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Malaysian polytechnic lecturers' teaching practices with ICT utilization to promote higher-order thinking skills

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Malaysian polytechnic lecturers' teaching practices with ICT utilization to promote higher-order thinking skills

by

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IN THE MEMORY OF

My Father '*Bapa*', Allahyarham Ali Omar, who departed peacefully on June 26, 1984

and

My Grandmother '*Nenek*', Allahyarhamah Hajah Zaiton Abdul Manaf, who passed away on Friday morning, December 22, 1995

Thank you so much for all your love and sacrifices for me. May Allah SWT have mercy on you and place your souls among those of believers.

DEDICATION

This dedication goes to my beloved family for their unconditional love, continuous support, patience, and prayers for me to become who I am today. Million thanks.

Pn. Fatheela Hissuddin
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Nur Athirah Azahar
Nur Afifah Azahar
Amirul Ali Azahar
Daim Mustafa Azahar
Qaseh Khateeja Mohamad Zaki

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LIST OF ACRONYMS

ICT:	Information and Communication Technology
HOTs:	Higher-Order Thinking Skills
DPE:	Department of Polytechnic Education
DPPCE:	Department of Polytechnic and Community College Education
MOE:	Ministry of Education, Malaysia
MOHE:	Ministry of Higher Education, Malaysia

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ABSTRACT

In recent years, Information and Communication Technology (ICT) has been having a significant impact in the field of education, and as a result drawing considerable attention. The advent of the digital and information age has made the development of critical and creative thinking, and higher-order thinking skills (HOTs) vital to future success. Thus, experiences that expose students at higher levels of Bloom's Taxonomy in constructivist-based learning environments are becoming an increasing practice. Take for example a country like Malaysia where ICT is becoming more and more pervasive in today's polytechnic institutions; however, very little is understood of polytechnic lecturers' perceptions of the utilization of ICT to promote HOTs. This research study is set out to address these issues by discovering the lecturers' teaching experiences and practices concerning the ICT utilization to promote HOTs in their course instruction at Malaysian polytechnics.

Surveys to collect quantitative and qualitative data were administered to 700 polytechnic lecturers at three selected Malaysian polytechnics, and an analysis of lecturer-made lesson plans was conducted. A 75-item survey instrument with a Likert-type scale was used to investigate factors and lecturers' perceptions of the importance of teaching methods, strategies, barriers, and ICT utilization to promote HOTs teaching and learning. A total of 389 surveys were returned for an overall response rate of 56%, and thirty-five lesson plans of engineering mathematics courses were analyzed. Descriptive and inferential statistics were

conducted using STATA software, and the qualitative data were analyzed pertained to the element of HOTs level (analysis, synthesis, and evaluation) and the use of ICT.

Findings showed that significant differences were found between high group and low group of lecturers' ICT utilization on level of support and training, and confidence level into their teaching practices to promote HOTs. Lecturers across demographic factors acknowledged that HOTs teaching practices were influenced by variety of teaching methods. In sum, Malaysian polytechnic lecturers' perception on teaching practices to promote of HOTs appears to be a significant issue, and they recognized the use of ICT in their course instruction. However, their teaching practices with ICT utilization in mathematic classrooms were not thoroughly carried out in ways that would facilitate HOTs among students. The "incongruence" between polytechnic lecturers' perceptions and their teaching practices as intended by the Malaysian polytechnic curriculum and Malaysia's ICT policy in education might affect the success of promotion HOTs outcomes in polytechnic educational settings. Recommendations on professional development and training in ICT integration, HOTs teaching-learning strategies, and constructivist practices were offered.

CHAPTER 1: INTRODUCTION

Dewey (1933) believed that people are born with the ability to think and that the educator's role is to develop learners to become effective thinkers. Teaching thinking skills to promote students' intellects has been a major challenge to educators for a long time and there are continual demands to improve students' learning and thinking skills. Educators need to facilitate students' ability to analyze, synthesize, and evaluate facts and information, and use thinking skills to solve problems and make decisions (Brown, 1999). In today's highly competitive global "knowledge economy", students need to be self-directed and possess lifelong learning skills. They are required to possess "21st century skills", such as creativity and critical thinking, problem solving, and analytical reasoning in their learning, according to Wagner (2008). Students can no longer survive by memorizing textbooks; they now need to explore and experience authentic tasks that can be connected to the real world, in which they can develop, master, and demonstrate authentic skills (Krishnan & Muhammad Yassin, 2009).

One of the objectives of the Malaysian education system is to "develop and enhance students' intellectual capacity with respect to rational, critical, and creative thinking" (Curriculum Development Center [CDC], 1993, p.2). While the focus on teaching thinking skills has been stated in Malaysian education curricula for a long time and has been emphasized more recently, the Minister of Education has decided that "the education system will be revamped to encourage rational and analytical thinking" (Indramalar, 1997, p.4). This indicates that the Ministry of Education's (MOE) commitment is to promote the teaching of thinking skills in Malaysian educational institutions. Currently, traditional pedagogical approaches are still being practiced in the polytechnic teaching environment in Malaysia. Lecturers are also expected to provide teaching materials and conduct assessments as required in every syllabus**.** Teaching and learning styles or approaches are improvised and the development of a new way of assessing students is required to measure the real capabilities or competencies of the students (Department of Polytechnic Education [DPE], Malaysia, 2010). As mentioned before, learning and working in the 21st century requires that we know how to think, specifically how to reason, analyze, evaluate evidence, and communicate effectively. These critical-thinking tools are vital survival skills that every educator must have to be effective in the 21st century classroom. These are vital survival skills for all of us (Wagner, 2008).

Benjamin Bloom (1956) created the term, higher-order thinking skills (HOTs) and defined the levels of analysis, synthesis, and evaluation of knowledge. In the analysis level, learners engage in two processes: (1) identify causes for particular events, and (2) analyze information to reach a conclusion. Learners are required to think deeply and critically. In the synthesis level, learners make predictions and solve problems. Moreover, learners are encouraged to produce a variety of creative answers, instead of finding only one correct answer. In the evaluation process, learners evaluate ideas and information and offer their thoughts and opinions on the value of the issues being examined. Additionally, Bloom's view could be summarized as an individual would "use cognitive skills from previous knowledge and apply them to new problems/issues/situations" (1956, p. 38). Bloom's HOTs taxonomy has been the primary reference for improving human thinking skills for many researchers over the years. Several researchers (Johnson & Lamb, 2011; Sparapani, 1998; Udall & Daniels, 1991) have recognized that HOTs also are creative thinking, critical thinking, problem solving, and decision-making. To equip students with these skills and make them competitive, educators need to teach cognitive strategies that help their students think critically, solve problems, and make decisions (Pogrow, 1994).

HOTs can be enhanced by using technology (Kelman, 1989); technology is a promising tool to engage students in critical and creative thinking (Muir, 1994). Hence, the ability to apply technology to teach HOTs is expected among educators (Croxall, 2002) and Malaysian polytechnic lecturers are also expected to have these skills. The questions of how Information and Communication Technology (ICT) has been used in Malaysian polytechnics have not been addressed. There are only a few studies (Zolkofle, Zainal Abidin, & Muhammad, 2010) that demonstrate the applications of software or hardware in the polytechnic environment in the Malaysian context. There are even fewer inquiries that demonstrate how Malaysian polytechnic lecturers' use ICT to teach HOTs. Miri, David, and Uri (2007) state that there is a "hole between theory and practice…(among) teachers who claimed to purposely teach for the promotion of HOTs" (p. 355). The Polytechnic Management Curriculum Committee (Department of Polytechnic Education [DPE], Malaysia, 2010) designs their curricula around the authentic real-life skills. ICT is a part of everyone's life in our increasingly technological world, so it should be integrated into all polytechnic program curricula to better prepare students for their future. Now, there is a need to find a balance between using ICT and traditional teaching methods. Good learning outcomes can be achieved not only in learning environments that use ICT, but many lessons are best taught using ICT. Thus, this study was designed to investigate Malaysian polytechnic lecturers' teaching experiences and practices and the use of ICT to promote HOTs in their teaching.

The Importance of Higher-Order Thinking Skills and Information and Communication Technology Utilization

Higher education institutions across the world have continued to emphasize teaching, research, and service in academician workloads. Due to the evolution of knowledge and advances in ICT, academician teaching roles, at least in Malaysia, have been to promote effective teaching, to advance research, and to heighten and strengthen cooperation between educational institutions and industries (Education Development Plan for Malaysia 2001 – 2010, 2001). Bennett and Robinson (2000) stated that the most valuable employees needed to posses three skills: (1) basic academic skills, (2) higher-order thinking skills, and (3) certain personal qualities. The abilities to think critically, reason creatively, and make sensible and justifiable decisions are vital for people desiring to perform well in their jobs. According to Jonassen (1996), critical thinking can be divided into three skills: evaluating, analyzing, and connecting. Furthermore, a critical-thinking model can promote HOTs.

