Analisis dan Reka Bentuk Sistem (SAD) di Universiti Utara Malaysia (UUM). Dapatan kajian telah dianalisis dengan menggunakan *Structural Equation Modeling* (SEM) untuk mengenal pasti kesan langsung faktor-faktor dalam model konsep. Dapatan kajian menunjukkan bahawa model SECI berpadanan dengan data untuk kaedah pengajaran PBL dalam pendidikan Kejuruteraan Perisian (SE). Tiga kesan secara langsung yang signifikan wujud antara faktor dalam model SECI. Walau bagaimanapun, kesan secara langsung bagi proses SECI kepada prestasi pelajar adalah tidak signifikan. Dapatan kajian ini juga menunjukkan bahawa model SECI tidak sepenuhnya wujud dalam proses penjanaan pengetahuan untuk kaedah pengajaran PBL bagi pendidikan SE.

Katakunci: pemindahan pengetahuan; pengetahuan tasit; Pembelajaran Berasaskan Masalah (PBL)

Abstract

Problem Based Learning (PBL) is a teaching method that is able to transfer tacit knowledge from lecturers to students based on Socialization, Externalization, Combination, and Internalization (SECI) model. However, the SECI model does not include students' performance factor, which is an indicator to measure the effectiveness of teaching and learning processes. Hence, this study proposes a conceptual framework to evaluate the effectiveness of using PBL as a teaching method in transferring tacit knowledge by enhancing the SECI model. The methodology begins with constructing a questionnaire to investigate the SECI and Performance processes in transferring tacit knowledge from lecturers to students. The respondents are students of System Analysis Design (SAD) in Universiti Utara Malaysia (UUM). The gathered data were analyzed using Structural Equation Modeling (SEM) to identify the effect of the significant direct relationship among the factors. The findings reveal that the SECI model fits the data for PBL teaching method in Software Engineering (SE) education. Three significant direct effects (regression weights) were obtained between the factors of SECI model. However, the direct effects of SECI processes on performance of students are not significant. The findings of this study also evidence that the SECI model is partially present in the knowledge creation processes in the PBL teaching method for SE education.

Keywords: knowledge transfer; tacit knowledge; Problem Based Learning (PBL)

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List of Abbreviations

AMOS	Analysis of Moment Structures
AVE	Average variance extracted
BIT	Bachelor of Information Technology
BMM	Bachelor of Multimedia
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Construct reliability
Chisq	Chi-Squared
Chisq/df	Chi Square/Degree of Freedom
EFA	Exploratory factor analysis
GFI	Goodness of Fit Index
KM	Knowledge Management
NFI	Normal Fit Index
PBL	Problem Based Learning
RMSEA	Root Mean Square Error of Approximation
SAD	System Analysis and Design
SE	Software Engineering
SECI	Socialization, Externalization, Combination and Internalization
SEM	Structural Equation Modeling
TLI	Tucker Lewis Fit Index
UUM	Universiti Utara Malaysia

CHAPTER 1

INTRODUCTION

This chapter sets the background of this study, which then leads to the problem statement, research objective, research questions, and research hypotheses. It also describes the significance of the research, scope of research, and operational definition.

1.0 Background

The world we live today is very different than that in the past. While everything that we perform today is shrinking, the economic development is borderless and based on knowledge compared with the last decade. In fact, there is a rapid advancement and progression in knowledge and technology.

Currently, knowledge has been widely discussed among the knowledge management researchers as knowledge management is applied, in all industrial sectors, public and private organizations and humanitarian institutions and international charities worldwide. Thus, having an effective knowledge management is now recognized to be the key driver of new knowledge and new ideas to the innovation process, to new innovative products, services and solutions.

In the knowledge management discipline, the tacit knowledge is important to understand. This is because it is the relevant information that resides in an individual's head. It is not written, but it refers to the knowledge someone has gathered through experience. It is often untapped, because it is hidden. However it is a treasure trove of knowledge.

Besides, it can vary as well as can be articulated and passed on from a senior to the apprentice (Busch, Richards & Dampney, 2003). In this study, the tacit knowledge refers to the SAD knowledge that lecturers have gained and experienced, which is difficult to be written down, yet to an extend, it can be articulated in the class. Thus, the key to successfully leveraging it in classroom environment is by implementing PBL teaching method that accelerates the students' ability to solve problems.

The College of Arts and Sciences, Universiti Utara Malaysia offers Bachelor of Information Technology (BIT) and Bachelor of Multimedia (BMM) for undergraduates. In BIT and BMM curricula, SAD is one of the core courses. The syllabus for SAD combines theoreticalpart, methodology, techniques of SAD, as well as the practices for handling analysis and design phase during system development. In SAD, the students need to have the skills to analyze problems and design the solutions. In addition, the students are expected to see beyond increasing knowledge and skills and in order to improve their competency as well as performance in system development practice. In order to fill the gap between the theoretical part and practice of SAD, PBL has been introduced as a teaching method for SAD course.

In regards to that, Ahmad (2010) found that tacit knowledge is able to be transferred from the lecturers to the students via PBL teaching method using SECI model. Although PBL has been a successful teaching method for SAD course, the effectiveness of knowledge transfer in PBL as a teaching method in term of students' performance has not been researched. It is highlited here because students' performance is one of the indicators to measure the effectiveness of teaching and

learning process (Carliner, 2004; Rosenberg, 2006). Accordingly, this study attempts to determine the effectiveness of PBL as a teaching method in SAD course in transferring lecturers' tacit knowledge to their students by enhancing the SECI model in order to measure students' performance.

This is essential for equipping the graduates with flexible learning experience, critical thinking in solving problems, and ability to make strategic decisions. Having graduates equippedwith those characteristics, it is hoped that they can bridge the gap between the theories in SAD and the practices in developing systems.

1.1 Problem statement

PBL is a learning technique that uses inductive thinking approach. It involves an observation of a problem, analysis of gathered data, and formulation of the principles of the findings. In higher education, a study by Ahmad (2010) concludes that tacit knowledge is able to be transferred from the lecturers to the students via PBL teaching method through SECI model. Hence, Ahmad (2010) has initially evidenced that PBL is a successful teaching method for SAD course. Further, the findings are potential to be a motivation for inducing the effectineness of knowledge transfer in terms of students' performance.

However, research regarding the effectiveness of knowledge transfer in PBL as a teaching method in terms of students' performance is still lacking. Students' performance is iscoined here because it is one of the indicators to measure the effectiveness of teaching and learning process (Carliner, 2004; Rosenberg, 2006). Based on the deficit, a model of tacit knowledge transfer using PBL teching method

is necessary as a guideline to lead the effectiveness of teaching and learning process. In conjunction, this study is carried out to derive a conceptual model of tacit knowledge transfer using PBL in SAD course at higher education. Further, the outcome is expected to improve the knowledge transfer process and significantly improves students' performance in SAD course.

1.2 Research Questions

This study attempts to answer the following research questions.

a) What are the knowledge transfer processes using PBL teaching method for SAD course?
b) What are the effects of SECI model to Students' Performance using PBL teaching method for SAD course?
c) How to contruct a knowledge transfer model using PBL teaching method for SAD course?

1.3 Research Objectives

The main objective of this study is to come out with a conceptual model for knowledge transfer using PBL as a teaching method for SAD course. In order to achieve the main objective, the following sub-objectives have been formulated:

a) To determine the knowledge transfer process using PBL teaching method for SAD course.
b) To investigate the effects of SECI model to Students' Performance using PBL teaching method for SAD course.

c) To construct a knowledge transfer model using PBL teaching method for SAD course.

1.4 Research Model

In our study, we propose a conceptual model that is formed by five factors namely Socialization, Externalization, Combination, Internalization and Performance as shown in Figure 1.1. Socialization is a process of transferring expertise from a lecturer to a student via email, forum, and sharing of experience among student and colleagues. Meanwhile Externalization means a process of explaining the tacit knowledge into writing format through teaching material (lecture notes and PBL documents) but inconsistent form so that it can be shared with the student as the basis of new knowledge.

On the other hand, Combination refers to the process of collecting inconsistent explicit knowledge such as teaching materials and external sources into a group of complex and systematic explicit knowledge. During the process of Internalization, the experience acquired through previous process is converted into a valuable knowledge for student. Performance is measured based on the students' results of final semester examination. In this study, a model represents a complete causal relationship, starting from Socialization to Externalization, Combination, Internalization and finally Performance, in which indirect relationship between Socialization and Internalization influences the students' performance.

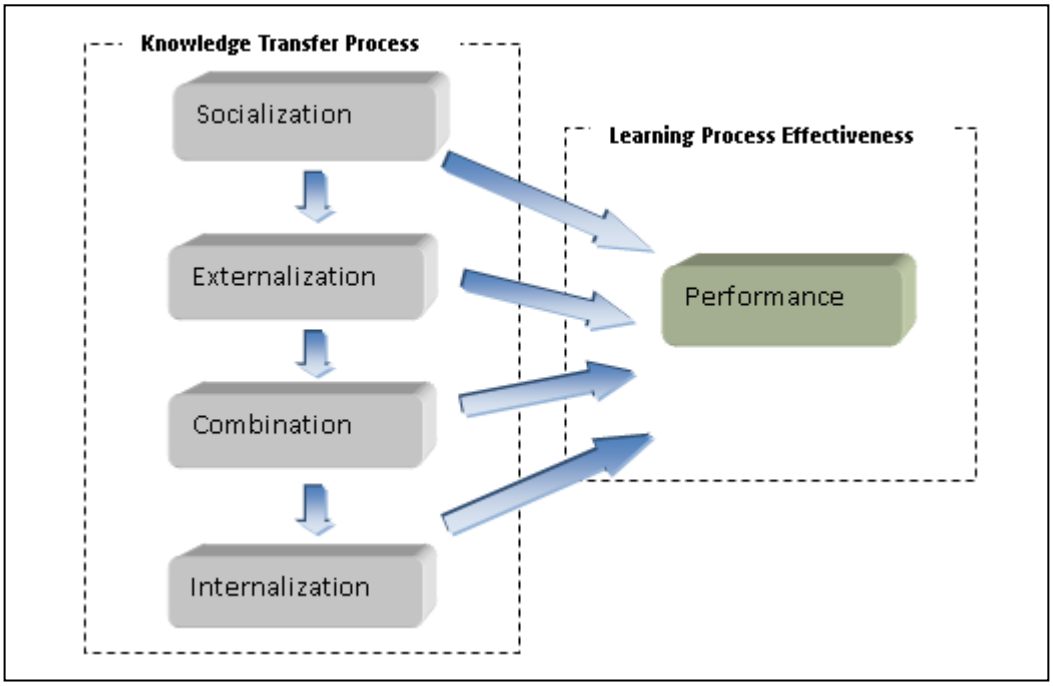

Figure 1.1: Conceptual Model

1.5 Research Hypotheses

In answering the research questions, the following hypotheses have been formulated for testing:

H_1: The socialization has a significant effect on the externalization.

