

THE PATTERNS OF MALAYSIAN UNDERGRADUATE ENGINEERING
STUDENTS' INTELLECTUAL DEVELOPMENT

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DEDICATION

To my beloved family...husband, Azfarizal Amid; mother Kamariah Hj. Roslan; father, Ahmad Sadimin; and children, Aisyah Nurkhairina and Muhammad Zikir Iman.

Thank you for your encouragement, support, prayers and understanding throughout this challenging time. May Allah bless all of us.

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ABSTRACT

Knowing students' intellectual development is important to improve the quality of engineering education. Before this, most studies explored intellectual development in the context of western countries. This study explores the patterns of Universiti Teknologi Malaysia (UTM) undergraduate engineering students' intellectual development. The respondents were from two engineering faculties across different academic years. The intellectual development theory was based on 'Perry's Model of Intellectual and Ethical Development in College Year: A Scheme', which described intellectual development of students in higher education institution. The adapted Perry Developmental Questionnaire (El-Faragy, 2010) was used to assess students' intellectual development levels based on Perry model which contains 18 items. From the model, the questionnaire consists the constructs such as teaching method, learning influences, students perceptions, and curriculum structure. Therefore the model determined these constructs influence students' intellectual development. A total number of 515 engineering undergraduates were selected from two engineering faculties across different academic years. The objective of this study was to capture the patterns of intellectual development levels (dualistic, multiplicity, commitment in relativism) among Malaysian undergraduate engineering students in relation to their perceptions of learning experiences in different engineering faculties. The analyses of the data showed that there was a significant difference between the patterns of students' intellectual development between dualistic, and multiplist level among first year and third year undergraduates in engineering faculties. There was also significant difference between genders in the patterns of students' intellectual development levels (dualistic, multiplicity, commitment in relativism) in different engineering faculties. The result showed that women have higher intellectual development than men. It can be concluded that the difference in intellectual development between genders found in this study is the opposite of those proposed by Perry.

ABSTRAK

Mengenali kematangan pelajar terhadap perkembangan intelek diperlukan untuk meningkatkan kualiti pendidikan kejuruteraan. Banyak kajian lepas yang dilaksanakan dikaji dalam konteks negara barat. Kajian ini mengenal pasti corak kematangan intelektual di kalangan pelajar sarjana muda kejuruteraan di salah sebuah universiti di UTM. Responden kajian melibatkan pelajar setiap tahun pengajian di dua fakulti kejuruteraan. Teori kematangan intelektual yang digunakan adalah berdasarkan Model Perry '*Intellectual And Ethical Development In College Year: A Scheme*'. Teori ini menerangkan kematangan pelajar kejuruteraan di institusi pengajian tinggi. Soal selidik '*Perry Developmental Questionnaire*' (El-Farargy, 2010) diadaptasi untuk disesuaikan demi menilai perkembangan intelektual pelajar berdasarkan tahap dalam Model Perry yang mengandungi 18 item. Dari model, soal selidik yang terdiri daripada konstruk seperti kaedah pengajaran, pengaruh pembelajaran, pelajar persepsi, dan struktur kurikulum. Oleh itu model yang ditentukan oleh konstruk ini mempengaruhi perkembangan intelek pelajar. Seramai 515 pelajar kejuruteraan dipilih daripada kedua-dua fakulti merentas tahun pengajian. Objektif dalam kajian ini adalah untuk mendapatkan corak tahap kematangan intelektual (*dualist, multiplist, commitment in relativism*) di kalangan pelajar sarjana muda kejuruteraan di dua fakulti kejuruteraan di UTM. Dapatan kajian menunjukkan terdapat perbezaan yang signifikan diantara corak kematangan intelektual pelajar di tahap dualist dan multiplist di antara pelajar tahun satu dan tahun tiga pengajian. Terdapat juga perbezaan corak yang signifikan diantara jantina terhadap kematangan intelektual (*dualist, multiplist, commitment in relativism*). Keputusan menunjukkan pelajar perempuan memiliki kematangan yang tinggi berbanding pelajar lelaki. Kesimpulan dibuat bahawa keputusan kajian dalam perkembangan intelek diantara jantina adalah berbeza dari Model Perry seperti dicadangkan oleh Perry.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In the 21st century, characteristics, needs and preferences of students evolve with the rapidly changing world around them (Ginkel, 2006). Educating students today in engineering is a far more different and complex proposition than it has been in the past. Following the current and future requirements, the Washington Accord (WA) and the Malaysian Engineering Accreditation Council (EAC, 2012) which is one of the WA members, emphasizes that engineering students develop a multitude of outcomes in their four years of learning before they graduate. EAC also stresses the importance of having an in-depth understanding on the range of complex problem-solving and engineering activities, which indicate students' intellectual maturity. Therefore students should apply these skills in an efficient and organized manner and should be able to adapt in different situations.