In Malaysia, in spite of the promising technological advances that have occurred in industry and computer information, instructional methods in many classrooms continue to be dominated by a didactic teaching style (Ali & Noordin, 2010). Such traditional pedagogy requires a paradigm shift to adopt a higher-order thinking model: switching from viewing the educator's role as a provider of knowledge to that of a facilitator of knowledge (Dexter, Anderson, & Becker, 1999). Traditional teacher-centered instruction is implemented through lectures, rigorous examinations, and student written reports. In such environments, the teacher's role is to direct learning in each aspect (Tu & Twu, 2002). This teaching method has failed to reach student's higher-order thinking, owing primarily to the teacher's ineffectiveness in motivating students. Hence, students play a passive role and do not have a chance for reflection as a learning outcome (Liu, Zhuo, & Yuan, 2004).

Several researchers (Costello & Chapin, 2000; Tao, 2000) have found that when students engage in problem solving, there are gains in motivation for learning, increased freedom to engage in higher-order thinking (analyzing, synthesizing, and evaluating), and improved conceptual understanding of the subject matter. In technical and vocational education, creativity in solving problems has become a primary goal. By using creative problem-solving strategies and thinking about alternative ways of solving problems, students may be better able to solve societal and practical problems. Thus, it is necessary for educators to embed higher-order learning goals into their curricula (Lewis, Petrina, & Hill, 1998). Efforts should be made to help students acquire critical and creative thinking skills because, as Langer (1991) wrote, "the current era requires that students acquire the kinds of critical-thinking skills that are needed to use communication devices and technologies we meet daily in our everyday living and in an entry-level job" (pg. 12).

In addition, with advances in new technologies, Dede (2007) states that educational practices must change to meet the current and emerging needs of students as we continue in the 21st century. He points out that the world economy is no longer driven by industrialization but rather by innovation and knowledge. As a result, students need to be prepared to function effectively in this world economy that is knowledge-based and that rewards creative innovations.

With the importance of HOTs in conjunction with the use of ICT, this research study is focused on the lecturer's teaching practices with ICT to promote HOTs in their instructional delivery. The subjects of this study are lecturers who are teaching at polytechnic institutions in Malaysia. These areas remain unexamined, particularly in the context of the Malaysian polytechnic educational system.

Statement of the Problem

Malaysian educators are constantly encouraged to use ICT and promote HOTs in their teaching. While examples are often given in other higher educational institutions, they are rarely provided in the polytechnic institutional setting. Are polytechnic lectures aware of the promotion of higher-order thinking approaches during their teaching? Are polytechnic lecturers already using ICT and meeting the Malaysia's ICT policy in education, which includes the teaching of HOTs? And if not, why not, and in what specific areas do they need more training or support? This study investigated the Malaysian polytechnic lecturers' teaching experiences and practices with ICT utilization to promote HOTs. Of specific interest is Bloom's higher-order thinking taxonomy, and if and how polytechnic lecturers are being taught using ICT.

In Dooley's (2003) study of Australian schools, he has stated that Asian students are more studious, passive, achievement-oriented, and there is emphasis on rote learning than in non-Asian students. Given those results, in the current study it is likely that Malaysian polytechnic lecturers who use traditional lectures may not be aware of higher-order thinking approaches (promoting dialogue, asking questions, and engaging in discussion). The number of educators who integrate ICT in their lessons in order to develop interesting and effective teaching methods is still low in Malaysia (Aladdin, Hamat, & Yusof, 2004; Education Development Plan for Malaysia 2001 – 2010, 2001; Sidin, Salim, & Mohamed, 2003; Abd Rahman, Ismail, & Razali, 2003). However, the statistical results of ICT integration among Malaysian educators have not been reported, so this limits available knowledge about the integration of ICT in Malaysian educational institutions. It is generally known that teaching and learning theories are not usually implemented properly in the classroom (Boddy, Watson, & Aubusson, 2003) and there is a gap between theory and practice. Therefore, to gain a deeper insight into the reality of ICT use in Malaysian polytechnic institutions, there is a need to discover the types of ICT that Malaysian polytechnics lecturers are using in their teaching, if they are using ICT to promote HOTs, and if so, how they perceive the use of ICT into their teaching practices.

Purpose of the Study

The primary purpose of this mixed methods study was to determine from a selected group of Malaysian polytechnic lecturers' experiences how much emphasis they had been able to place on teaching students to use HOTs while using ICT in the classroom at a technical polytechnic setting in Malaysia. Another goal of this study was to analyze the Malaysian polytechnic lecturers' teaching practices using ICT to promote HOTs.

Research Questions

The main research question in this study was:

(1) How do Malaysian polytechnic lecturers perceive: (a) level of support and training and confidence level in promoting HOTs using ICT and (b) the use of ICT to promote HOTs in their teaching-learning process?

Subsequent research questions were:

(2) How do Malaysian polytechnic lecturers perceive the importance of teaching methods to promote HOTs in their classrooms?

(3) What teaching strategies are considered important to enhance students' HOTs outcomes among Malaysian polytechnic lecturers?

(4) What are the critical success factors and barriers for Malaysian polytechnic lecturers who are using teaching methods to promote HOTs in their teaching?

(5) How do demographic factors (gender, years of professional service in teaching, age, highest academic degree level, and institution) influence Malaysian polytechnic lecturers' teaching practices to promote HOTs?

Context of Study: Polytechnics in Malaysia

Malaysian polytechnics are post-secondary institutions under the Ministry of Higher Education (MOHE), established to train school leavers to be technical personnel (TVETipedia, 2011). A large portion of technical and vocational education courses are offered in Malaysian polytechnic institutions. Hence, polytechnic institutions have become the chosen route in producing semi-professional technical workers and for students who are keen to acquire technical knowledge (Esa, Razzaq, Masek, & Selamat, 2009). In order to strengthen the role of polytechnics in education and training, the Department of Polytechnic Education has launched a plan for the transformation of polytechnics for the empowerment of technical education to support the Malaysian vision to be a developed country by the year 2020 (Department of Polytechnic Education [DPE], 2010). The 27 polytechnics are currently accommodating more than 88,000 students from various courses, including engineering, trade and commerce, and services in 50 programs offered at a diploma level. Student entrance into these polytechnics is managed by a central agency, the Department of Polytechnic Education (DPE). In spite of each polytechnic having its own director who is appointed by the DPE, the overall management of these polytechnics, such as staff appointments, curriculum development, provision for infrastructure, and educational facilities are controlled by DPE. It could be reasonably expected that students enrolled in a particular program in one polytechnic are similar to students enrolling in the identical program in another polytechnic.

Students commonly have six semesters to fulfill at least 93 credit hours, for a minimum duration of three years in their program (Department of Polytechnic and Community College Education [DPCCE], 2009). Students who enroll in the first year will be taught the basic concepts and theoretical knowledge in their field of study. Upon graduation, students can further their studies in universities to attain their degree qualifications.

A traditional method of lecturing is employed in almost all courses, including engineering mathematics, electrical technology, electronic systems, microcontroller and computer applications, business and accounting. The assessment method for all courses is composed of at least 50% coursework, which includes projects, assignments, quizzes, and tests, and another 50% is devoted to final examinations to be counted towards the students' overall grade (Department of Polytechnic and Community College Education [DPCCE], 2009).

In order to increase the quality of the teaching system and to further improve the quality of technical and vocational higher education in Malaysia, polytechnic lecturers are recommended to emphasize a student-centered learning pedagogical approach, such as case study and project-based learning (Department of Polytechnic and Community College Education [DPCCE], 2008). In conjunction with this format, polytechnic graduates are expected to evolve and develop other personal skills and abilities, such as creative and critical thinking, problem solving, social and communication skills, and personal values, along with strong technical and technology skills. However, the present situation reveals that there is room for improvement in the implementation of this approach. The educational system in polytechnics has been practicing the traditional form of education and assessment, which is perceived as contradictory to a student-centered learning approach (Ling, 2010).

For ICT utilization in a polytechnic institution setting, a study conducted at one of the polytechnic institutions in the northern part of Malaysia shows that the ICT usage in that particular polytechnic was at the moderate level (Basir Ahmad, Abd Rashid, & Elias, 2010). This indicates that the use of ICT among polytechnic lecturers in their teaching is still fairly low and not fully utilized. Hence, it is expected that this study will produce a significant contribution to the subject, as well as helping polytechnic administrators and graduates to meet teaching and learning expectations.