H_2: The externalization has a significant effect on the combination.

H_3: The combination has a significant effect on the internalization.

H_4: The socialization has a significant effect on the performance.

H_5: The externalization has a significant effect on the performance.

H_6: The combination has a significant effect on the performance.

H_7: The internalization has a significant effect on the performance.

1.6 Significance of the Research

This study investigates the knowledge transfer process in the PBL Teaching Method for SAD Course. The findings:

a) Identify the relationship of knowledge transfer processes in PBL teaching method for SAD course.
b) Identify the relationship of knowledge transfer process towards student's performance in PBL teaching method for SAD course.
c) Identify the conceptual model of tacit knowledge transfer for PBL teaching method.

1.7 Scope of Research

This study employs second year students who were registered for SAD course in School of Computing, Universiti Utara Malaysia. Additionally, they have been exposed to PBL teaching method. Hence, the results can be generalized through the similar groups. Hence, the generalization based on theory should be driven by the teaching method being used. Besides, the SECI model is an initial study, and no intervention for analyzing any alternative model is discussed.

1.8 Operational Definition

Tacit knowledge – intentions, ideas, experiences, and perceptions that support the expertise in conscious and sub-conscious states, which creates knowledge through learning contents.

Explicit knowledge – routine and structured ideas, experiences, perceptions, and thinking in documents, easily accessed and distributed to form part of knowledge through learning content.

Socialization – social interaction and transaction process among students-lecturers, and colleagues to transfer tacit and explicit knowledge.

Externalization – individual and collaborative knowledge organization process, monitored by lecturers. It involves organizing lecturers' tacit knowledge into teaching materials for forming students' explicit knowledge.

Combination – knowledge gathering and sharing process, as well as reflections on the knowledge so that it contributes to new knowledge to be shared individually and collaboratively in groups.

Internalization – knowledge assessment and sharing process, which could be utilized in forming new knowledge or improving the existing knowledge.

Knowledge creation – knowledge management is a systematic process involving exploration, selection, organization, maintenance, and transfer of information in improving one's abilities in the field.

1.9 Report Organization

This report consists of five chapters. This chapter elaborates the background of the study, including problem statement, objective, research question, and the hypotheses. Also, the significance of the study and its scope are discussed. Nevertheless the operational definitions clarify the terminologies being used throughout the report.

Next, Chapter Two highlights the background and related works to the research. Chapter Three discusses the methodology of the research which covers phases, activities and deliverables of two main phases of the research. It is followed with Chapter Four that presents and discusses the results and findings. Finally, Chapter Five summarizes the research as well as addressing some recommendations for future enhancement.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the research background and reviews the previous studies which mainly focus on managing knowledge and how knowledge transfer has occured in PBL teaching method in SAD course. Nevertheless, theories behind knowledge transfer are discussed at length.

2.0 Knowledge

Knowledge refers to structured information while information is a collection of data that have been processed (APA, 2002). It can be divided into two forms namely tacit knowledge and explicit knowledge (Anantatmula & Kanungo, 2006). While tacit knowledge is the expertise or experience of individuals, which are difficult to be served by another individual, explicit knowledge is easily communicated, understood, and shared with other individuals.

2.1 Tacit Knowledge

Tacit knowledge is defined as the human ability to make strategic decisions (Anantatmula & Kanungo, 2005; Anderson, 2004). It is difficult to be communicated, understood, processed, and translated into explicit knowledge. Hence, it should be transformed into explicit knowledge to be easily communicated and understood by other individuals.

Tacit knowledge consists of thinking skills, decision making, and some of the learning skills. It is not based on subject content and it is constantly changing from one level to a higher level based on experience gathered during the learning process.

Although tacit knowledge cannot replace academic intelligence, it is a high-valued complementary for graduates to compete in the competitive advantage (Argyis, 1994; Asparouhov & Muthen, 2008).

2.2 Application of SECI model

Nonaka and Takeuchi (1995) introduced SECI model in the industry field to transfer and organize tacit knowledge into explicit knowledge from experts to novices. The model implements continuous processes in improving novices' tacit knowledge. On the other hand, Kutay and Aurum (2007), and other researchers (Hardaker & Smith, 2002; Huang & Liaw, 2004; Shehabat, Mahdi & Khouadi, 2008; Zheng & Yano, 2007) have outlined the potentials of SECI model in learning environment, in which most studies appreciate the SECI model in managing knowledge in higher learning institution. However, Kutay and Aurum (2007) only assessed the model in mobile learning context, which leads towards expository. They concluded that the model is not appropriate in explaining knowledge management in educational context. Their findings were based on learners' perception on processes in SECI model by referring to its potential benefits, communication level, and possibility of knowledge improvement for each process. With reference to the needs in Vygotsky (1978), the SECI Model is able to guarantee and ensure good guidance and sharing among lecturers, learners, and peers based on the learning contents and external resources. Interestingly, Vygotsky (1978) never suggests the way, and it is up to the lecturers' ability as well as learners' in managing it.

Similarly, Huang and Liaw (2004) suggest a framework to create knowledge in learning environment. The framework comprises of learners, lecturers, system infrastructure and architecture, materials, and teaching methods that emphasizes on constructive theori. Specifically, they never emphasize on the final output of the knowledge creation process.

In adition, Zheng and Yano (2007) address three important elements in learning environment: knowledge, social context, and technical context. Knowledge includes interest, expertise, and experience, while social context refers to human being and technical context, associated with technology. These elements interrelate among each other through the processes in SECI model to maximize learning effectiveness and efficiency. This leads to the suggestion of context awareness model when studying the contribution of the three factors in determining the collaboration practice in learning environment (based on activity theory). Zheng and Yano (2007) also explain the importance of tacit knowledge in learning environment although they did not analyze the tacit knowledge in learning context.

Agreeing with Zheng and Yano (2007), Shehabat, Mahdi, and Khoualdi (2008) define the tacit knowledge in higher learning institution as lecturers' *intellectual capital* that contains contextual knowledge, prerequisite, home works, and examination and assessment. They suggest a model called knowledge transformation model to simplify the interpretation of lecturers' tacit knowledge into explicit knowledge kept in the learning system. Particularly, the knowledge transformation model involves socialization through meetings and discussions in obtaining lecturers' tacit knowledge. During the dialogue session with lecturers, their tacit knowledge is addressed into explicit knowledge by collecting and

manipulating them. Similar with the models discussed in the previous paragraphs, the model only explains how the transformation goes from lecturers' tacit knowledge into the explicit knowledge in the learning management system (LMS) without dictating any specific tools. Additionally, Hardaker and Smith (2002) agree that the Internet enables the e-learning to be a platform for knowledge creation. They outline three guidelines of learning as part of the appropriate pedagogy.

- Knowledge web is a complete and comprehensive resource center, complementing the experts, books, library, and archive.
- Communication in virtual community complements the face-to-face relationship.
- Immersive experience in sharing environment in the Internet expands the learning environment in the real environment.

Further, hypermedia tools used in managing learning environment are categorized into interactive, static, individual, and group. Accordingly, Hardaker and Smith (2002) adapt the SECI model by proposing various learning patterns for each socialization, externalization, combination, and internalization in the LMS. In an LMS, exploratory learning involves online social interaction from experts (lecturers) to learners. Meanwhile, collaborative learning relates with lecturers' tacit knowledge organization into writing, and individual learning is based on teaching-based learning pattern (Hardaker & Smith, 2002). On the other hand, interactive learning is implemented at group level in which individuals' explicit knowledge is transferred into the group and formed into tacit knowledge at organizational level. Based on those descriptions, it is deduced that the knowledge transformation model

is focused more on expository method because it focuses on behaviorist learning perspective.

The studies described in the previous paragraph focus on the processes in SECI Model (socialization, externalization, combination, and internalization) that appear in knowledge transformation based on deductive approach, specifically expository method. With the model, it is understandable that the tacit knowledge obtained at the end of the creation process is not well explored. In fact, SECI model is appropriately implemented in inductive context particularly PBL method, which requires significant interactions and transactions among lecturers, learners, and peers at the beginning of the process. Additionally, it is based on problem solving approach.

In short, it could be noted that knowledge exploration in searching for the best solution theoretically requires learners to involve in socialization, externalization, combination, and internalization processes. Hence, this study is carried out by analyzing the tacit knowledge in aducation i.e. independence of learning, independence of thinking, and independence of decision making in each process in SECI Model. This study makes use of highly related elements in online environment that support socialization, externalization, combination, and internalization processes as the platform for learners to create knowledge.

2.3 SECI

According to a study by Barreto and Eredita (2004), SECI model transforms individual's tacit knowledge into explicit knowledge. It can be shared within groups and among groups and stored as tacit knowledge of individuals as well as

organizations to apply in situations of productivity and quality. Hence, the result of knowledge generation is tacit knowledge that can enhance individual's knowledge learned directly and indirectly, obtained during the processes involved.

SECI model consists of SECI factors that associate interaction and transaction of tacit as well as explicit knowledge. These factors should be implemented in a sequence to ensure the tacit knowledge is able to deliver completely from experts to novices (Nonaka & Takeuchi, 1995). In the model, socialization refers to the sharing of knowledge that creates the tacit knowledge, such as the sharing of mental model and technical skills. Meanwhile, externalization refers to the processes of representing the tacit knowledge in writing formats or the explicit knowledge in any form of raw data so that they could be shared as the basis for the creation of new knowledge. Further, combination refers to the process of transforming the raw explicit knowledge into a group of complex and systematic explicit knowledge. In the internalization process, the gathered experiences in earlier processes are transformed into valuable morales in views of the individuals and the organization. Those four factors makes-up a cycle in the SECI model that portrays the dissemination of knowledge among individuals and further the knowledge is expanded by other individuals in a dynamic knowledge creation environment. In higher education, Ahmad (2010) has revealed that these factors are capable of assessing the transfer of knowledge from lecturers as experts to their students as novices via PBL teaching method. Thus, the PBL method is discussed in he next section.

2.4 PBL Method

PBL is a learning technique that uses inductive thinking approach based on closed observation of a problem, analisis of data, and formulation of principles. Savery and Duff (1995) have listed learning objectives, raising issues, performance issues, and the role of facilitator as the main criteria in implementing PBL. They are able to support the accomplishment of the goals of PBL, which is to introduce students to independent learning and knowledge generation in enhancing meta-cognitive ability. It can further help them to solve real and simulated problems which revolve around the concepts and principles related to the field of study.