Based on the future needs, the accreditation criteria of engineering programs include several attributes that engineering graduates should possess. For example, ABET (2010) states that engineering students must know how to apply the following skills: knowledge of science, mathematics and engineering; multidisciplinary skills; ability to formulate and solve problems, etc. In Europe, the accreditation body called European Network for the Accreditation of Engineering Education (ENAE) has indicated that the quality of engineering programs will have impact on HEIs in terms of economic, cultural, financial, social and political life (Ginkel and Dias, 2007). Engineers Australia Policy (2010) stated that the professional engineers should apply their lifelong learning, critical perception and

engineering decision to the engineering services performance. Engineers should be able to apply their analytical skills to design solution to complex problems by well-developed comprehension of scientific principle and engineering theory.

Malaysia aims to become a developed and high-income nation by 2020. With this objective in mind, Malaysia needs to develop its human capital, and the country must place emphasis on a few important areas to ensure change happens (National Economic Advisory Council Malaysia, 2010). One of the major changes is to mainstream quality technical education and vocational training, which allows more people to have access to this type of education. In addition, competency levels of university graduates need to be raised to prepare them for entering the workforce (Ministry of Higher Education, 2006). Therefore, it is crucial for educators of higher education institutions to take up the challenge to instill and develop instructional practices that will produce engineering students with the required skills and intellectual maturity.

According to Perry (1970 & 1999), the emphasis on higher education should be on the development of an individual to be a thinker and someone who is matured. Science and engineering graduates are expected to have higher order thinking skill based on their intellectual development level. Therefore, students' achievement on cognitive development serves as a useful indicator of students' maturity as a way to improve the quality of engineering education. To understand students' intellectual development, several theories of cognitive development by Perry (1970, 1990), Magolda (1992) and Piaget (1972) may help in understanding students' progression in intellectual development.

Theories of cognitive development are used to clarify the growth of university students' thinking from simple to complex in many previous studies (Pascarella & Terenzini, 2005; Lavis, 2005). In the context of engineering education, these theories have a similar meaning with intellectual development that can be defined as the intellectual growth of how individuals or students organized their minds, ideas or thoughts for their ability to understand, analyze and evaluate certain concepts or problems to make sense of the world that they live in (Norhayati, 2012).

The intellectual development in general as mentioned in the synopses of Perry's model shows on the tendencies of growth. The directions that people take as they move from less to more reasoning that are complex. However, it is always different between individuals (Perry, 1970 & 1981). In these cases, the progression of intellectual development among undergraduate engineering students in different year of study, faculties or between gender is important to measure and identify the difference to show the development on their abilities to think logically and critically to be a good engineer (Olds, Miller and Pavelich, 2000).

Magolda (1992) conducted a review on intellectual development among college students. She mentioned that many students enter university assuming that the university educators can provide the right answers to most of their questions, and the role of students is to acquire this information. It is important to note that students use these assumptions to guide their learning. Piaget (1972) concluded the theory of cognitive development is about the development of human intelligence and about the mental process because of biological maturation. He said that students constantly interact and develop their maturity with the world around them. In other word, knowledge is actually invented and continually reinvented. Therefore, development as argued by Piaget (1972) can influence every other aspect of human development, such as emotional, social, and moral aspects. Consequently, these assumptions, which are used by students in their learning, enable educators to understand how students learn and acquire new knowledge.

Perry (1970 & 1981) adopted an epistemological approach pioneered by Piaget (1952) in his theory that is aimed in tracing the development on ways of reasoning among American engineering university students. Similar to Piaget's (1952) theory of cognitive development, Perry's (1970 & 1981) intellectual development models focuses on how students think but not on what students think (Zhang, 2002). This theory specially was constructed to understand the cognitive development of university students.