Significance of the Study

As Malaysian polytechnic lecturers assess their instructional practices, it is likely that they may be encouraged to consider focusing on HOTs goals as an alternative to lecture and drill practices methods. In the current Malaysian teacher-centered method and the large-sized classes of passive learners, it has not been common for teachers to engage their students in discovering the reasons for learning or the anticipated outcomes, since teaching towards examinations has been the standard (Dooley, 2003). This study may be significant in collecting information about current Malaysian polytechnic lecturers using ICT to promote HOTs. Additionally, this study may be useful to (1) Malaysian polytechnic lecturers and administrators who seek to encourage the use of teaching and learning strategies that emphasize HOTs outcomes, (2) those who plan and deliver in-service professional development to Malaysian polytechnic lecturers, (3) aid the DPE and MOHE in making better policy decisions and applying educational strategies with greater certainty, and (4) establish expectations for hiring new lecturers.

Determining Malaysian polytechnic lecturers' specific use of ICT provided insights as to what type of support these lecturers may be lacking in order to meet the MOHE's aspirations. If Malaysian polytechnic lecturers had not reported using a variety of ICT in their classrooms to promote HOTs, the attention to this issue would not have been researched. Future research will need to be done concerning the reasons and critical success, which will create the positive outcomes in Malaysian polytechnic institutions.

This study will be important to help Malaysian polytechnic lecturers, administrators, the MOHE, and future researchers better understand the promotion of HOTs and ICT utilization in their teaching in a technical polytechnic setting in Malaysia. Limited studies have been conducted to assess HOTs and ICT utilization among lecturers in their teaching in a Malaysian polytechnic environment. This study hopes to increase the awareness of the promotion of HOTs and integration of ICT in the teaching-learning process. Although this study was conducted at only three Malaysian polytechnics, the data may be generalized to similar demographics areas. The specific examples lecturers provided as to how they were teaching HOTs using ICT will be useful to other polytechnic lecturers and possibly in other educational environments. Finally, the research study results can serve as a foundation for the research community to move on with further research on teaching-learning effectiveness, HOTs, and ICT utilization.

Definition of Terms

The following definitions are provided to ensure understanding of these terms in a consistent manner throughout the study.

Bloom's Taxonomy for Learning: Benjamin Bloom, an educational leader and his colleagues developed three domains to measure learning achievements of learners: the cognitive domain, affective domain, and psychomotor domain. Bloom (1956) applied six-level classification system that observed student behavior to interpret the level of student achievement. The following level in the cognitive domain:

1. Knowledge: "Requires behaviors and test situations which emphasize remembering (recognition or recall) of ideas, material, or phenomena" (p. 62).
2. Comprehension: "Involves objectives, behaviors, or responses, which represent an understanding of the literal message contained in a communication" (p. 89).
3. Application: "Requires students to know an abstraction well enough that they can correctly demonstrate its use when specifically asked to do so" (p. 120).
4. Analysis: "Emphasize the breakdown of the material into its constituent parts and detection of the relationship of the parts of the way they are organized" (p. 144).
5. Synthesis: "Includes putting together elements and parts of ideas and concepts to form a whole" (p. 162).
6. Evaluation: "Requires making judgments about the value of something for some purpose as related to ideas, works, solutions, methods, or materials" (p. 185).

Higher-order thinking skills (HOTs): Bloom categorized thinking skills beginning from the concrete and progressing to the abstract: knowledge, comprehension, application, analysis, synthesis, and evaluation. The last three levels of Bloom's Taxonomy: analysis, synthesis, and evaluation are considered higher-order thinking skills (Johnson & Lamb, 2011).

Information and Communication Technology (ICT): It includes hardware (computers, handheld devices, printers, digital cameras), software and system applications (programming classes, productivity software), media (the Internet and videoconferencing) and the networks that tie computers together ((Washington State, 2005; Moursund & Bielefeldt, 1999).

ICT Utilization: It refers to lecturer uses of ICT for teaching and learning. This includes the use of mainstream hardware and application software, curriculum/subject-based software, the web, and multimedia tools.

Teacher-centered instruction: Traditional teaching characterized by lecturing, passive student learning through note-taking, and emphasis on memorization of facts and concepts. The lecturers take the role of authorities, leaders, and assessors. The students play the role of followers and subordinates.

Learner/Student-centered instruction: An instructional process in which the content is determined by the learners' needs, the instructional materials are geared to the learners' abilities, and the instructional design makes the learners active participants (Schrenko, 1994).

Creative thinking: An innovative way of perceiving information as categorized by four components: fluency (creating multiple thoughts), flexibility (changing views quickly), speculating about new ideas, and elaboration of thoughts (Cotton, 1992).

Critical thinking: The process of using cognitive skills or strategies that leads to a desirable outcome. This type of thinking covers solving problem, formulating inferences, and making decisions (Halpern, 1996).

Problem solving: The synthesis of the rules and concepts into higher-order rules, which can be applied to a situation for resolution (Gagne, 1985).

Inquiry approach: A concept of learning that "involves a process of exploring the natural or real context world that leads to asking questions and making discoveries in the search for new understanding" (Molebash & Dodge, 2003, p.160).

Metacognition: Learners' awareness of the learning process; it contains two concurrent processes: monitoring learners' progress while they learn and making changes if learners realize they do not perform well. Metacognition covers self-reflection, self-responsibility, initiative, goal setting, and time management (Winn & Snyder, 1996).

Dissertation Organization

Chapter 1 consists of the introduction and background, statement of the problem, significance of the study, definition of terms, and organization of the dissertation. Chapter 2 includes the review of literature and research related to HOTs concepts and ICT utilization as they may apply to higher-education institutions. The methodology and procedures of the study are described in Chapter 3, in which the research study design, data collection, and data analysis are presented. The results of analyses and the findings of the study are presented in Chapter 4. Chapter 5 includes a summary of the study, discussion of the major findings and results, and links to the literature, conclusions, limitations, recommendations, further research, and implications of the study.

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

This chapter discusses the literature reviewed for this study, which focused on establishing a theoretical framework based on Information and Communication Technology utilization in a constructivist learning approach and higher-order thinking skills concept. This framework is followed by a discussion on: (1) metacognition in higher-order thinking, (2) teaching methods and strategies for higher-order thinking skills, (3) opportunities and challenges for teaching higher-order thinking skills, (4) Information and Communication Technology utilization in promoting higher-order learning, and (5) higher-order thinking skills in the Malaysian context.

Theoretical Framework

The theoretical framework which guides this study is based on the use of Information and Communication Technology within a constructivist learning approach and supported by the higher-order thinking skills development from Bloom's Taxonomy of Learning Domain as an instructional theory. The following elaborates more on this theoretical background.

Information and Communication Technology Utilization in a Constructivist Learning Approach

This new constructivist-oriented pedagogical approach encourages a transformation of teaching from teacher-centered to learner- or student-centered learning. Constructivist learning theories, which assessed the intellectual aspects of learning that emphasized the process of knowledge construction, was innovated by Dewey (1933), Piaget (1963), Bruner

(1963), and Vygotsky (1978). This learning approach promotes that an individual through his or her interactions in the environment meaningfully constructs knowledge. Wilson and Cole (1991) and Jonassen (1994) summarized that the common characteristics of constructivist learning are learner- or student-centered, with opportunities for blending learning in authentic tasks, and cooperative learning. Student-centered learning views knowledge as constructed by learners instead of being given to them, while learning in authentic tasks emphasizes the importance of the learning content relative to the actual environment. Lastly, cooperative learning is associated with the social aspect of learning.

Dart (1997) believed that the student-centered teaching approach would generate students' deep approach to learning, while the teacher-centered approach would lead to the surface approach to learning. Students who apply the deep approach are more likely to comprehend the meaning of the lessons and try to connect different pieces with one another, while those who adopt the surface approach will see lessons as a requirement to be completed and are more likely to remember disconnected facts (Lee, Johanson, & Tsai, 2008). Hence, many researchers have suggested that deep approaches would lead to higher-quality learning outcomes (Cano, 2007; Trigwell & Prosser, 1991).