Previous studies have discovered that students are trained to develop critical thinking, are adaptable to change, able to work independently, able to demonstrate effective communication skills, and become continual learners through techniques in PBL (Abdullah, 2008). According to Araz and Sungur (2007), students tend to acquire scientific conceptions related to genetics, integrate and organize the knowledge through PBL method better than by the traditional ways. Additionally, Abdullah (2008) also found similar pattern, that PBL method enhances thinking and communication skills among the students in order to develop critical, creative, and competent human capital. Further, the findings have been supported by Drake and Long (2009), who discovered that PBL can help in gaining expertise in the skills that enable students to become lifelong learners.

In short, the previous studies discussed in the previous paragraphs explain that PBL is an inductive thinking approach. It requires strong interactions and transactions between lecturers and students at the beginning of the problem solving approach, and need to be conststent through the end.

2.5 SECI in PBL

The best solution for explaining the knowledge requires students to engage in the PBL activities that execute the processes in the SECI model. Practically, the four factors in SECI, which are socialization, externalization, combination, and internalization, should take place in the PBL activities. This implicates that the activities should be designed in a way that students have to participate actively in all knowledge acquisition and creation tasks.

While it has been explained in the previous paragraphs, the concept of each factor in SECI is addressed again in this paragraph. Particularly, socialization is a process of transferring expertise from lecturers to students via email, forum and sharing of experience among students and their colleagues. Externalization means a process of explaining the tacit knowledge into writing format through learning environment or explicit knowledge but inconsistent form so that it can be shared with the students as the basis of creating new knowledge. The learning environment will be measured by mode, system performance, social presence, and media richness. In contrast, combination refers to the process of collecting inconsistent explicit knowledge such as teaching material, external sources or via online system into a group of complex and systematic explicit knowledge. Further in the internalization, the experience acquired through previous process is converted into a valuable knowledge for student in term of learning, thinking and decision making skills.

Based on the descriptions in the previous paragraph, this study has decided to make full use of PBL in executing the processes in SECI model. As a result, all interactions and transactions in guided PBL technique implemented in SAD course at UUM are illustrated Figure 2.1. The learning takes place in which the lecturers

explain about the course. The ideas, views, and information are shared and revised with other learners and are documented for referencing. In gaining more knowledge, learners explore through the teaching materials and external resources provided by their lecturers. Based on the gathered information, learners refer to their lecturers and peers, to form their tacit knowledge or sharpening their existing skills. In short, it was ensured that the lecturers' tacit knowledge are transformed into group's explicit knowledge and organized into learners' tacit knowledge in a structured way.

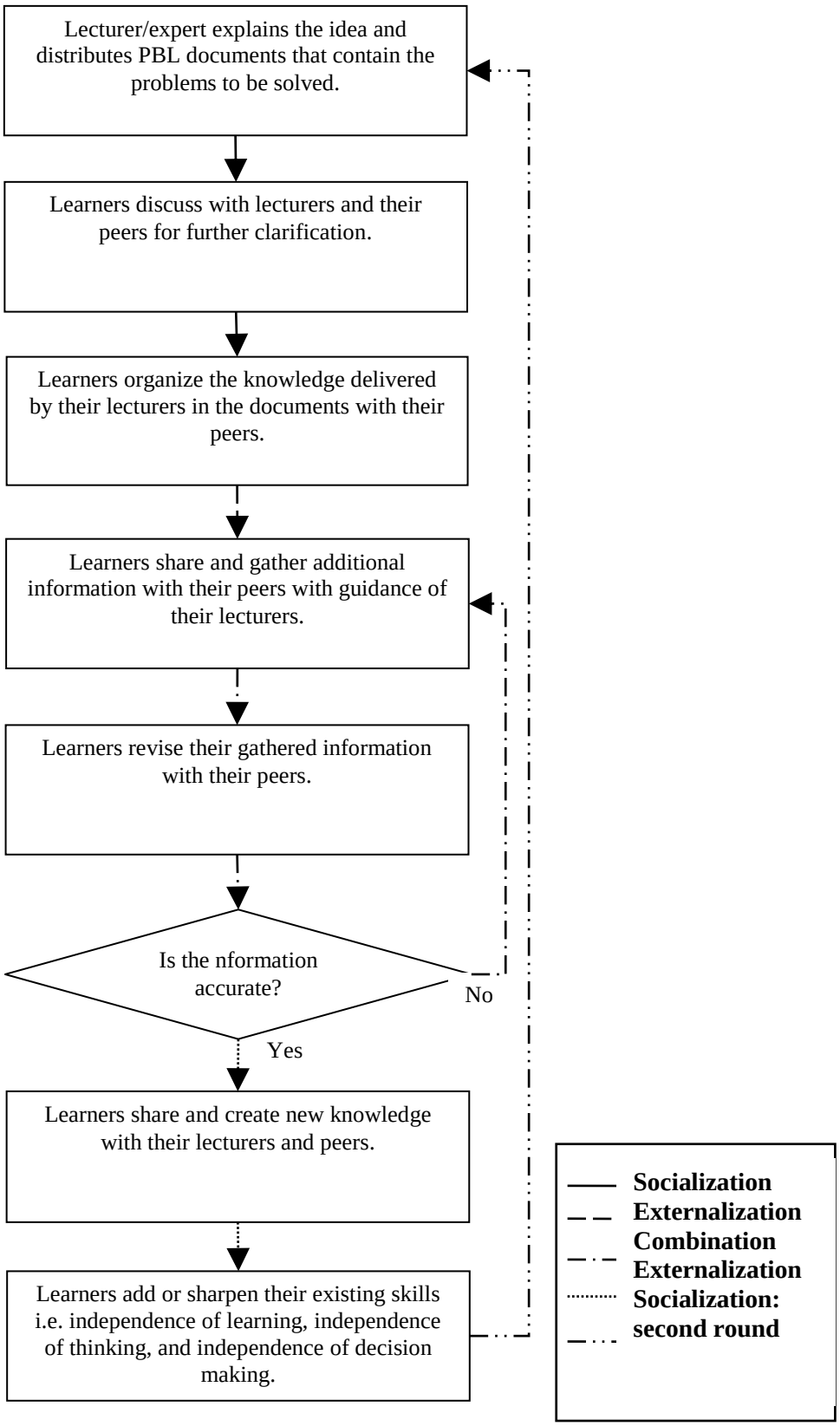

Figure 2.1: Flow chart of the PBL technique

Previously Kutay and Aurum (2007) who studied Software Engineering (SE) programme at University of New South Wales (UNSW) Australia found that SECI processes did not exist in their educational context. However, later Ahmad (2010) through her study in UUM found differently. She has proven that SECI processes exist in PBL teaching method. Although the processes are not explicitly written or documented, the activities could be seen intertwined. However, both of the studies have not discussed the effectiveness of the knowledge transfer in PBL from performance perspective.

2.5.1 Performance

Performance and user satisfaction are two main elements to measure the learning outcomes (Rosenberg, 2006). Particularly, performance is one of the factors to determine the effectiveness of learning process by using technology (Jashapara, 2004). It is part of an assessment, which is an important element in teaching and learning process that grows from the determination of desired learning outcomes (Rejab, Hassan, Awang & Ahmad, 2010). In regards to performance, Folanshade and Akinbobola (2009) and Kai-Li Teh and Nooraida Yakob (2013) found that students taught with PBL technique performed significantly better than those taught with conventional learning method.

2.6 Summary

This chapter reviews the existing literatures on theories on knowledge transfer. They are discussed to strengthen the foundation ofthis study. Also, studies utilizing SECI and PBL are discussed to determine the gap being bridged in this study.

Nevertheless, they are followed by some discussions on the implementation of knowledge transfer in PBL, which shed lights in axecuting the works in this study. Having discussed those topics, based on the existing literatures, this study notices that the importance and potentials of SECI in supporting knowledge acquisition, knowledge creation and knowledge transfer are clear. However, the 'how-to' aspect in the processes has not been dictated, but has been left up to researchers to axecute, appropriate with the context and necessities. Accordingly, this study carries out various activities to achieve the objectives stated in Chapter 1, which is detailed in Chapter 3.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter discusses the activities that this study has axecuted in ensuring that the aim is achieved. Altogether, three (3) main phases have been gone through; theoretical study, empirical study, and model validation. In the following sections, each phase is explained in detail, emphasized on the activities, how they have been conducted, together with the technique used. Also, the justifications for selecting each technique are addressed.

3.0 Introduction

The main objective of this study is to propose a conceptual model for knowledge transfer using PBL as a teaching method for SAD course. Data have been collected through a survey (*survey research design*), adapted from Cohen, Manion, and Marrison (2000).

Figure 3.1 summarizes the activities involved in this study, which are divided into theoretical study, empirical study, and model validation. In theoretical study, tgis study reviewed the literature to understand about the SECI model and PBL in SE education domain. Having gathered the information, a critical analysis was done on the existing frameworks and models, which has led to the formation of the conceptual model.