According to Perry (1970 & 1999), the emphasis on higher education should be on the development of an individual to be a thinker and someone who is

matured. Science and engineering graduates are expected to have higher order thinking skill based on their intellectual development level. This is essential to improve future scientists and engineers that can provide effective solutions to cater social needs through various scientific tools and engineering designs (Sheppard, 2003). To understand how an individual progresses in their intellectual development and finally achieves intellectual maturity, it is important to understand the pattern of their progression in intellectual development at different levels based on their previous learning experiences.

1.2 Background of Study

High achievement in many professional skills is greatly facilitated by the concurrent growth in intellectual development. This is where the independence in learning, commitment to ethics, willingness to lead and show the initiative are the hallmarks of the relativistic thinker. Therefore, the engineer with lower thinking skills which means slow achievement from the dualistic to multiple stages of intellectual development, and also still dependent to the authority for the direction and decision making will not score highly on professional skills that may cause them to be unattractive to employers (Duffy, 2011). Based on the employers' needs, today's higher education is now facing new challenges in preparing matured engineers as envisaged in vision 2020 that for status of an industrialized nation by 2020. This is a big challenge for universities to improve the quality education system in Malaysia in preparing future intellectually matured students. Therefore, all engineering programs are expected to develop students intellectually in addition to acquire knowledge and skills in specific engineering discipline (Old, Miller and Pavelich, 2000).

This study is relevant with UTM because of its status as the premier accredited technology-based university in Malaysia. Therefore, there is a need to measure students' level of intellectual development across the year of engineering students' as the first action as indicator to get a better understanding on engineering students at UTM.

This study is based on Perry's Model (1970). This is among the earliest model on intellectual development among engineering undergraduates during their study in university. The model was developed through a longitudinal research. In general, Perry's Model (1970) is valid and the theory that described the cognitive development plays an important role in students' academic performance (e.g., Ryan, 1984a, 1984b; Schommer, 1990, 1993; Schommer, Calvert, Gariglietti, & Bajaj, 1997; Schommer, Crouse, & Rhodes, 1992; and Carmel-Gilfilen, 2012). All the stages define by Perry (1970) are highly relevant in order to show university students' intellectual development progress (Norhayati, Khairiyah, Azlina, & Daniel, 2012). Furthermore, there have suggested the validity of Perry's theory by researchers of cross-cultural studies (e.g., Durham, Hays, & Martinez, 1994; Zhang, 1999a) given that cultural factors have been proven to have strong impact on cognitive development (e.g., Mwamwenda, 1992; Rogoff & Chavajay, 1995; Slone, Dixon, & Bokhorst, 1993).

Perry's model measures male students of Harvard University. Through self-reports, students' experiences and development throughout the years in university were investigated. Perry found those students' presumptions as well as expectations of teaching and learning change over time. He stated that, freshmen are usually at dualism (right versus wrong) stage and students will progress to the relativism stage when they are in their senior year. In one of his earlier studies, Perry (1970) demonstrated that there are nine developmental positions for university students' conceptions of knowledge, from the absolute position that views knowledge's exactness to the view that all knowledge are relativist. From the research done by Perry (1970), he found that most students were in Position 1, which is dualistic thinker when they entered the university. He also found that most students whom he taught reached Position 6 which is had the commitment and independent thought by the time they graduated. Students achieved Positions 7 to 9 when they were in the employment.

There are numerous studies available on intellectual development. Among them are Epistemological Reflection Model by Baxter Magolda (1992), Form of Intellectual and Ethical Development by Perry (1970), Women Way of Knowing by Belenky (1986), Reflective Judgement Model by King and Kitchener (1994) and

more. All these researchers argued that students themselves are responsible for their own intellectual development. However, most of the theories and models of intellectual development done by above-mentioned researchers were constructed for Western students. All these models are used to measure students' position along the levels constructed hierarchy to view or show students' progress in understanding knowledge, solving complex problems, and solving open-ended problems during their university studies (Felder and Brent, 2004). However, there is a lack of studies done on students' intellectual development in Malaysian context especially in engineering. One of the studies, done by Suhaida (2012), identifies intellectual development levels of education students in the education faculty at UTM. Research by Nadila (2009) studies the effect of learning environment in technical and vocational education students' intellectual development. Meanwhile, Daniel (2012) studied on the differences between intellectual maturity and genders through active learning among university students.