The constructivist approach encourages the use of technology as a teaching aid (Willis & Mehlinger, 1996). The combination of constructivist theory and the use of technology are likely to lead to meaningful applications of technology tools to facilitate students' higher-order skills (Rakes, Fields, & Cox, 2006). Information and Communication Technology (ICT) utilization should be blended within a learning theory to support the methodology. In the majority of today's classrooms, the instruction is based on traditional learning theories where ICT is being used only as a tool in the replacement of traditional tools. Research findings recommend that teachers cannot depend on technology tools or learning theory separately. These two aspects must come together to create a productive classroom atmosphere (Muniandy, Mohammad, & Fong, 2007). Thus, for successful ICT integration in classrooms, it is vital for teachers to further enhance their Technological Pedagogical Content Knowledge (TPACK), to exhibit an understanding of how technology constructively relates to pedagogy and content (Mishra & Koehler, 2006). It highlights that good teaching requires the knowledge to utilize ICT and to present concepts and pedagogical approaches that integrate ICT in constructive ways to teach content.

Furthermore, many studies based on Mishra and Kohler's TPACK framework (2006) have outlined the salience of an understanding of pedagogy, content, and technology in building the necessary skills to practically and effectively integrate ICT in classrooms (Angeli & Valanides, 2008; Doering, Scharber, & Veletsianos, 2009; Kocoglu, 2009; Ward & Overall, 2010). Building pre-service teachers' TPACK during teacher education programs and supporting them in exercising their TPACK would help them in integrating ICT in the classroom (Ward & Overall, 2010).

According to Perkins (1991), there are three fundamental goals in education: remembering knowledge, understanding knowledge, and applying knowledge. These goals are considered as the first three levels of lower-order skills in Bloom's Taxonomy. ICT development has positively influenced education and broadly influenced all aspects of human life over the past twenty years. Teaching and learning processes have been advanced through changes and impacts from ICT infusion. Rakes et al. (2006) stated that the student-centered learning approach of constructivism improves students' learning outcomes from basic learning skills to higher-order of skills.

There is a positive correlation between teachers who use constructivist pedagogy and their technology utilization in the classrooms (Judson, 2006). Hernandez-Ramos' (2005) study targeted teachers in the Silicon Valley in California to investigate what factors primarily influence teachers' technology utilization in their classroom. The findings revealed that three major factors influenced teachers' technology integration practices: (1) ICT exposure during their teacher training programs, (2) teachers' understanding of ICT application, and (3) teachers' belief in the constructivist approach. Constructivist teachers support student use of technology in order to develop their own understanding of information, by integrating authentic experiences into their learning environments. Boethel and Dimock (1999) stated that when teachers integrate technology into a constructivist learning environment, student learning performance is greatly improved.

ICT can be used as tools for developing thinking skills. Computer applications have been developed to facilitate critical thinking and higher-order learning. These tools enable students to construct a knowledge base and multimedia presentations that represent students' meaningful knowledge, engaging them in higher-order learning and thinking skills (Salomon & Globerson, 1987). In addition, ICT is viewed as a promising platform for the application of constructivist principles to learning. For example, computer simulation software that helps learners construct new understandings through exploratory activity has a great potential for giving authenticity for learners (Patokorpi, 2007).

The role of ICT, which is an important tool for constructivist approaches particularly in mathematics education, is increasing as a focus point of learning mathematics, with new designs and ICT devices. In the past, we taught mathematics by focusing on the rote work, memorization, and mastery of solving problems by hand, but now the way we teach mathematics is changing. "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (National Council of Teachers of Mathematics [NCTM], 2000). ICT has changed the methods for mathematics instruction and the ways that mathematics is learned and assessed. Teachers need to select and use appropriate instructional technology to develop, enhance, and extend students' understanding of the concepts and applications of mathematics.

Higher-Order Thinking Skills

The concept of higher-order thinking is derived from the *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) and is popularly known as Bloom's Taxonomy. This taxonomy identifies hierarchical progression skills that students are expected to learn, from the easy to the difficult level. The levels of Bloom's Taxonomy, from lowest to highest are Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Huitt, 2011). Teachers have been trained for many years to use Bloom's Taxonomy of higher-order thinking skills (HOTs) to help students become critical and creative thinkers.

This study used Bloom's highest three cognitive learning objectives: analysis, synthesis, and evaluation as a foundation for higher-order thinking. Although different theoreticians and researchers use different definitions of HOTs, generally they agree that higher-order thinking or learning means the ability to go beyond the information given, to inculcate a critical attitude, to have metacognitive intelligence, and to solve problems (McLaughlin & Luca, 2000). Numerous researchers (Lipman, 1991; Paul, 1993) have discovered that the most frequently occurring issues in the literature of higher-order thinking are independent thinking skills and moderate judgment qualities. Using Bloom's taxonomy as a key concept, Newcomb and Trefz's model (1987) considered four cognitive levels for HOTs: remembering, processing, creating, and evaluating. Different terminologies have been used to describe the thinking process: remembering and processing levels were identified as lower-order thinking, and creating and evaluating levels were categorized as HOTs (Edwards & Briers, 2000). The comparison of the conceptualization of Bloom taxonomy and Newcomb-Trefz's levels of learning model are exhibited in Figure 2.1.

Resnick (1987) stated that the characteristics of higher-order thinking: (1) involve non-algorithmic sequences, (2) include levels of complexity, (3) yield multiple solutions, (4) involve nuanced interpretation, (5) involve the application of multiple criteria, (6) include uncertainty, (7) involve a self-regulation thinking process, (8) involve imposing meaning, and (9) require effort to process or understand. All these aspects of the concept are a concrete definition of the phenomenon in human cognition. Collectively, HOTs "engage learners in ….discovery learning, reasoning, organizing, and argumentation" (Torf, 2003, p.253).

Whittington, Stup, Bish, and Allen (1997) believed that thinking critically means thinking at a higher level of cognition, which is an essential skill and must be reinforced in school. Cano and Martinez (1991) stated that students of vocational agriculture should be challenged "to develop stronger cognitive abilities and critical-thinking abilities at higher levels" through the instruction they receive, to support the importance of teaching thinking skills (p. 28). Additionally, there has been limited research in vocational and technical education about students' learning levels related to their cognitive behaviors (Cano & Newcomb, 1990).

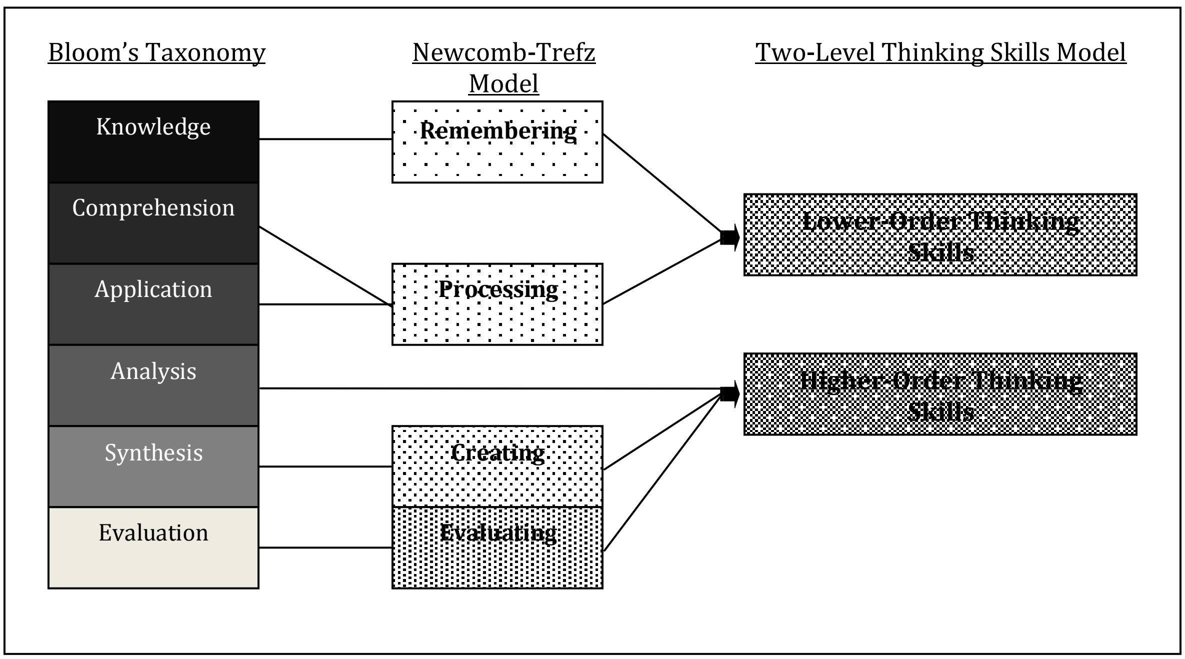

Figure 2.1: The comparison of the conceptualization of Bloom Taxonomy and Newcomb-Trefz's Learning Model, and a Two-Level Thinking Skills Model (from Whittington, 1995, p. 33).