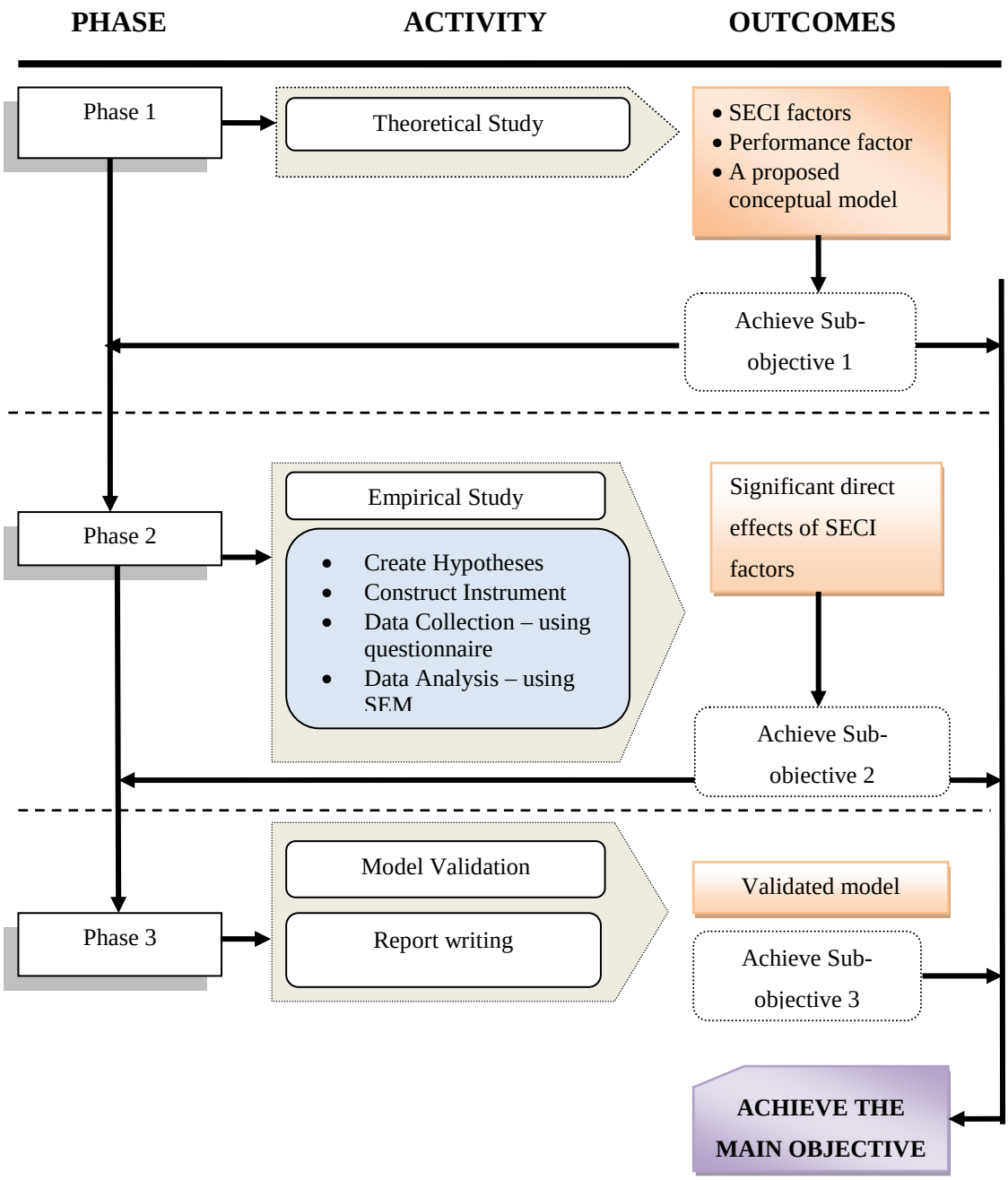

Figure 3.1: Research Procedure

In the second phase, this study carried out an empirical study. Data were collected from students in SAD course through a questionnaire. Then, in the third

phase, this study validated the constructed model using case study technique. The gathered data were analyzed using SEM. This study decided to use SEM because it is efficient in identifying the causal relationship among factors in the SECI model and in testing the fitness of the SECI model using indices including chi-square, i.e. a Root Mean Square Error of Approximation (RMSEA) (Browne & Cudek, 1992), Comparative Fit Index (CFI) (Bentler, 1989), and Chi Square/Degree of Freedom (Marsh & Hocevar, 1985).

3.1 Sampling

This study employed purposive sampling in determining the subjects. It helped a lot because the selection of subjects was made based on the needs of this study (Cohen et al., 2000) and it represents the population in this study well (Lavrakas, 2008). Having considered the needs of this study (outlined in Chapter 1), 79 students in SAD course were employed for collecting desired data. The sample size is sufficient as suggested by Kenny (2014). The students were ensured actively engaged in all PBL activities in their course with help of their course instructor.

3.2 Variables

There are two variables in this study, exogenous (independent variable) and endogenous (dependent variable). Also, the exogenous is known as latent independent variable while the endogenous is known as latent dependent variable (Schumacker & Lomax, 2004). In this study, two rounds of testing were carried out. In the first round, the socialization construct was decided as the exogenous while the others (externalization, combination, internalization, and performance) were

endogenous. Meanwhile in the second round, all constructs were made endogenous. However, this study focuses on knowledge creation process in the SECI Model in the first round only.

3.3 Instrument

The dimensions in the instrument in this study were constructed based on the SECI model and were distributed manually. The relationships among the dimensions depict the process involved in the SECI model (socialization, externalization, combination, and internalization) and student's performance. The full list of the dimensions is provided in Appendix A. Each item is measured using Likert scale between 1 and 5, as detailed in the following list:

- 1 = strongly disagree,
- 2 = disagree,
- 3 = not sure,
- 4 = agree, and
- 5 = strongly agree

Meanwhile, performance is measured based on the subjects' results of final examanitaion.

3.3.1 Reliability

The instrument with all dimensions has been revised by four experts for validation. The experts were selected based on their expertise in the PBL teaching method particularly in SE domain and have been rendering their expertise in knowledge management field for over 5 years. Considering their recommendations,

some small modifications were made involving rewording, sentences rephrasing, and item renumbering. Based on the collected pilot data, the instrument is proven highly reliable with Cronbach Alpha greater than 0.7 (Nunnaly, 1978).

3.4 Structural Equation Modeling (SEM)

SEM is used to identify the significant direct effects of relationships among socialization, externalization, combination, internalization processes (SECI model) and performance. It can be developed by using Analysis of Moment Structures (AMOS) software, which is used to determine the fitness of a model. The indices used in this study include chi-square, i.e. a Root Mean Square Error of Approximation (RMSEA) (Browne & Cudek, 1993), Comparative Fit Index (CFI) (Bentler, 1989), Tucker Lewis Fit Index (TLI) (Tucker & Lewis, 1973), Normed Fit Index (NFI) (Reinard, 2006), and Chi Square/Degree of Freedom (Marsh & Hocevar, 1985). The model fitness assessment for both the CFA and SEM are based on the criteria outlined in Table 3.1, in which thisstudy can choose at least one fitness index from each category.

Table 3.1: Criteria for Model Fit Assessment

Name of category	**Name of index**	**Index full name**	**Level of acceptance**	**Literature**	**Comments**
Absolute fit	Chisq	Chi-square	P > 0.05	Wheaton et al. (1977)	Sensitive to sample size > 200
	RMSEA	Root Mean Square Error of	RMSEA<0.08	Browne and Cudeck (1992)	Range between 0.05 and 1.00 is acceptable.

		Approximation			
	GFI	Goodness of Fit Index	GFI > 0.90	Joreskog and Sorbom (1984)	GFI = 0.95 is a good fit
Incremental fit	CFI	Comparative Fit Index	CFI > 0.09	Bentler (1989)	CFI = 0.95 is a good fit
	TLI	Tucker-Lewis Index	TLI > 0.9	Bentler and Bonett (1980)	TLI = 0.95 is a good fit
	NFI	Normed Fit Index	NFI > 0.8	Reinard (2006)	NFI = 0.95 is a good fit
Parsimonious	Chisq/df	Chi Square/Degree of Freedom	Chi square/df < 5.0	Marsh and Hocevar (1985)	The value should be less than 5.0.

This study tends to notify that SEM is a second generation technique that enables the use of simultaneous modeling of relationships among multiple independent and dependent constructs (Gefen, Straub & Boudreau, 2000). Its' advantages includes the ability to empirically test complex theoretical assumptions in detail and it allows for test of quantitative predictions against the gathered data.

3.5 Measurement for Model Specification

A group of goodness-of-fit indices were used to determine the fitness of the respective measurement models (variables), overall measurement model, and the structural equation model in this study. In detail, as mentioned in earlier section, the indices include Chi-Squared (Chisq), Root Mean Square Error of Approximation

(RMSEA), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and Chi-Squared/degree of freedom (Chisq/df). In this study, a combination of all fit indices was used to assess a model.

3.6 Summary

This chapter explains the procedures in carrying out this study as a whole. It explains the sampling technique, variables, instrument, and specification measurement model in detail. Next, Chapter 4 exhibits the results gathered from the testings, and discusses the findings.

CHAPTER 4

RESEARCH FINDING

Chapter 4 outlines the tests being carried in this study. Techniques for each testing have also been described. Consequently, this chapter discusses the findings of the testings. In conjunction, quantitative analysis using appropriate statistical methods is described in detail to ensure that the objectives of the study are achieved.

4.0 Demographic Background

Data have been collected through 79 respondents, comprising of 35 males and 44 females. The age of the respondents ranges between 20 and 23 years old, with majority of them are Malaysian (85% or n=67). Majority of the respondents (49) were BIT students, with another 27 BMM students and 3 BEduIT students.

In this study, a holistic approach to model evaluation was employed using SEM technique using AMOS. The Exploratory Factor Analysis (EFA) was not carried out because the constructs and indicators in this study are fully based on an existing theory (SECI model). Theoretically, it is required in case of identifying the variables in each construct (Hair, Anderson, Tatham & Black, 2006).

Further, the items in this study are categorized into five constructs (socialization, externalization, combination, internalization, and performance) as seen in Table 4.1, which are formed based on the relationships among the elements in the PBL method. Having tested the data, the reliability value was recorded as r = 0.89.

Table 4.1: Summary of items

Construct	Indicators	Number of Items
Socialization	SE1, SE2, SE3, SF1, SF2, SF3, SF4, SF5, SF6, SC1, SC2, SC3	12
Externalization	EM1, EM2, EM3, EM4, EM5, ES1, ES2, ES3, ES4, ES5, ES6, ESP1, ESP2, ESP3, ESP4, EMR1, EMR2	17
Combination	CTM1, CTM2, CTM3, CTM4, CES1, CES2, CES3, CES4, COS1, COS2, COS3, COS4	12
Internalization	IL1, IL2, IL3, IL4, IL5, IT1, IT2, IT3, IT4, IT5, IDM1	11
Performance	PERF_GRT	1

4.1 Confirmatory Factor Analysis (CFA)

For this study, the criteria for model fit assessment for both the CFA and SEM are explained illustratively by Figures 4.1 through 4.4 supported with Tables 4.2 through 4.5 respectively. According to Hair et al. (2006), a significant and acceptable factor loading should be greater than 0.3. Below than that, the item should be removed. In this study, the recommendation by Hair et al. (2006) has been agreed. Hence, referring to the facor loading for items in Figures 4.1 through 4.4, all items with factor loadings less than 0.3 have been removed, and were re-tested as the final model. As a result, the comparison between the initial model and the final model can be seen through the paired diagrams.

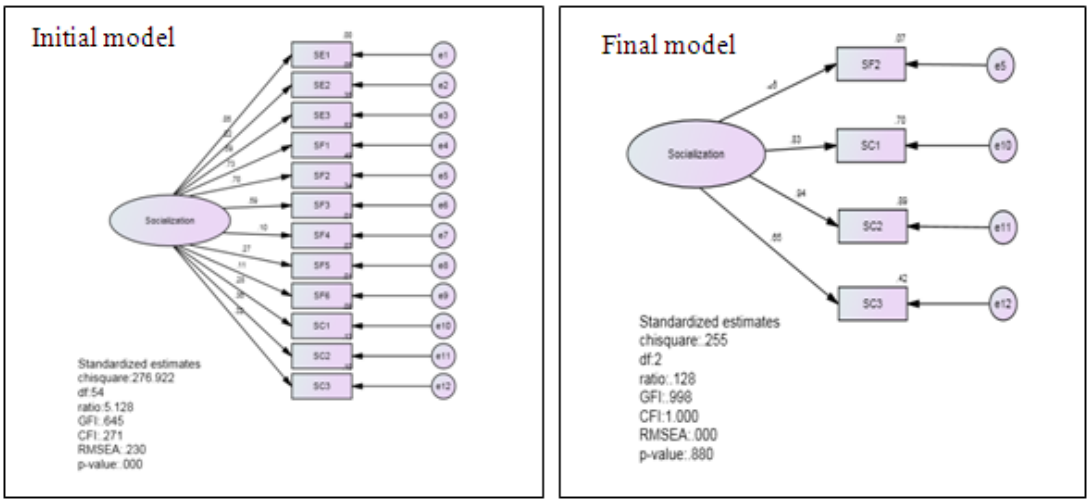

Figure 4.1: The CFA procedures for Socialization

In Figure 4.1, it can be seen that there are eight items in Socialization have factor loading less than 0.3. When these were removed and the model was tested, the factor loading for all items in the final model increased to greater than 0.3. The final values of goodness-of-fit indices are described in Table 4.2.