Therefore, attention should be paid to the intellectual development of undergraduates throughout the programme by assessing their progression from dualistic to relativistic thinking. The progression of thinking can be explained by knowing the pattern of intellectual development levels, among engineering undergraduates. This knowledge will assist engineering academics to understand their learners and help them to improve their teaching strategies. Other than that, the pattern of students' intellectual development level also acts as an indicator on the impact of engineering program in developing students' maturity on their higher order thinking skills, problem solving skills, and lifelong learning.

1.3 Problem Statement

According to Sheppard (2003), science and engineering graduates need to possess a high level of intellectual development for them to become future engineers and scientists who can provide effective solutions to problems and needs. Engineering educators are responsible to instill and develop instructional practices that will produce students with relevant skills and intellectual maturity.

Because of UTM first higher learning institutions that major in engineering field that focuses on students' knowledge, skills and value, it is important to make sure that all engineering students able developed their maturity especially in intellectual development in order to be a good professional engineer. However it is noted that there is a lack of research on students' intellectual development in Malaysian context especially in engineering. Where, there are numerous studies on intellectual development proposed by previous researchers in Western country.

Therefore, the purpose of this study is to capture the patterns' of intellectual development level among UTM engineering undergraduates in order to understand the learners. This study utilizes Perrys' Model as measurement method in assessing the level of intellectual development in every year of study. The findings of the study will be able to provide highly relevant information of UTM engineering undergraduates' intellectual development. This study focuses on students in different year of study, and all of them are from two different faculties in UTM which is from Civil Engineering Faculty and Chemical Engineering Faculty.

1.4 Objective and Research Questions of Study

The objective of this research is:

1. To capture the patterns of intellectual development levels (dualistic, multiplicity, commitment in relativism) among different academic years in UTM engineering undergraduates in relation to their perceptions of learning experiences in engineering faculties.

The research questions of the objective are:

1. Are there significant differences in intellectual development levels (dualistic, multiplicity, relativism) among undergraduates from engineering faculties?

2. Are there significant differences between chemical and civil engineering undergraduates' patterns of intellectual development levels (dualistic, multiplicity, relativism)?
3. Are there significant differences in intellectual development levels (dualistic, multiplicity, relativism) between chemical and civil engineering undergraduates' across different academic years?
4. Are there significant differences in intellectual development levels (dualistic, multiplicity, relativism) among undergraduates from engineering faculties across different academic years?

1.5 Hypothesis

Based on research objective and research question, there are four null hypothesis outlined as below:

Null hypothesis 1: There is no significant difference in intellectual development level (dualistic, multiplicity, relativism) among undergraduates from engineering faculties.

Null hypothesis 2: There is no significant difference in intellectual development levels (dualistic, multiplicity, relativism) among undergraduates from chemical and civil faculties.

Null hypothesis 3: There is no significant difference in intellectual development levels (dualistic, multiplicity, relativism) among undergraduates from engineering faculties across different academic years.

Null hypothesis 4: There is no significant difference in intellectual development levels (dualistic, multiplicity, relativism) between genders among undergraduates from engineering faculties across different academic years.

1.6 Scope of the study

The general scope of this study is to capture the patterns of intellectual development level among UTM engineering undergraduates based on the model of Perry's Scheme of Intellectual Development (1970), because it has a valid framework developed by the longitudinal research and wide used in several study in different study areas. The sample involved in this study are engineering undergraduates in different year of study at two different Faculties in UTM who are enrolled on 2013/2014 in semester one. The study is conducted in Faculty of Chemical Engineering and Faculty of Civil Engineering. This research is using a survey of Perry Developmental Questionnaire, which is adapted from El-Farargy (2010).

1.7 Significance of Study

The main purpose of this research is to capture the pattern of intellectual development levels among engineering undergraduates in different year of study. The findings of this study can serve as a guide for engineering educators to understand their learners in concerning their progression of maturity in three levels of intellectual development from their learning experience. This knowledge will enable educators to implement better instructional practices.

Meanwhile, it is helpful for students to know their intellectual level to increase the effectiveness of their learning styles themselves. As future engineers,

they need to solve many problems by coming up with creative ideas, analyzing situations, and evaluating something based on their surroundings. By knowing their intellectual development, it can help them to know their thinking ability. This is based on their ways of learning and knowing the knowledge.