In the revised version of Bloom's taxonomy modified by Anderson and Krathwohl (2001), the version is not hierarchal, but two-dimensional. They devised a chart consisting of cognitive processing skills (remembering, understanding, applying, analyzing, evaluating, and creating levels) and knowledge dimensions (factual, conceptual, procedural, and metacognitive) (Bailey, 2002; Cruz, 2003; Morris, Porter, & Griffiths, 2004). Additionally, Lorin Anderson, a former student of Bloom, has updated and considered a technological revision in this revised taxonomy in order to add relevance for 21st century students and teachers. The remembering level involves tasks such as using bullet points, highlighting, and using a search engine. Understanding is associated to Boolean searching "and" or "or". The applying level relates to using computer applications. In the analyzing level, a student can place links in a document or be able to validate their resources or material. Evaluating is demonstrated through blogging and posting to a social network application. Finally, creating involves programming, or publishing a document (Churches, 2008).

Metacognition in Higher-Order Thinking Skills

Metacognition has been defined in several different ways. According to Flavell (1979), who was the first scholar who defined this term, metacognitive means "knowledge and cognition about a cognitive phenomenon" (p. 29). He noted that metacognitive knowledge comprises three categories: knowledge of (1) person variables, (2) task variables, and (3) strategies variables. Knowledge of person variables involves general knowledge of how humans learn and process information. Knowledge of task variables is knowledge about the nature of the task. Lastly, knowledge of strategy variables consists of knowledge about when and where it is appropriate to use effective strategies (Flavell, 1979, 1987). The self-questioning approach is a common monitoring strategy to ensure that a learning goal is achieved. Metacognition refers to higher-order thinking, which includes active attempts through cognitive processes to control learning (Livingston, 1996).

In addition, metacognition has been defined as "thinking about thinking" (Blakey & Spence, 1990; Livingston, 1997) and applicable to facilitating students' abilities of "learning how to learn" (Argyris & Schon, 1978). Many instructional programs that have been designed for teaching higher-order thinking will include metacognition as a significant component. A study conducted by Scardamalia, Bereiter, and Steinbech (1984) used reflective processes to guide students writing compositions. Students learned how to analyze their thinking, to identify and clarify their problems at the planning stage, and to develop solutions. Schoenfeld's (1985) research on mathematical problem-solving ability focused on asking students questions. Students learned to monitor and direct their progress in order to solve problems. Adey and Shayer (1993) conducted a study of engaging metacognitive knowledge to promote higher-order thinking in which students learned to use verbal communication to explain, using what, why, and how type of questions. Students learned how to reflect on their thinking processes and to be aware of the difficulty stage. Next, students were asked to use their thinking skills in new situations. Using words to describe thinking and ideas is another form of metacognition (Zohar, 1999).

Another example of engaging metacognition is mentoring, as it permits metacognitive learning and self-reflection to expand in a cooperative teaching and learning relationship. Learning is promoted when students are aware how they are learning and understanding within a social context. Self-reflection drives to deeper thinking and shifts into deeper learning (Hine & Newman, 1996).

Teaching Methods and Strategies for Higher-Order Thinking Skills

The Malaysian Ministry of Education has encouraged teachers to implement new teaching and learning approaches to develop students' thinking, including constructivist learning, project- or problem-based learning, and critical inquiry. Through the transformation of the curriculum, elements of creativity and innovation, entrepreneurship, and ICT are taught to students (Wee, 2010). McKeachie and Svinicki (2010) discovered that educators gain new ideas about teaching from colleagues more than from workshops or reading. Ajzen and Madden (1986) suggested that educators should consider four matters if they want to make meaningful changes in responding to challenges in their teaching approaches/strategies: (1) to ensure a given goal can be met, (2) to realize how much control there may be on proposed changes, (3) to consider the outcomes of changing and how beneficial they will be, and (4) to analyze how others view the change. Numerous researchers (Dean, 1986; Gall, 1984; Lewis, 1999; Marzano, Pickering, & Pollock, 2001) have reported that questioning skill techniques can promote reflective learning and drive students to higher levels of academic achievement. Many teachers deliver course content through a lecturing mode; however, this instructional method is not sufficient for the best student learning (McKeachie & Svinicki, 2010).

According to Chickering and Gamson (1987), students must not only listen in the classroom, but they must also focus on reading, writing, discussing, relating information to previous experiences, and engaging in solving problem activities. Kerka (1992) believed that "learning is moving from basic skills and pure facts to linking new information with prior knowledge; from relying on a single authority to recognizing multiple sources of knowledge; from novice-like to expert-like problem solving" (p. 3). Furthermore, Johnson and Thomas (1992) introduced five general principles pertaining to teaching methods that could promote effective learning strategies:

1) Facilitate students' classification of their knowledge to make the information of working memory easy to understand; teachers may use concept maps, which visually represent concepts and relationships.

2) Build on what students already understand to aid them in the recognition and comparison of the difference between previous and current knowledge.

3) Help information processing to show problem-solving methods; teachers may select strategies with appropriate methodologies and facilitate thoughts about procedures.

4) Facilitate deep thinking through incorporation to improve student cognitive abilities; teachers may use to peer tutoring or pair problem-solving techniques to help students' learning.

5) Make thinking processes precise, using paragraph analysis and forecasting and summarizing for the future; teachers may demonstrate the appropriate intellectual procedures.

The above strategies show that the teacher's role in developing thinking skills is different from traditional teaching instruction.

Additionally, alternative assessment methods are very useful to prevent students from rote learning; an example would be open-book examinations focused on increasing students' problem-solving skills. Using open-ended problems can be linked with open-book examinations to evaluate the creative thinking and problem solving abilities of the students (Hang, 1997). Another common strategy can be used to assist students to develop HOTs is scaffolding (Lebow, 1993; Niederhauser & Lindstrom, 2006). Scaffolding strategy, developed by Lev Vygotsky (1978), has a support process for students in their learning and then gradually removes that support process as the students master the lesson. Rosenshine and Meister (1992) addressed six components in scaffolding that could promote higher-order cognitive skills of learners: "(1) presenting a new cognitive strategy, (2) regulating difficulty during guided practice, (3) varying the context for practice, (4) providing feedback, (5) increasing student responsibility, and (6) providing student responsibility" (pp. 26-32).

Based on a study conducted by Lerch, Bilics, and Colley (2006), Bloom's taxonomy has been applied successfully in a mathematics algebra class. Students were required to note their goals for the class and what they desired to learn. Then, they had to write what exact steps they planned to follow to achieve their goals in order to make students more aware of how they were learning. By analyzing their own goals, they noticed when and with what teaching methods they performed better. Additionally, students were asked to reflect on how they did and what they needed to do to attain a higher grade. All these required a skill of synthesis. Further reflection gave students the opportunities to assess the group project experience and how each performed as an individual member.

Questioning Techniques

Specifically, Bloom's (1956) six classification of thinking skills have become a standard for researchers to develop their questioning strategies/approaches. Teachers can evaluate students' understanding and readiness by lower-level types of questions. Nevertheless, higher-level types of questions stimulate students to think critically and to solve problems (Davis, 1993; Snyder & Snyder, 2008). According to Prichard and Bingaman (1993), students' achievement improved when teachers posed higher-order versus low-level types of questions. Students who are asked to synthesize and describe their thinking in their classes increased 75% in their understanding and retention of new information (Wolfe & Brandt, 1998). Various questions provoke different levels of thinking and effective educator questioning practices positively influence student learning. Open-ended questions with no specific prescriptive answers can generate the most complex responses and higher-order thinking. More complex questions use probing for learning. Probes can ask for specific applications, clarifications, or generation of examples or tasks. This type of question is more likely to reach beyond a yes-no answer, to have more than single answer, and to elicit a summary or synthesis (Davis, 1993; Kasulis, 1984).

Numerous researchers (Aschner, 1961; Bloom, 1956; Carner, 1963; Pate & Brener, 1967; Sanders, 1966) have conducted studies on how questions can be categorized into levels. The levels have been placed into a formation that requires students' use of complex processes to seek an answer. In Lewis's (1999), study she indicated that teachers interested in teaching for higher-order thinking were required to engage students in dialogue (see Figure 2.2). The development of teacher questioning skills is an essential aspect of promoting HOTs among students.

	Structured	Open-Ended
	Simpler cognitive abilities <-------------------------------> More complex cognitive abilities	
	Teachers dominate discussion	Students involve more discussion
Year	Researcher	Levels: Low to High
1956	Bloom	Knowledge – Comprehension – Application – Analysis – Synthesis – Evaluation
1961	Aschner	Memory – Reasoning – Evaluating or Judging – Creative thinking
1963	Carner	Concrete ----------------- Abstract ----------------- Creative
1966	Sanders	Memory–Translation–Interpretation–Application–Analysis–Synthesis—Evaluation
1967	Pate & Bremer	Convergent -- Divergent

Figure 2.2: Lewis's Levels of Question and Developing Questioning Skills (from Lewis, 1999, p. 4).