Table 4.2: The assessment of fitness for the Socialization measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute Fit Indices			
Chisq	0.255	P > 0.05	Satisfactory
RMSEA	0.000	RMSEA < 0.08	Satisfactory
GFI	0.998	GFI > 0.90	Satisfactory
Incremental Fit Indices			
CFI	1.000	Greater than 0.90	Satisfactory
Parsimony Fit Index			
Chiq/df (Ratio)	0.128	Less than 5	Satisfactory

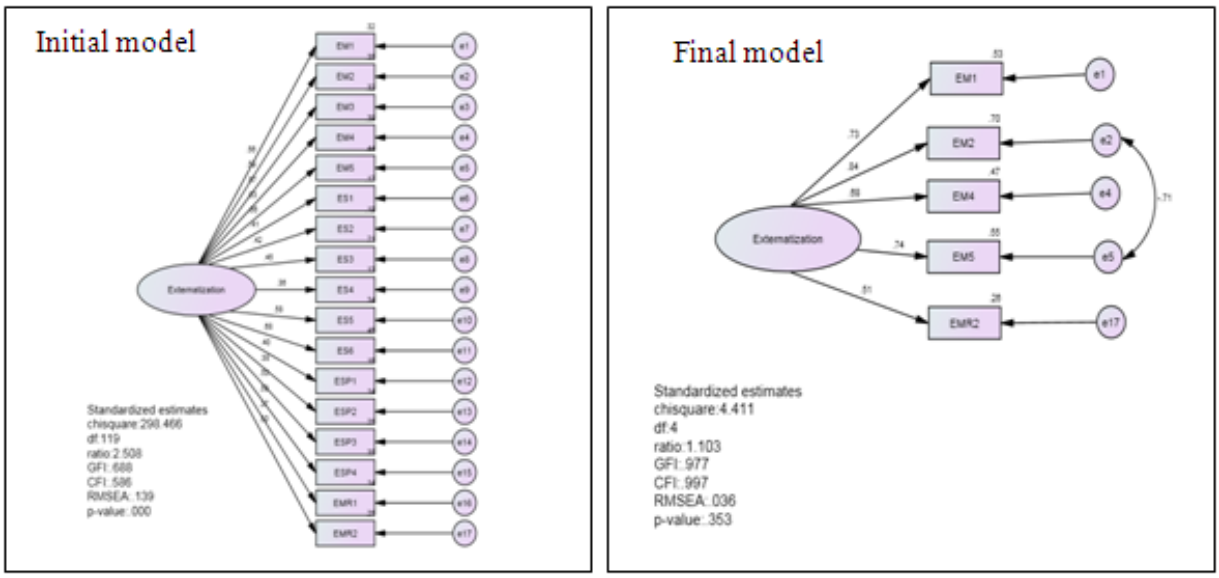

Figure 4.2: The CFA procedures for Externalization

Similar with the items in Socialization, the factor loading for items in Externalization depicted in Figure 4.2 are not quite high. Accordingly, twelve items have to be removed because their factor loading are less than 0.3. Eventually, having tested the final model, the factor loading for all five items are greater than 0.3. Hence, they are accepted, as described in Table 4.3.

Table 4.3: The assessment of fitness for the Externalization measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute Fit Indices			
Chisq	4.411	P > 0.05	Satisfactory
RMSEA	0.036	Range between 0.05 and 1.00 is acceptable	Satisfactory
GFI	0.977	GFI > 0.90	Satisfactory
Incremental Fit Indices			
CFI	0.997	Greater than 0.90	Satisfactory
Parsimony Fit Index			
Chiq/df (Ratio)	1.103	Less than 5	Satisfactory

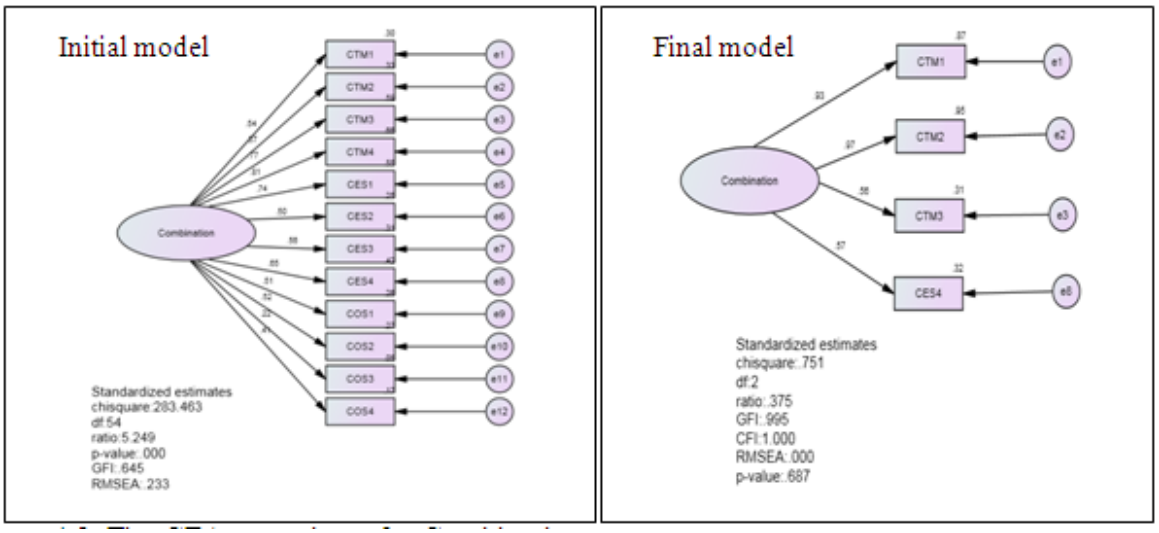

Figure 4.3: The CFA procedures for Combination

Figure 4.3 shows that there are 12 items in the initial model for Combination. However, eight of them have factor loading less than 0.3. Hence, they were removed. When the final model was re-tested, their factor loading were greater than 0.3. Hence, they are accepted and described in Table 4.4.

Table 4.4: The assessment of fitness for the Combination measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute Fit Indices			
Chisq	0.751	P > 0.05	Satisfactory
RMSEA	0.000	Range between 0.05 and 1.00 is acceptable	Satisfactory
GFI	0.995	GFI > 0.90	Satisfactory
Incremental Fit Indices			
CFI	1.000	Greater than 0.90	Satisfactory
Parsimony Fit Index			
Chiq/df (Ratio)	0.375	Less than 5	Satisfactory

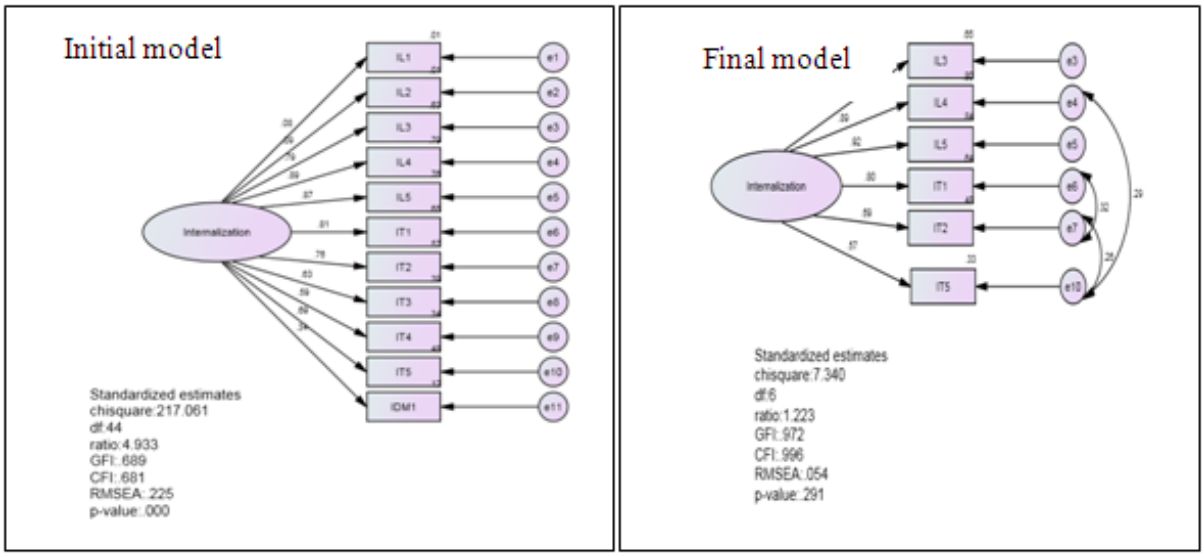

Figure 4.4: The CFA procedures for Internalization

In the Internalization, Figure 4.4 shows that initially the model contained eleven items. However, six of them have factor loading less than 0.3. Accordingly, they were removed. Eventually, in the final model, their factor loading are greater than 0.3. Hence, they are remained, and the results are described in Table 4.5.

Table 4.5: The assessment of fitness for the Internalization measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute Fit Indices			
Chisq	7.340	P > 0.05	Satisfactory
RMSEA	0.054	Range between 0.05 and 1.00 is acceptable	Satisfactory
GFI	0.972	GFI > 0.90	Satisfactory
Incremental Fit Indices			
CFI	0.996	Greater than 0.90	Satisfactory
Parsimony Fit Index			
Chiq/df (Ratio)	1.223	Less than 5	Satisfactory

4.2 The measure of validity and reliability of a measurement model

Once the CFA for the measurement is completed, the unidimensionality, validity, and reliability should be determined before the analysis of correlation can be done (Awang, 2012). Hence, the requirements suggested by Awang (2012) as follows have been complied:

1. The requirement for unidimensionality that has been achieved through the item-deletion process and model re-specification.
2. The requirement for validity has been fulfilled through convergent validity, construct validity, and discriminant validity. Consequently, the following are results obtained from the specified tests.
    i. Average Variance Extracted (AVE) is slightly greater than 0.50, which is acceptable - Convergent validity.
    ii. All fitness indices for the model meet the requirement level - Construct validity.
    iii. All redundant items have either been deleted or constrained, and the correlation between exogenous construct is less and equal to 0.85 - Discriminant validity.
3. The requirement for reliability has been fulfilled through internal reliability, constructs reliability, and AVE. The list below details the results.
    i. Cronbach alpha is greater and equal to 0.60 - Internal Reliability.
    ii. Construct reliability (CR) is greater and equal to 0.60 - Construct Reliabilty.

iii. AVE is greater and equal to 0.50 - Average Variance Extracted.