The findings are also beneficial to know whether today's teaching and learning can help the students to increase their intellectual development. Therefore the findings will be able to help in providing feedback for Continuous Quality Improvement (CQI) in teaching and learning for engineering undergraduates nowadays. This is because each engineering programme has its own accreditation system.

This study would also benefit the Ministry Of Higher Education in Malaysia (MOHE) to produce new generation of engineers and change teaching methods with awareness of students' maturity in intellectual for these in the 21st century. The study can be used as a guideline or reference as widely by the lecturers or universities to assess all the engineering students' intellectual development in UTM context. Therefore, this can help lecturers in using appropriate teaching methods as their first step to make learning become more interactive. Student's progression in intellectual development will be increased parallelly through out their long learning journey.

1.8 Theoretical framework

The level in the intellectual development of undergraduates is based on their cognitive performance. Therefore, the progression of intellectual development level among students will be developed during their undergraduate studies at university (Moore, 1989). In this research, the researcher attempts to identify the pattern of intellectual development levels (*Dualistic, Multiplicity and Relativism*) that are more predominant among engineering undergraduates across year of study from different faculties.

A number of conceptual frameworks of intellectual development in universities were examined for their utilization in this study (Belenky, Clinchy, Goldberger, and Tarule, 1986; King and Kitchener, 1994; Magolda, 1992; and Perry, 1970). In this study, the researcher used Perry's Model Scheme where there are nine stages of students' intellectual development adopted by many universities educators (Kloss, 1993). This model was chosen because it has a valid framework based on the longitudinal study that has been done.

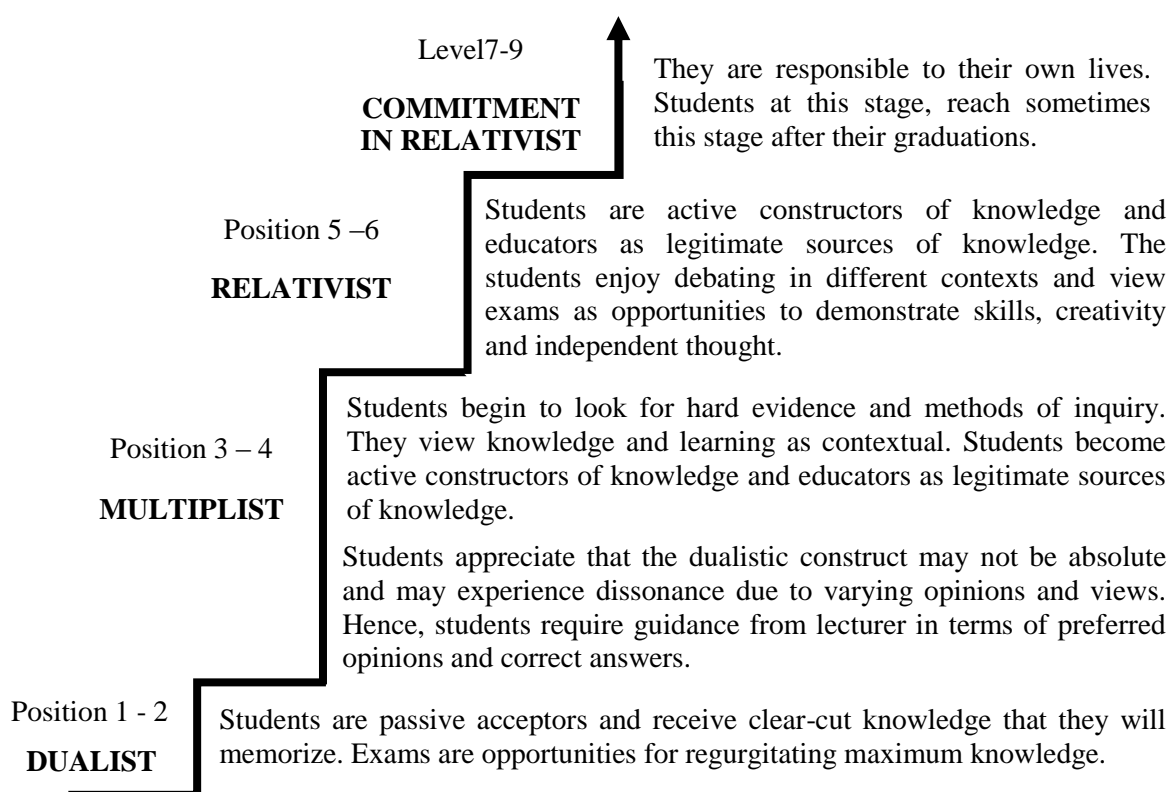


Figure 1.1 Summary of Perry Scheme of Intellectual Development for Views on Students' Development