Another important questioning technique to develop students' HOTs involves teacher wait-time after asking a probing question (Carin & Sund, 1971). Students need time to organize their thoughts and generate a more complex answer. As suggested by Lewis (1999), teachers should increase wait-time to five seconds or longer for a student to respond. A research project conducted at Columbia University showed a positive outcome on students' learning when teachers increased their wait-time: (1) the classroom shifted from teacher-centered to student-centered, (2) teachers gave themselves an opportunity to hear and to think, thus increasing their flexibility, and (3) the number of questions students were asked and the number of generalizations required for answering questions accumulated (Carin & Sund, 1971).

Collaborative and Small Group Learning

Various names have been given to this kind of learning and there are some differences among them, including peer-to-peer learning, cooperative learning, collaborative learning, team learning, and study groups. Johnson, Johnson, and Smith (1991) created three types of group activity: formal learning groups, informal learning groups, and study teams. Formal learning groups can be used to teach students specific tasks and problem-solving skills and these small groups may last for one class period or several weeks. Informal learning groups are formed for one class session or one discussion. The purpose of the small groups is to engage students' attention on learning material content and to develop a participatory atmosphere for interactive learning. Study teams are diverse and long-term learning groups create a stable relationship during an entire course/class. The purpose of the study team is to analyze or synthesize each team member's ideas for solving problems or decision-making.

Students who engage in small groups are more likely to learn and retain information than in other instructional activities. In the collaborative process, students are able to engage in development work, to report progress, and to participate in intergroup collaboration, and these learning activities take place simultaneously (Nelson, 1999). Furthermore, small-group learning permits students to practice related course material using conceptual frameworks, hence, constructing a deeper level of content understanding (Kurfiss, 1988).

Mahiroglu's (2007) study in Turkey, on teachers applying HOTs using Project-Based Learning, demonstrated that there are many opportunities to require students in one's classroom to use HOTs and how teachers and students could grow in their thinking process. In Project-Based Learning, students have to analyze the resources and evaluate which are appropriate and relevant for their assignments. They synthesize the information and create a product. Then, they present the project to the class in order to get feedback from their peers and teachers. Through these activities, students would support each other and work cooperatively to accomplish project-learning goals and problem-solving tasks (Wilson, 1995). Project-Based Learning uses the learner-centered approach and engagement and can fulfill the demands of varied styles of learning. Additionally, it builds and heightens problem-solving skills, while promoting student creativity and active participation (Rogers, 2002).

Opportunities and Challenges for Teaching Higher-Order Thinking Skills

In today's technology-savvy society more than ever, teaching students to become effective thinkers is a recognized aim of education. This is to equip the students with lifelong learning and thinking skills that are essential to acquire facts and process information in an ever-changing world. As one of the functions of education is to supply a mindful workforce to society, it is important that thinking should be integrated in the educational curriculum. Basic knowledge alone is not sufficient to meet the demands of the workforce market in the future. A focus on thinking skills should be as important as other basic knowledge and skills such as reading, writing, science, and mathematics, etc. (Cotton, 2003). For many reasons, our educational systems should be concentrating on systematically promoting HOTs to our students. According to Purkey (1970), teaching thinking skills aids students to survive in their learning since (1) teachers can improve student proficiency in thinking by giving precise and clear instruction in various situations that require improved thinking, and (2) instruction in thinking provides students an awareness control over their thinking. Combined with the improved learning achievements resulting from such thinking, students develop a sense of self-confidence associated with those achievements in their learning.

Several studies (Hillocks, 2002; Marchant, 2004; Pennington, 2004) have reported that the majority of the teachers have been using rote memorization or drill. They assumed that this type of instruction is an efficient teaching approach. Sometimes, considering the demands of administrators, teachers have to forgo teaching actively and creatively to develop higher-order knowledge (McNeil, 1990).

Sparapani (1998) detailed six challenges that hinder higher-order thinking and learning in educational settings:

(1) Students do not have enough time for reflection, discussion, interaction, and providing feedback due to the short time of the class schedule.

(2) Student attitudes reflect the status quo of the classroom. Students are satisfied with the teachers asking questions and them answering the questions.

(3) Teachers' attitudes are a major issue because higher-order thinking requires more time, energy, and creativity to prepare challenging student learning activities.

(4) Sufficient resources must be provided. Both students and teachers will lack motivation if they receive limited or no resources.

(5) The classroom atmosphere directly reflects upon the students and a stimulating classroom can stimulate students' thinking and imagination, which can promote HOTs.

(6) Authentic assessment practices and learning can reflect students' current intellectually capacity. However, traditional objective-testing forms of assessment may not support creative thinking.

High-stakes examinations assess lower-order knowledge (e.g., recall, comprehension) instead of higher-order skills (Chudowsky & Pellengrino, 2003; National Academy of Education, 1997; Neil, 2003). Regularly, student successes or failures in higher-order learning are determined by a single high-stakes objective test, rather than reflective essays of perceptions of phenomena (Marchant, 2004; Pennington, 2004). Teachers often use previous examination questions or sample inquiries that are narrow in content and curriculum. Narrowing the curriculum leads teachers to focus on recalling fundamental information rather than in-depth understanding of concepts or causes and effects. Further, teachers are more likely to use such less-time-consuming instructional strategies as lectures or asking questions for taking notes, rather than engaging students in critical thinking, problem solving, and inquiry skills activities (Abrams & Madaus, 2003; Darling-Hammond, 2004). On top of that, teachers must be comfortable using whatever ICT tools and applications they are demonstrating and this might be a barrier as ICT is changing more rapidly than most people can keep abreast (Coleman, King, & Stary, 2001).

Finally, a few research studies (Bissell & Lemons, 2006; Martin, 1993) provide adaptive advice on teaching effective HOTs strategies; hence, teachers and students have had little help for planning and applying this type of thinking skill in their own teaching and learning context.

Information and Communication Technology Utilization in Promoting Higher-Order Thinking Skills

ICT has been shown to enhance and teach HOTs. Bransford, Brown, and Cocking (2000) pointed out that ICT could improve critical and creative thinking, information use skills, conceptualizing skills, and problem-solving skills. ICT can play dual roles, as both an important instructional tool and as an object that has influenced the political, social, and economic functioning of world society (Berson, 1996). These dual roles indicate that ICT should be integrated into educational curriculum and ICT has the potential to facilitate development of students' HOTs. Many studies on technology integration into educational curriculum give evidence that ICT promotes HOTs (Berson, 1996; Butler & Clouse, 1996; Ehman & Glenn, 1991; Fontana, Dede, White, & Cates, 1993; Harris, 1996; Hopson, Simms, & Knezek, 2001-2002; Lancy, 1990; Rooze & Northup, 1989; Ryba & Anderson, 1990; Shiveley & Vanfossen, 1999; Yaeger & Morris, 1995).

According to Means and Olson (1994), technology can "stimulate problem-solving and other thinking activities" when it is used successfully (p. 18). Kennedy (1994) explained how interactive computer programs are a positive influence on the development of HOTs. The purpose is to have students solve real-world problems instead of complete basic worksheets or simple assignments. ICT is often used to conduct research; however, it should be employed as a stepping-stone to the discovery of new relationships between ideas. Additionally, when a computer is used to its full potential, it can transform thinking and create new knowledge (Kallick, 2001). Baylor and Ritchie (2002) found that the level of constructivist modes of the technology uses dictated the impact of the technology on the higher-order thinking. It is apparent that ICT itself does not develop HOTs, but it needs to be used with pedagogical concepts in order to improve the HOTs.

Lewis (1999) claimed that students who used visual and auditory computer-based tutorials significantly improved their grades and interest levels for learning. Web applications can enhance recall of previous knowledge and the application of new information (Sexton, Raven, & Newman, 2002). Typically, teachers use face-to-face instruction with hands-on activities to develop students' technological literacy and proficiency and problem-solving skills (Fang & Yang, 1996). Nevertheless, ICT tools can be extensively used to deliver lower-level knowledge (e.g., memorizing facts and drill and practice) and higher-level thinking (e.g., creative thinking, synthesizing abstract concepts, and problem-solving skills) (Lin, 1995).

Green (2001) conducted a study to assess the effectiveness of the use of the wireless laptop at Latrobe High School. The findings showed that the use of ICT could stimulate the classroom climate and improve collaborative learning and inquiry learning among students. Another study conducted by Franklin and Peng (2008) explored the use of the iPod Touch, and math videos to eight grade mathematics students' at school located in Southeastern Ohio.