Having detailed the criteria, Table 4.6 shows the acceptable model fitness that has been obtained since all the chosen fitness statistics were verified to the requirements. While all the factors have acceptable reliability values, each factor has also been measured individually subjected to the test.

Table 4.6: The CFA results

Construct	**Item**	**Factor Loading**	**Cronbach alpha (above 0.6)**	**CR (above 0.6)**	**AVE (above 0.5)**
Socialization	SF2	0.259	0.6420	0.7894	0.5189
	SC1	0.651			
	SC2	0.834			
	SC3	0.943			
Externalization	EM1	0.730	0.8470	0.8302	0.5001
	EM2	0.837			
	EM4	0.682			
	EM5	0.739			
	EMR2	0.508			
Combination	CTM1	0.934	0.834	0.8550	0.6114
	CTM2	0.972			
	CTM3	0.556			
	CES4	0.565			
Internalization	IL3	0.806	0.839	0.6742	0.6228
	IL4	0.893			
	IL5	0.918			
	IT1	0.800			
	IT2	0.692			

IT5	0.573

In addition, Table 4.7 lists the correlation among the dimensions. The diagonal values (in bold) are the square root of AVE while other values are the correlation between respective constructs. It shows that the discriminant validity is achieved because the diagonal values are higher than those values in its row and column.

Table 4.7: The Discriminant Validity Index Summary

Construct	Socialization	Externalization	Combination	Internalization
Socialization	**0.7203**			
Externalization	0.602	**0.7072**		
Combination	0.336	0.398	**0.7819**	
Internalization	0.474	0.226	0.171	**0.7892**

Table 4.8: The assessment of normality for the data

Variable	min	max	skew	c.r.	kurtosis	c.r.
IT5	3.000	5.000	0.202	0.633	-0.131	-0.206
IT2	2.000	5.000	-0.552	-1.731	2.736	4.290
IT1	2.000	5.000	-0.604	-1.893	2.454	3.847
IL5	3.000	5.000	0.727	2.279	1.420	2.226
IL4	3.000	5.000	0.300	0.940	0.202	0.317
IL3	3.000	5.000	-0.051	-0.161	-0.300	-0.471
CES4	3.000	5.000	-0.100	-0.315	-0.790	-1.238
CTM3	2.000	5.000	-0.728	-2.282	0.299	0.469
CTM2	1.000	5.000	-0.810	-2.539	-0.367	-0.575
CTM1	1.000	5.000	-0.872	-2.734	-0.444	-0.696
EMR2	2.000	5.000	-0.896	-2.810	2.598	4.074
EM5	4.000	5.000	0.680	2.133	-1.537	-2.410
EM4	3.000	5.000	0.202	0.633	-0.131	-0.206
EM2	2.000	5.000	-0.823	-2.582	0.828	1.298
EM1	3.000	5.000	-0.305	-0.956	-0.661	-1.037

Variable	min	max	skew	c.r.	kurtosis	c.r.
SC3	2.000	5.000	-0.895	-2.805	0.999	1.567
SC2	2.000	5.000	-0.818	-2.564	1.526	2.393
SC1	2.000	5.000	-0.696	-2.182	1.273	1.997
SF2	3.000	5.000	-0.152	-0.478	-0.570	-0.894
Multivariate					115.652	15.723

Further, before proceeding to the modeling of the structural model, the normality assessment for the data was examined. Table 4.8 exhibits the normality reading for every item involved in the measurement model. The values of skewness (between -1.0 and 1.0) explain that all of the items fall within the good range. This indicates that the data are normally distributed.

4.3 Analyzing the SEM structural model

Having addressed the normality, validity, and reliability of the measurement model, this section models all constructs into SEM for further analysis. In SEM, multiple relationships among the constructs could be modeled and analyzed simultaneously. The criteria for analyzing the SEM structural model are illustrated in Figures 4.5 through 4.9 and Table 4.9.

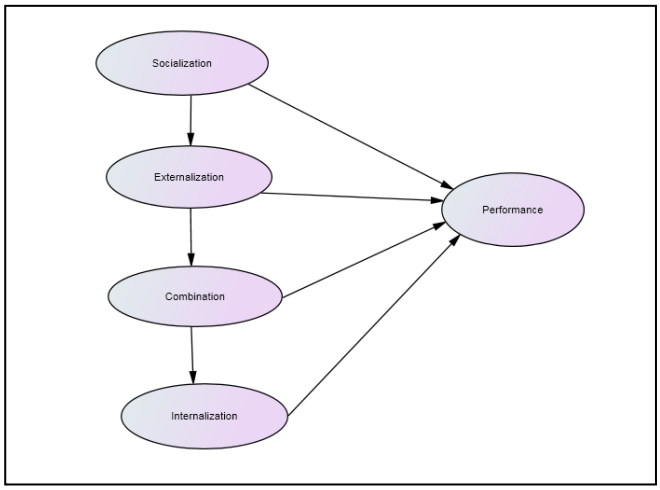

Figure 4.5: The schematic diagram of the model in the study

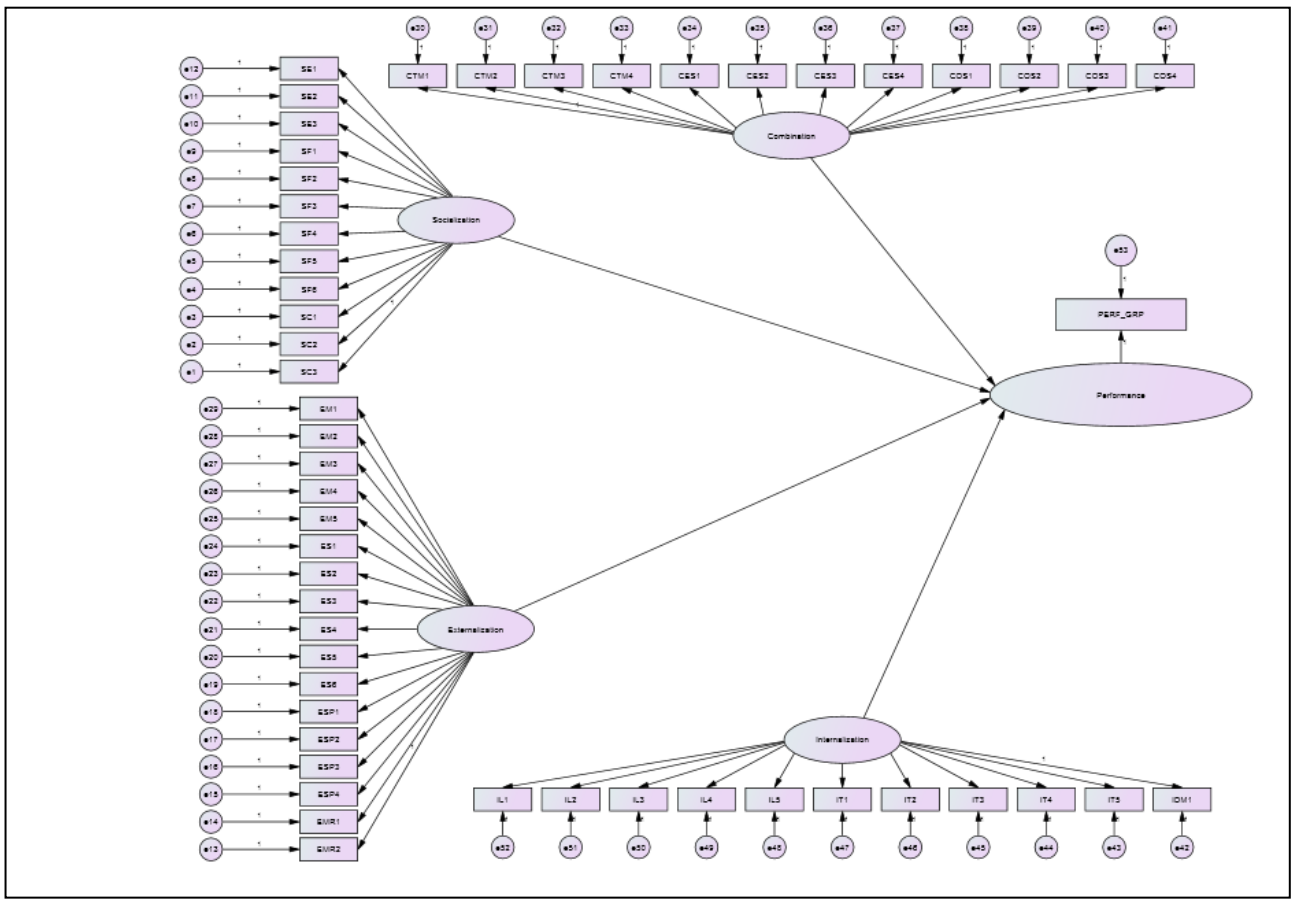

Figure 4.6: The graphical representation of a schematic diagram of the model in AMOS

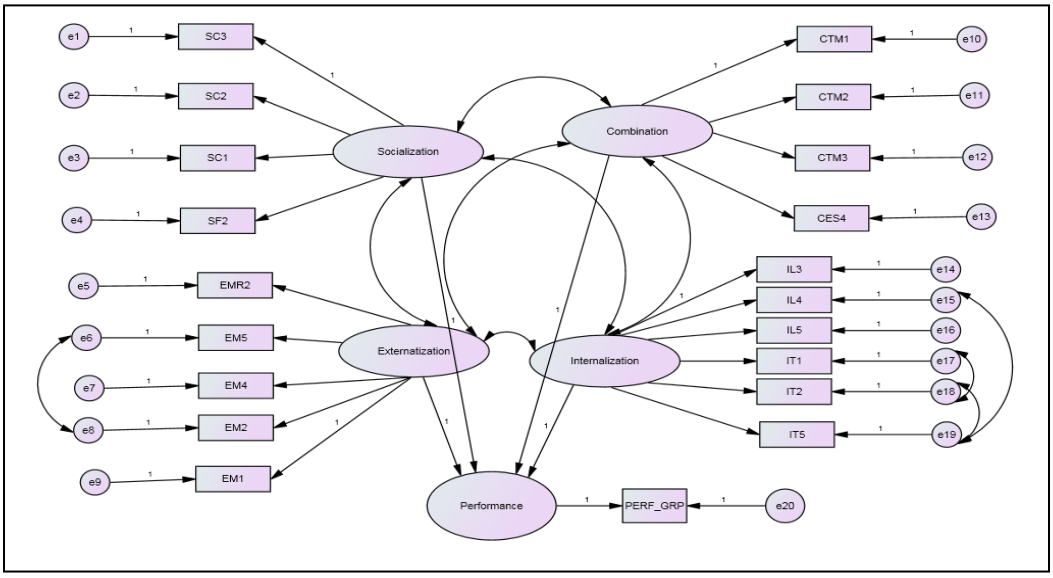

Figure 4.7: The measurement model is assembled into the structural model for further analysis