However, it was judged too complex for easy recall. Therefore, in this study, Perry's Scheme was classified into three broad stages, which are Dualist, Multiplist and Relativist. Figure 1 below shows the summary of the scheme of intellectual development characteristics based on the work of a few previous researchers.

Therefore, this study utilizes the theory from the Perry Scheme of Intellectual Development (1970, 1999). Perry's theory suggests that university students can change their perspectives on knowledge and learning qualitatively in predictable ways as they proceed through the challenges of higher education. The Perry's model has range of "position" from 1 to 9, that conceptualised the development of higher cognitive skill on the level of intellectual development. Essentially, the nine positions on Perry's Model can generally be classified into three stages (Palmer, Marra, Wise, & Litzinger, 2003) as shown in Figure 1.1. In general, students are usually begin from dualist stage which is "right versus wrong" ideology, when they entered university (Position 1 – 2) as absolute thinkers (Kuhn, 1991). Dualist students think that the authorities have all the answers and view all things as right or wrong.

The future progress students mostly achieve into the second stage of Multiplist (Position 3 – 4). In this stage, all things are seen as to be having potentially equal value and correctness to students. Relativistic students use evidence, but without trust, where knowledge is understood based on their own opinions. Therefore, educators are expected to encourage exploration of knowledge from variety perspectives. However, all opinions are equally valid.

Finally, students reach in to the third stage of Relativism (Position 5 – 6). In this stage, students can make commitment and decisions within the relativistic context. Means that, students start to use evidence to explore the alternatives by finding a better or best answer in that particular context. Students in this stage start using their own value system.

The explanations from the theory of intellectual development by Perry (1970 & 1999) that is discussed previously about how students develop their maturity in the way their thinking to help lecturers understand how their learners learn. This shows certain relationship within the classification of the process on how students learn in Bloom Taxonomy that related to student cognitive development is parallel within the theory of intellectual development as shown in Table 1.1. The theory of Bloom Taxonomy has been revised by Anderson and Krathwohl (2001) to reflect contemporary understanding of how students learn.

Table 1.1 The Parallel of Intellectual Development Level with the Revised Stages of Bloom Taxonomy

Bloom Taxonomy		Explanation	Perry Stages Of Intellectual Development	
Higher order thinking skills ↑	Creating	Students are able <i>to take</i> various pieces of information and <i>form</i> a whole <i>creating</i> a pattern where one did not previously exist.	Stages 5 – 9 Commitment in Relativism	Higher order thinking skills ↑
	Evaluating	Involves students' ability <i>to look</i> at someone else's ideas or principles and <i>see</i> the worth of the work and the <i>value</i> of the conclusions.		
Lower order thinking skills	Analysing	Students have the ability to take new information and break it down into parts to differentiate between them.	Stages 3 – 4 Multiplist	Lower order thinking skills
	Applying	Students take new concepts and apply them to another situation.		
	Understanding	Involves students' ability to read course content, understand and interpret important information and put other's ideas into their own words.		
	Remembering	Recognizes students' ability to use rote memorization and recall certain facts.		
			Stages 1 – 2 Dualist	

The theory of cognitive constructivism can also be related in this study, to understand the learners' learning process based on their existing cognitive structure. The cognitive constructivism is the work by Jean Piaget (1926, 1936) that describes about what students can and cannot understand the learning at different stages by construct their knowledge through experiences. The cognitive development is able to explain the cognitive activities that contribute to students' intellectual development on how students developed their cognitive abilities. Basically, constructivism explains that students construct their own understanding and knowledge of world through experiences of thing and reflecting those experiences (Thirteen Ed Online, 2004).