This study showed that the use of an iPod Touch helped middle school students learn about algebraic equations, the concept of slope, absolute value, and elimination. The development of math movies for use on the iPod improved the ability of students to present difficult concepts in a visual format.

In a study of Web-based instruction associated with hands-on activities to assess the growth and effect of students' problem-solving skills, Lee (2002) noted that problem solving was considered a practical teaching approach to enhance students' understanding of subject matter, learning motivation, and HOTs (Costello & Chapin, 2000; Hamil, 1997). In another study, Wenglinsky (1998) conducted research using learning games with computers to measure students' higher-order thinking and lower-order thinking skills. He noted that HOTs were correlated with simulation and application and drill and practice were considered in the dimension of lower-order skills. In a similar study done by the Cognition and Technology Group at Vanderbilt (1992), the findings showed that students who used the Jasper video software for mathematics instruction had improved problem-solving skills.

Many researchers (Davis, 1992; De Bono, 1994; Perkins, 1986) have supported instructional strategies on the Web, including brainstorming, semantic web, creative writing, and role-playing to promote HOTs for learners. This type of environment may inculcate learner risk-taking, disclosure, and idea experimentation. In the studies of English and Yazdani (1999) and Collis (1997) on computer assisted project-based learning, they agreed that ICT can support professional expertise and vocational skills, and this method of learning has been considered successful as an instructional strategy in many contexts. In this approach to learning, students are required to possess the following skills areas:

(1) Problem solving: Students need to demonstrate skill in using the Internet to seek information, and to select available resources that are relevant to an assignment/task, and to the interest, insight, and problem assessment skills of peer group members who collaborate to find a solution to an assignment/task.

(2) Collaboration: Students need to share the workload, share tasks, and maintain a tight schedule. These types of activities demand that student consider the requirements to be responsible, flexible, and adaptive.

(3) Peer evaluation: Students are required to assess information, to create criteria for completing a task, to view the scope of their inquiry, and to decide the directions in which they are going to work. Finally, students evaluate the learning outcomes of their peers.

(4) Personal Reflection on task and process: Students will be asked to maintain a reflective journal in which personal thoughts of progress of skills and competencies are recorded/written. Students reflect on the cognitive skills and skills they have applied, identify the skills that need to be developed, and develop learning goals that are carried over to a new next assignment/task. This order of learning reflection may provide a promising framework for the development of personal and process knowledge.

Online learning is the latest teaching medium being offered at many educational institutions. Hence, it is necessary for students to learn to communicate and be educated through websites or learning/course management system such as Blackboad, WebCT, Moodle, and others. Blogs offer a new way to communicate online and are being used in schools to encourage students to discuss various classroom issues. Blogging is found to promote those students who are too shy to participate in class (Wassell & Crouch, 2008). Additionally, YouTube provides a platform for people to post and share videos (YouTube, 2008). Teachers can use this technology to share their content material or resources with their students (Kupetz, 2008). It is suggested that teachers must relate and connect students' technology activities with their prior knowledge and interests. This will make the learning experience, and assignments more meaningful (ChanLin, 2008) and students will feel their personal needs are taken care of (Edmonds & Li, 2005).

ICT "can change teaching and learning by being a source of knowledge, a medium for transmitting content, and an interactive resource furthering dialogue and creative exploration" (Levin & Wadmany, 2008, p. 234) and should be a "partner in teaching and learning" (Levin & Wadmany, 2008, p. 251). The "interaction between teachers, students, and technology" need to be understood for ICT to be a positive influence (Levin & Wadmany, 2008, p. 237).

As the most important person in the classroom, teachers need to be aware that their role must shift from the traditional deliverer of knowledge to a facilitator who provides students with authentic and reflective activities. Teachers should consider how the new instructional technology could be utilized and integrated into their curriculum to engage their students in higher-order thinking activities. The most frequently cited factors associated with successful ICT integration in classrooms are knowledge, skills, attitudes, perceptions, beliefs and commitment (Dusick, 1998), gender, age and experience in using ICT (Wong, 2002), access to computer, ICT training experience and support (Abdul Razak, 2003).

Higher-Order Thinking Skills in the Malaysian Context

In Malaysia, the Minister of Higher Education revealed that approximately 30% of graduates from Malaysian public educational institutions were still unemployed during the year 2009 due to lack of creativity and soft skills (National Economic Advisory Council [NEAC], 2010). According to the President of Malaysian Association of Creativity & Innovation (MACRI), Datuk Ghazi Sheikh Ramli, the creativity of Malaysians is suppressed by the education system and a perceived need to follow Malaysian societal norms. He added that in more open global societies students could freely challenge the opinions of their lecturers and elders. In the formal Malaysian education system, teaching about thinking focuses on skills such as analysis and teaching students how to understand claims, follow or create a logical argument, find the answer, and focus on the correct answer. On the other hand, Harris (1998) suggested there was another type of thinking we should foster, one that focuses on exploring ideas, generating possibilities, and looking for many right possible answers instead of just one. Both types of thinking are important to a successful working life. Modern society demands that people incorporate and accommodate information from various resources and make judgments (Wilson, 2000).

Many attempts are being formed to nurture creativity and innovation through the Malaysian educational curriculum (Utusan Malaysia, 2008; Yong, 1993). Malaysian education has to be changed completely to enhance economic development based on creativity and innovation, asserted the Deputy Prime Minister of Malaysia, Tan Sri Muhyiddin Yassin (Zakaria, 2010). Further, the Prime Minister of Malaysia, Dato Seri Mohd Najib Tun Razak stated that Malaysia needs teachers who are creative, in addition to being committed and dedicated. Teachers must have a greater ability to adapt and improvise to keep their learners interested. Plus, they need to be multi-skilled and able to adapt and to impart knowledge effectively. He added that to teach thinking skills, teachers must know how to think, and "we do not want our children to learn by rote". Malaysia wants creative students who could formulate through power thinking (Bernama, 2011). As a result of these statements, Malaysian teachers are encouraged to apply pedagogies to promote creativity and students are encouraged to be innovative and creative with new ideas. Students are encouraged to participate in creative activities by permitting them to become conscious of the ways in which they think and learn. The new ways of thinking include trying to engage students in the teaching-learning process through assessment of what is taking place during the learning process (Rajendran, 2001).

The teaching of thinking skills in schools started in the 1990s and the teaching of thinking at higher-education institutions is considered to be a recent development. Malaysian universities have begun offering courses on thinking and teaching thinking in recent years, more evidently after 1998. Universities such as University Putra Malaysia, University

Malaya, Northern University of Malaysia, and more recently Sultan Idris University of Education have introduced these courses at the undergraduate level (Rajendran, 2008). In Malaysian polytechnic institutions, there is no course specifically developed for thinking or teaching thinking that has been offered; however, the elements of thinking skills are embedded in the polytechnic curriculum. Moreover, a few studies to investigate the teaching of thinking skills to prospective graduates of universities in Malaysia have been undertaken. Rajendran (2004) conducted one of the studies that had attempted to investigate the infusion of thinking skills into university programs.

A report on Malaysia's experience addressed the fact that teaching higher-order thinking helps students become independent learners and effective thinkers in order to meet stated educational goals. In Rajendran's study (2000), he revealed that there is the lack of ability among students to apply knowledge transferred through schools and classrooms to real-world problems. He discovered that "many students are unable to give evidence of a more than superficial understanding of concepts and relationships that are fundamental to the three subjects they have studied, or an ability to apply the content knowledge, they have acquired to real-world problems" (Rajendran, 2000, p.1).

Several related studies (Bourke, 2004; Chelliah, 2001; Lee, 1999; Taylor, 2001) on pedagogy that supports the promotion of thinking skills agreed that both teacher-centered and learner-centered approaches develop and promote HOTs; however, to develop independent learners, a learner-centered approach is more suitable. A learner-centered approach requires creative teaching, engaged learning, and a learner-centered curriculum. In Rajendran's

(2010) research findings, he concluded that there has to be a comprehensive review of educational programs and there have to be more explicit, systematic, and continuous efforts to infuse the teaching of HOTs into the educational curriculum. In another words, as reiterated by the Malaysian Prime Minister, in order to cope with the fast-changing world where new knowledge is being produced daily while old knowledge is being reorganized and redefined, to teach the children how to learn and how to think must be highly emphasized. They must be fully prepared with the skills that enable them to be good thinkers and lifelong learners (Abdul Shukor, 2001) and help the nation create a knowledge society and promote national knowledge and economic growth (Abdul Karim & Hashim, 2004).