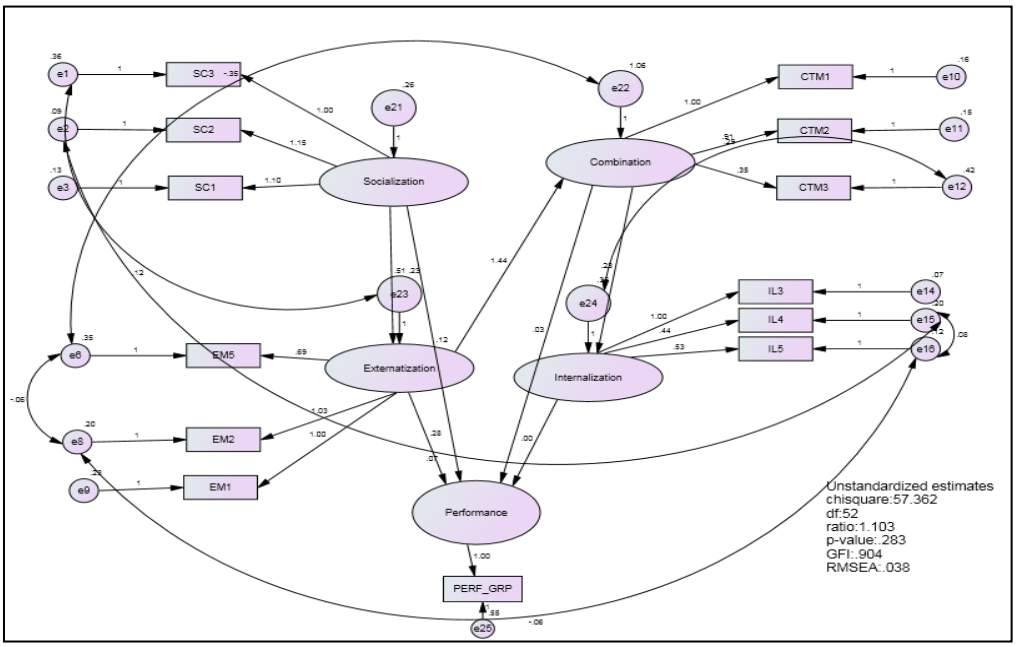

Figure 4.8: The standardized regression weights

Table 4.9: The assessment of fitness for the structural measurement model

Fit Indices	Fit Statistics	Recommended Fit Criteria	Conclusion
Absolute Fit Indices			
Chisq	57.362	P > 0.05	Satisfactory
RMSEA	0.038	Range between 0.05 and 1.00 is acceptable	Satisfactory
GFI	0.904	GFI > 0.90	Satisfactory
Incremental Fit Indices			
CFI	0.989	Greater than 0.90	Satisfactory
Parsimony Fit Index			
Chiq/df (Ratio)	1.103	Less than 5.0	Satisfactory

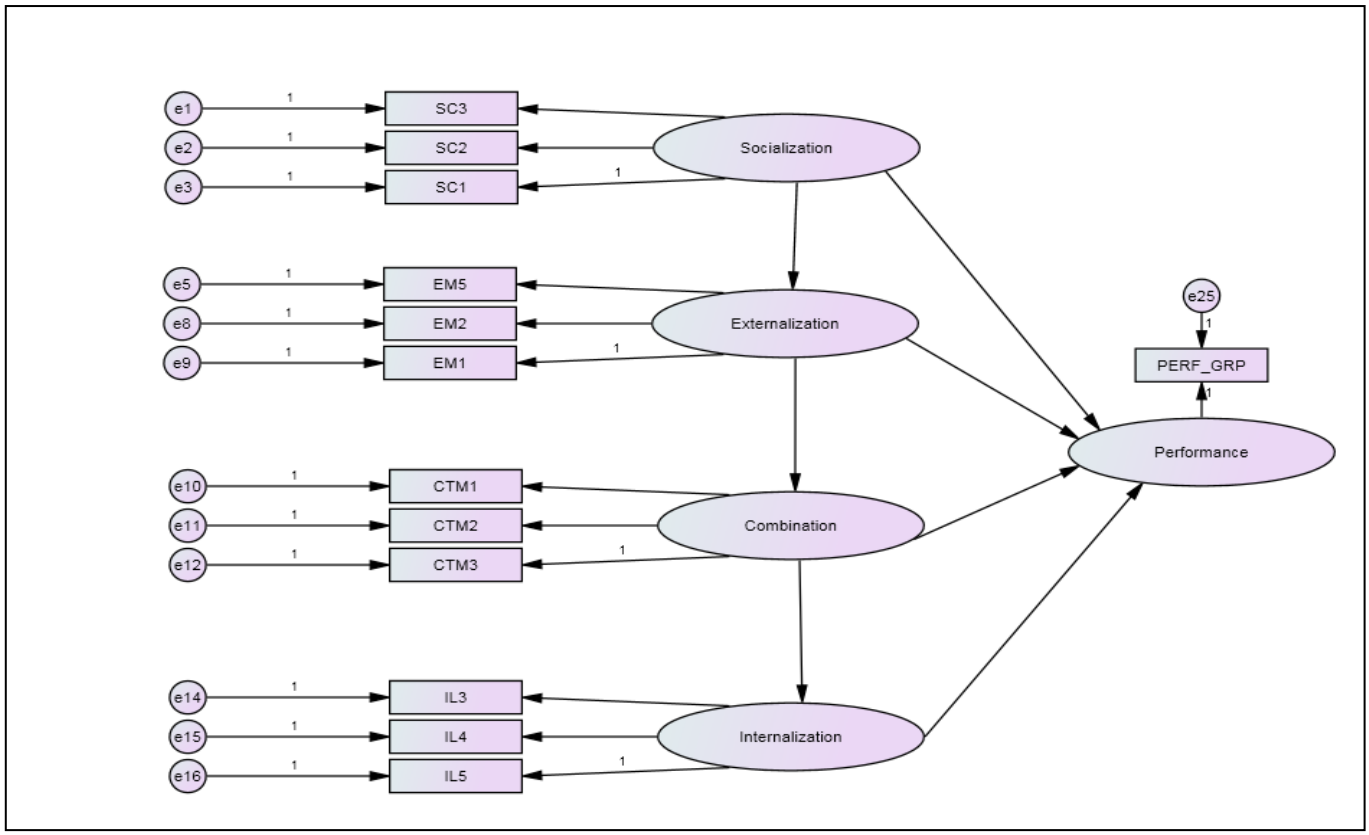

Figure 4.9: The structural model

4.4 Results of hypotheses testing

Having finalized the models, as described in the previous section, this section discusses the hypotheses testing. The results of hypotheses testing are listed in Table 4.10, in which each hypothesis statement is listed in Table 4.11.

Table 4.10: The results of hypothesis testing from the AMOS output

Construct	**Path**	**Construct**	**Estimate**	**S.E**	***p*-value**	**Hypothesis Result**
Socialization	→	Externalization	0.5090	0.1380	0.000	Supported
Externalization	→	Combination	1.4440	0.3240	0.000	Supported
Combination	→	Internalization	0.2340	0.0610	0.000	Supported
Socialization	→	Performance	0.1200	0.2160	0.5790	Not supported

Externalization	→	Performance	0.2830	0.2580	0.2730	Not supported
Combination	→	Performance	0.0320	0.0990	0.7440	Not supported
Internalization	→	Performance	0.0000	0.1590	0.9980	Not supported

Table 4.11: The Result of Hypothesis Testing

Hypothesis	**Hypothesis statement**	**Result**
H_1	The socialization has a significant effect on the externalization.	Supported
H_2	The externalization has a significant effect on the combination.	Supported
H_3	The combination has a significant effect on the internalization.	Supported
H_4	The socialization has a significant effect on the performance.	Not supported
H_5	The externalization has a significant effect on the performance.	Not supported
H_6	The combination has a significant effect on the performance.	Not supported
H_7	The internalization has a significant effect on the performance.	Not supported

Referring to the results in Table 4.10, it is understandable that H_4, H_5, H_6, and H_7 indicate that the direct effect of SECI on the performance is not significant at 0.05 significant level. They also explain that externalization has significant and direct

effects on socialization, that combination has significant and direct effects on externalization, and that internalization has significant and direct effects on combination.

4.5 Summary

This chapter presents the findings of the testings, obtained using quantitative analysis. The findings reveal that the direct impacts of socialization on externalization, externalization on combination, and combination on internalization are siginificant in PBL. Interestingly, they also indicate that the direct impact of SECI on students' performance is not significant in PBL. Based on these findings, further discussion and interpretation are addressed in Chapter 5 together with some recommendations for future enhancement.

CHAPTER 5

DISCUSSION AND CONCLUSION

The findings discussed in Chapter 4 discover the impact of SECI model on performance in SE domain. The findings were obtained through hypotheses testing and are used to answer the research questions outlined in Chapter 1. Further, this chapter discusses also the limitations in this study, the contributions to the body of knowledge, and recommendations for future studies.

5.0 Objectives of the Study-Revisited

This study aims at testing the fitness of the SECI model in SE domain. In order to achieve the main objective, three specific objectives have been formulated: (1) to determine the knowledge transfer process using PBL teaching method for SAD course, (2) to investigate the effect of SECI model to Students' Performance using PBL teaching method for SAD course, and (3) to construct a knowledge transfer model using PBL teaching method for SAD course.

At the end of this study, the main aim has been accomplished through the achievement of the three supporting objectives. The first objective was achieved through a theoretical study to understand the SECI model and PBL in SE education domain. Having gathered the information, a critical analysis was done on the existing frameworks and models, which led to the formation of the conceptual model described in Chapter 4. The second objective was achieved through an empirical study on the causal relationships among the factors in the conceptual model. There are significant direct effects of socialization on externalization, externalization towards combination, and combination towards internalization. Through the

hypotheses testing, hyphotheses H1, H2, H3 were found highly supported. However direct effects of SECI on performance is not significant. Thus, H4, H5, H6, H7 are not supported.

5.1 Research Implications and Discussions

5.1.1 KM in SE education

The intensity of knowledge transfer process in SECI Model is determined through the interaction and transaction of tacit and explicit knowledge among lecturers and students. The process consists of all factors in SECI in developing students' tacit knowledge in SE education. Based on the obtained results, this study concludes that the model is applicable for PBL teaching method in SE domain. Therefore, PBL is a suitable teaching method for transfering tacit knowledge from lecturers to students and for enriching the student's knowledge in SE domain.