Piaget's cognitive constructivism believed that the intellectual development was a lifelong process. This theory is adaptation of instruction to the learner's developmental level. The way of instruction needs to be consistent and parallel with the developmental level of learner (Wood, Smith & Grossniklaus, 2011). Therefore, it is important to capture the patterns of students' intellectual development in order to guide the instructors in planning suitable instructional by understanding students' learning. Also to differentiate learners' developmental level from less mature to advance mature understanding learners. In these cases, researcher believes that all these theories are suitable to be taken as a guide in this study. The relationships of the theories are view in the Figure 1.2 below:

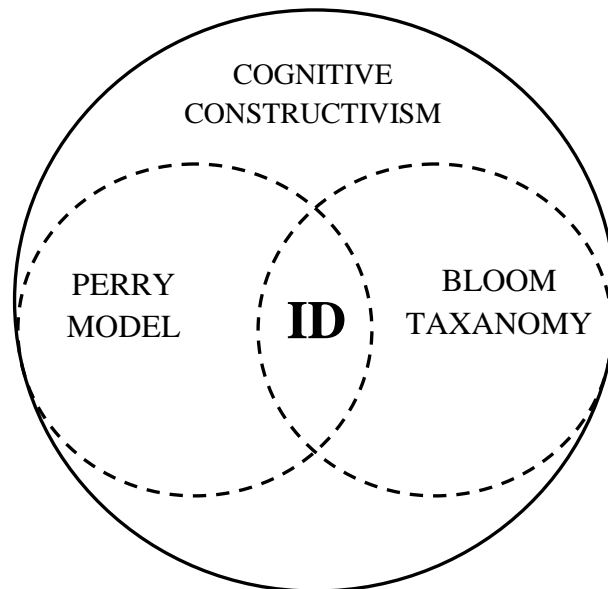


Figure 1.2 The Relationships of Theoretical Frameworks That Related To Describe Students' Intellectual Development

1.9 Conceptual Framework

The aim of the conceptual framework (Figure 1.3) of this research is to show the flow in gaining the result to capture the patterns of intellectual development level among UTM undergraduate engineering students. The results serve as feedback for educators, accreditation of engineering programme for their Continues Quality Improvement (CQI), for students itself, and for Ministry of Higher Education (MOHE). Consequently, the conceptual framework is needed based on the method of analysis concept (Najib, 2003).