This generally implicates that the optimum benefits could be gained by embedding the entire SECI in teaching and learning environment for SE education. The proposed model has been proven helpful for the SE domain, including the understanding of the process in transferring tacit knowledge from lecturers to students via PBL teaching method. In PBL, the lecturers are not only trying to develop knowledge, which is important in every learning process, but also trying to develop the soft skills that will help the students during the learning process and their professional life.

Meanwhile regarding performance, there is no direct effect from SECI process. This finding explain that the SECI process do not influence to students'

performance in PBL teaching method for SE domain. It is significant because PBL teaching method exposes students to learning independently through teamwork (Sahin, 2007) while the lecturers act as facilitators in student learning process. In this study, the subjects were in their third semester and were still in the early stage of learning. Thus, they need strong guidance from their lecturers and teamwork. This is inline with Holzman (2009) and Nonaka and Toyama (2007) who emphasize lecturers' involvement in the knowledge creation process in the early stage so that the outcome could enrich the existing knowledge. In the future, other factors should be considered too, especially factors that contribute to students' performance such as students' attitude, personality, team selection, maturity, and level of knowledge.

5.2 Limitations of Study and Recommendations for Future Works

Although this study has achieved all objectives stated in Chapter 1, some aspects could still be improved. First, while reviewing the literatures and experimenting the data, the scopes have been narrowed to suit the duration. Therefore, it is hoped that this model can be implemented using other teaching methods too in order to ensure the tacit knowledge is transferred from experts to novices. Future studies can also further analyze other available knowledge management models related to SE domain using other teaching method and approaches.

Besides, this study employed only students of SAD course (in UUM) for gathering data. As third semester students, their performance may be biased, influenced by their insufficient softskills, particularly interpersonal. Hence, the findings may not adequately represent the entire SE students in higher learning

institution. Thus, future studies are recommended to expand the subjects to various other subjects and perhaps in various universities.

On top of that, this study has not measured the subjects' current knowledge before proceeding with the test. Hence, the subjects' tacit knowledge at the beginning and after the intervention is not possibile to be compared. Thus, future studies are recommended to identify the prior (existing) tacit knowledge before the actual test is carried out (after the intervention).

REFERENCE

Ahmad. M. (2010). *An investigation of knowledge creation processes in LMS-supported expository and PBL teaching methods*. Unpublished PhD Thesis. Universiti Sains Malaysia.

Abdullah. N. (2008). *Effects of Problem Based Learning on Mathematics Performance and Effective Attributes in Learning Statistics in Secondary Level Schools*. Unpublished Master Thesis. Universiti Putra Malaysia.

American Psychological Association. (2002). *Publication manual of the American Psychological Association (5th ed.)*. Washington, DC: Author.

Anantatmula, V., & Kanungo, S. (2006). Structuring the underlying relations among the knowledge management outcomes. *Journal of Knowledge Management,* 10(4), 25-42.

Anantatmula, V., & Kanungo, S. (2005). Establishing and structuring criteria for measuring knowledge management efforts. *Proceeding of the 38th Hawaii International Conference on System Sciences*, 1-11.

Anderson, T. (2004). Toward a theory of online learning. in Anderson, T., & Elloumi, F. (Eds.), *Theory and practice of online learning* (pp. 33-60). Canada: Athabasca University. Retrieved 4 August, 2012, from http://cde.athabascau.ca/online_book/pdf/TPOL_book.pdf.

Araz, J.G., & Sungur, S. (2007). Effectiveness of Problem-Based Learning on academic performance in genetics. *Biochemistry and Molecular Biology Education*, 35(6), 448–451.

Argyris, C. (1994). Good communication that blocks learning. *Harvard Business Review*, *72*(4), 77-85.

Asparouhov, T., & Muthen, B. (2008). *Exploratory structural equation modeling*. Retrieved 5 January 2013, from http://www.statmodel.com/download/EFACFA84.pdf.

Awang, Z. (2012). *SEM using AMOS graphic*. 8th edition, UiTM Press.

Barreto, C., & Eredita, M. D. (2004). Unraveling expertise and knowledge creation: towards an instance-based model of knowledge (IMoK). *Proceedings of the 37th Hawaii International Conference on System Science*1-11.

Bentler, P.M. (1989). *EQS Structural Equations Program Manual*, Los Angeles: BMDP Statistical Software.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588–606.

Browne, M. W. & Cudek, R. (1992). *Alternative Ways of Assessing Model Fit, in Testing Structural Equation Models*, Newbury Park, CA: Sage Publications.

Busch, P., Richards. D., & Dampney, C. (2003, Feb 3-4). The graphical interpretation of plausible tacit knowledge flows. *Australian Symposium on Information Visualisation (InVis.au)*, Adelaide, South Australia.

Carliner, S. (2004). An overview of online learning. *MA, HRD Press, Inc*.

Cohen, L., Manion, L., & Morrison K. (2000). *Research methods in education*. London: Routledge Falmer, Taylor and Francis Group.

Drake, K.N., & Long, D. (2009). Rebecca's in the Dark: A Comparative Study of Problem-Based Learning and Direct Instruction/Experiential Learning in Two 4th-Grade Classrooms. *Journal of Elementary Science Education*, 21(1), 1-16.

Folanshade, A. & Akinbobola, A. O. (2009). Constructivist Problem Based Learning Technique and the Academic Achievement of Physics Students with Low Ability Level in Nigerian Secondary Schools. *Eurasian Journal Chemistry Education*, 1(1), 45-52.

Gefen, D., Straub, D. W., & Boudreau, M.-C. (2000). Structural equation modelling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*, 1–79.

Hair, J. F., Anderson, R.E., Tatham, R.L., & Black, W.C. (2006). *Multivariate Data Analysis*. Prentice Hall International, Inc, New Jersey.

Holzman, L. (2009). *Vygotsky at work and play*. NY: Routledge.

Jashapara, A. (2004). *Knowledge management: An integrated approach*. Prentice Hall, Harlow, Essex.

Jöreskog, K. G. & Sörbom, D. (1996). *LISREL 8 User's Reference Guide*. Chicago: Scientific Software International.

Kenny, D. A. (2014). *Measuring Model Fit*. Retrieved 10 March, 2014, from http://davidakenny.net/cm/fit.htm

Kutay, C., & Aurum, A. (2007). Knowledge transformation for education in software engineering. *International Journal of Mobile Learning and Organisation*. 1, 58-80.

Lavrakas, P.J. (2008). *Encyclopedia of survey research methods*. LA: SAGE Publications, Inc.

Marsh, H. & Hocevar, D. (1985). The application of confirmatory factor analysis to the study of self -concept: First and higher order factor structures and their invariance across age groups. *Psychological Bulletin, 97*, 562-82.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company: How Japanese companies create the dynamics of innovation*. Oxford, Oxford University Press.

Nunnally, J. C. (1978). *Psychometric Theory*. NY: McGraw-Hill.

Reinard, John C. (2006). *Communication Research Statistic.* United State: SAGE.

Rejab, M. M., Hassan, S., Awang, I., & Ahmad, M. (2010). Customizable Rubrics Model for Formative Evaluation of Problem-Based Learning Course. *Proceeding Of Annual International Conference On Infocomm Technologies In Competitive Strategies*, Singapore.

Rosenberg, M.J. (2006). *Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance.* CA, John Wiley and Sons, Inc.

Sahin, M. (2007). The importance of efficiency in active learning. *Journal of Turkish Science Education,* 4(2), 61-74.

Savery, J.R., & Duff, T.M. (1995). Problem Based Learning: An instructional model and its constructivist framework. *Educational Technology*. 35, 31-38.

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling*. NJ: Lawrence Erlbaum Associates, Inc Mahwah.

Teh, K. & Y, N. (2013). Problem-Based Learning as an Approach to Teach Cell Potential in Matriculation College, Malaysia. In Chiu, M. et al. (Eds.), *Chemistry Education and Sustainability in the Global Age* (pp. 121-130). Springer.

Tucker, L.R. & C. Lewis (1973), A Reliability Coefficient for Maximum Likelihood Factor Analysis. *Psychometrika, 38*, 1-10.

Wheaton, B., Muthén, B., Alwin, D. & Summers, G. (1977). Assessing reliability and stability in panel models. *In D.R. Heise (Ed.),* Sociological Methodology 1977 (pp. 84-136). San Francisco: Jossey-Bass.

APPENDIX A

RESEARCH INSTRUMENT

Construct	Indicators
Socialization	I always email the lecturer.
	I always make an appointment via email.
	Lecturer replies directly to my email.
	I use the consultation hour to communicate with the lecturer.
	Lecturer participates in the discussion by giving his/her comments and ideas.
	I get immediate responses to my question.
	I exchange ideas with my lecturer during discussion.
	I interact actively with the lecturer.
	I seek clarification from the lecturer whenever I have a question.
	I exchange ideas with my friends through group discussion.
	I collaborate with my friends to complete the assignment given.
	I interact actively with other students.
Externalization	I access the learning materials online.
	The learning zone offers flexibility of scheduling for my learning sessions.
	The activities in the learning zone are time consuming.
	I enjoy the activities offered in the learning zone.
	The learning zone allows me to work on my own before discussing with the lecturer.
	I can access learning zone from anywhere.
	The learning zone sometimes gets interrupted during my

	learning activities.
	There are no compatibility issues between my computer and the learning zone system.
	I need more training in using learning zone for learning.
	Learning materials can be viewed easily.
	Learning materials can be downloaded smoothly.
	I like the forum because it is like class discussion.
	I feel the presence of the lecturer during the forum.
	It is easy to contact the lecturer.
	I can exchange ideas with the lecturer.
	I had no difficulty with learning material presentations.
	The learning materials are easy to follow.
Combination	I download learning materials every semester.
	I view updates of learning materials from time to time.
	I download learning materials from time to time.
	I always check announcement from the lecturer.
	Notes equipped with additional references help me understand the topic better.
	I can evaluate my performance using the online quiz.
	I surf the links of external sources for my references.
	I bookmark sites that I feel important for my reference.
	The interfaces of learning zone are easy to use.
	The learning zone helps to reduce time of learning.
	I prefer to interact with the lecturer using learning zone rather than face to face meeting.
	I can continuously keep track my performance using online quiz.
Internalization	I do not depend on lecturer to study.
	I do not depend on friend to study.
	I find other material for study via Internet.
	I always contribute ideas to the group discussion.

	I frequently refer to external sources for additional information.
	I discuss with friend to get better understanding.
	I compare information from several sources before make my own assumption.
	I corrected my friends' mistake.
	I try to relate things that I have learned with daily life.
	I combine the information gathered before come up with my own opinion.
	I decide based on what I feel right.
Performance	Final Examination Result