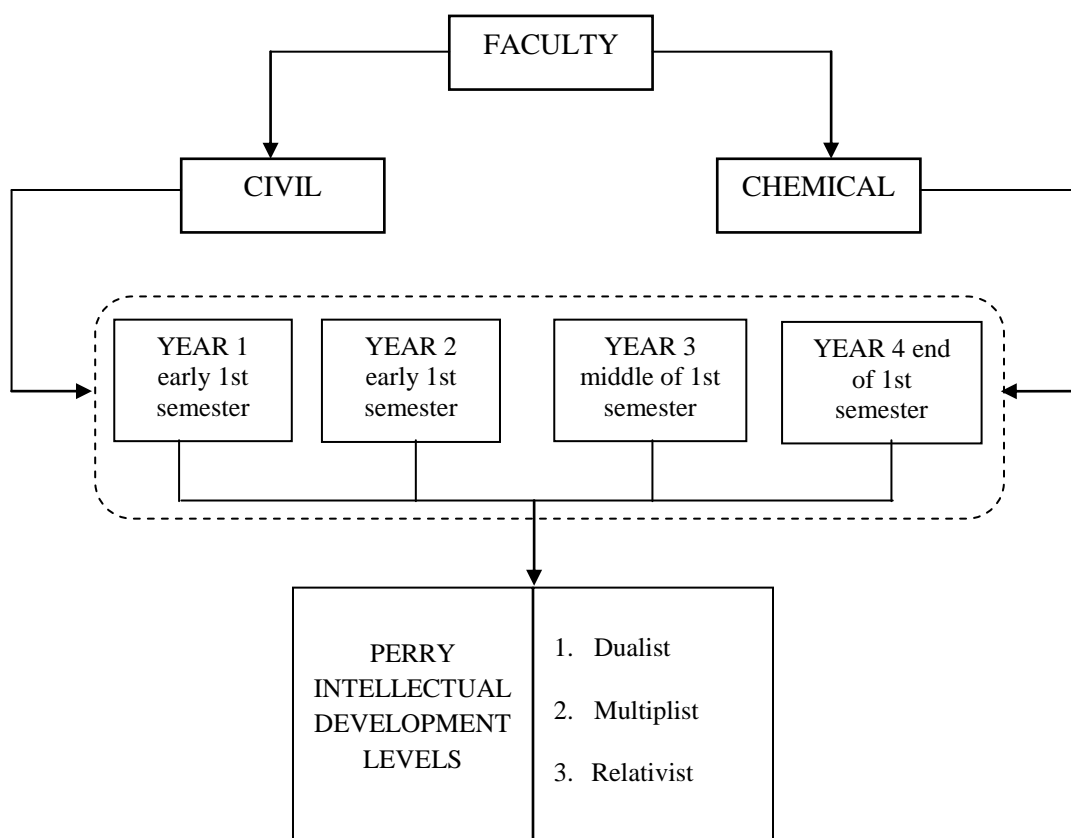


Figure 1.3 Conceptual Framework for Assessing Students' Intellectual Development

1.10 Definition of terms

Below is the list of words often used in this study with their definitions:

i. Intellectual development

Intellectual development of an individual is the maturity of their cognitive process that occurs at different rates and in different areas of their lives. Piaget (1972) concluded that intellectual development is the result of interaction between heredity and environmental factors. Kroll (1992) describes intellectual growth as the development from naive certainty to intelligent confusion. Students who choose engineering as their first degree mostly are at the stage of ignorant certainty. Intellectual development can be defined as the intellectual growth of students in such a way that they become capable of understanding, analyzing and evaluating a concept to make sense of the world around them.

ii. Dualist

Dualist as a term means that the division of something conceptually in to two conflicting or compared aspects, or the state of being (Oxford, 2012). Perry (1970 & 1999) defines dualist students as those who are usually among first-year students, where they view all knowledge as either right or wrong. They think that the authorities or educators have all the answers. Learning is an information exchange between student and educator.

iii. Multiplist

A term of Multiplist is a large number or variety (Oxford, 2012). According to the positions proposed by Perry (1970 & 1999), multiplicity is in position three (early multiplicity) and position four (late multiplicity). These two positions represent different views of answers when the right answers are not yet known.

Students in these positions are receptive to others students' point of view. Therefore, they improve in their analytical thinking skill (Lavis, 2005).

iv. Relativism

Relativism is the principle that the existing of knowledge, truth and morality in relation to culture, society or historical context and are not absolute (Oxford, 2012). According to Perry (1970 & 1999), relativism is in position five and six. Students in relativism stage start to recognize the need to support their opinions, where not all opinions are equally valid. Knowledge is viewed more qualitatively.

v. Perry's Scheme

Perry's Scheme is a theory of intellectual and ethical development that has nine stages in hierarchical structure of thought. This can be grouped into three stages of the ways of thinking (Dualism, Multiplicity and Commitment in Relativism) (Perry, 1970 & 1999).

vi. Undergraduates

Definition of an undergraduate is university students who have not yet received their first degree (Oxford, 2012). In UTM context define undergraduate students who entering university with an interest to obtain important information by concerning the programme and courses, entry requirement and etc. for undergraduate admission (UTM Web Team, 2012).

1.11 Summary

The purpose of this study is to capture the patterns of intellectual development level among UTM undergraduate engineering students in order to understand the learners. The modified instrument by adapting the Perry Developmental Questionnaire (Nancy, 2010) is expected to be relevant for determining UTM engineering undergraduates' intellectual development in different year of study in relation to their learning experience. The instrument will be used to track intellectual development among engineering undergraduates as defined by Perry's Scheme of Intellectual Development. This investigation could aid to describe the development in university students' thinking, from simple to complex. The patterns of students' development depend on how they view their surroundings. Researchers of previous studies had assessed the intellectual development of university students. However, there is not much research on intellectual development specifically focusing on UTM undergraduate engineering students, which can be applied to UTM students.

Therefore, the researcher believes that students will be matured during their studies in university. Knowledge of students' intellectual development can help students on their learning and educators on improving their teaching practices respectively. This study has one main objective. One is to capture the patterns of intellectual development levels (dualistic, multiplicity, relativism) among UTM undergraduate engineering students in relation to their perceptions of learning experiences in different engineering faculties across year of study. The literature review related to this research is discussed in Chapter 2.

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