Summary of the Literature Review

This chapter provided an overview of HOTs and ICT utilization in teaching and learning to promote higher-order learning among students. The main purpose for education is to develop the full potential of individuals in their capacity to serve society (Bowen, 1977). Many students have a limited ability to plan their own learning, to use metacognition about their own thinking, and to build effective learning strategies. Research has revealed that engaging students in active discussion can facilitate their retention of information, knowledge practice, and growth of HOTs. Educators need to stress the importance of involving students in discussion, encouraging students to construct their own meaning and judgments, and stimulating thinking in order to develop students' talents to the maximum degree possible. To promote optimum human learning, researchers have advocated higher-order thinking purposes for instruction, higher-order thinking activities, and teaching skills.

Educators are encouraged to utilize ICT and higher-order thinking strategies in a supportive environment. Studies indicated that many benefits of using ICT to teach students. ICT entails the method of teaching a lesson and the platform with which students create a task. Numerous researchers have believed that incorporating ICT into the curriculum can inculcate student problem-solving and HOTs in the process of searching and analyzing information sources and increase student ability in decision making. To ensure that ICT are practically and effectively utilized they must be implemented together with appropriate teaching and learning theories. Constructivist approaches which focus on learner/student-centered learning have long supported student engagement in the process of acquiring knowledge, and have looked for ways for teachers to become facilitators in the learning process, instead of being individuals who only dictate information. This approach seems to be a promising match for the ICT applications being developed today. ICT infusion and constructivist approaches provide a better utilization and integration of ICT into the classroom in an appropriate and effective manner, while giving the instructor the technology necessary to effectively design an instructional model that meets the requirements of a learner-centered emphasis.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter includes the research methods and procedures that were used in this study about Malaysian polytechnic lecturers' teaching practices with ICT utilization to promote HOTs. The chapter describes procedures for selection of the population and sample, research design, data collection, and the methods used for analysis of the data gathered.

Research Design

This research study was designed to explore and examine Malaysian polytechnic lecturers' teaching experiences and practices with ICT utilization to promote HOTs in their teaching. This study adopted a combination of quantitative and qualitative approaches to achieve its purpose. A mixed method design, as described by Creswell (2008), was used to answer the research questions. A mixed methods approach offers several strategies for research, depending on: (1) the sequence of the data collection methods, and (2) the degree of importance given to each method (Creswell, 2003). A concurrent nested strategy was chosen for this study. Qualitative and quantitative data collections were done concurrently, meaning that a particular sequence was not followed (e.g., qualitative data collection followed by quantitative data collection or vice-versa). It also means that the quantitative method is dominant in relation to the qualitative one (which is the embedded method) since the two address research questions in different ways (Figure 3.1).

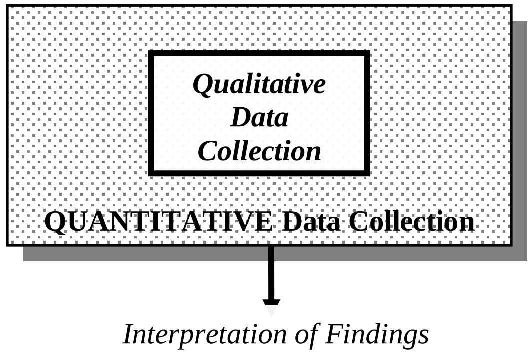

Figure 3.1: Concurrent nested mixed method strategy (adapted from Creswell, 2003, p. 241).

The quantitative approach gathered data about the teaching methods/approaches, teaching strategies, barriers, and the use of ICT to promote HOTs from Malaysian polytechnics lecturers. Quantitative data collection was employed using survey methodology, which allowed the data to be quantified and analyzed using statistical analysis (Gliner & Morgan, 2000).

The qualitative approach was utilized to further examine how Malaysian polytechnic lecturers use ICT to promote HOTs. The document analysis (of lecturer-made lesson plans) provided information and supported the quantitative result, of whether Malaysian polytechnic lecturers really put emphasis on promoting the development of HOTs in their classes. A careful analysis of selected lesson plans provided information on the teachers' experiences and practices. Additionally, lessons plans showed students' needs and demonstrated pedagogical practices. The design of the study is depicted in Figure 3.2.

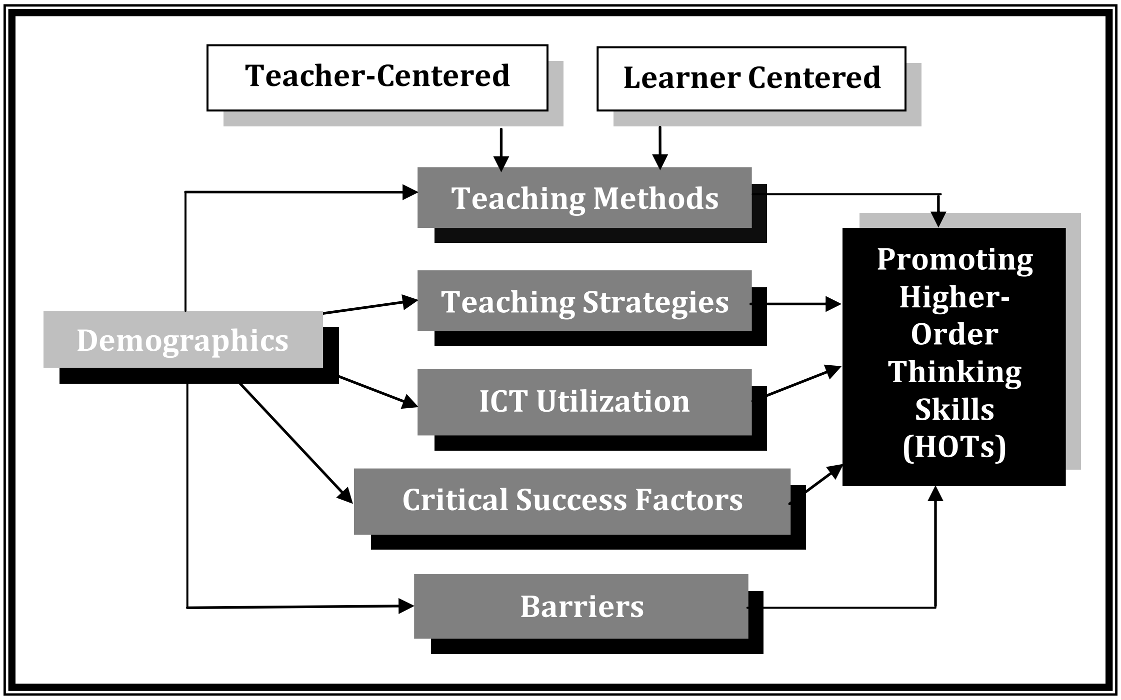

Figure 3.2: Design of the study.

Population and Sample

Polytechnic institutions are one segment in the Malaysian higher-education system that provides a tertiary level technical and vocational education and training. Polytechnics provide broad-based education and training to Malaysian high school leavers to enable them to acquire the necessary skills to be technical assistants and technicians in various engineering fields or middle-level executives in the commercial and service sectors. Polytechnics offer three-year diploma programs that require the Malaysian Certificate of Education (MCE) certificate as the entry requirement (UNESCO-IBE, 2006). All Malaysian polytechnics have similar admission requirements for students, with their admission application and offer processes centralized by Department of Polytechnics Education (DPE), Ministry of Higher Education, Malaysia (MOHE). At present, there are 27 polytechnics with 6,741 lecturers teaching polytechnic education programs throughout the country (Malaysian Ministry of Higher Education [MOHE], 2010).

For the purpose of the research study, the convenience sample was full-time Malaysian polytechnic lecturers who had taught polytechnic courses at three polytechnics – Polytechnic A, Polytechnic B, and Polytechnic C. All three polytechnics are located in the central area of Malaysia. While there are 27 polytechnic institutions in Malaysia, the selected three were chosen for convenience of the researcher due to time, logistical, and financial constraints. The use of convenience sampling was considered appropriate for the exploratory nature of the study (Zikmund, 2003).

Currently, there are 6,149 students enrolled in Polytechnic A, which was the first polytechnic built in Malaysia, 4,265 students enrolled in Polytechnic B, and 3,251 students enrolled in Polytechnic C. The full-time academic staff ranks were director, assistant director, head of department, senior lecturer, lecturer, and assistant lecturer. The academic staff population data provided by the Malaysian Ministry of Higher Education (2010) at Polytechnic A (589), Polytechnic B (384), and Polytechnic C (269) indicated that a total of 1,242 polytechnic lecturers teach engineering, technology, business, service and general education. The sample size in this research study was 389 Malaysian polytechnic lecturers.

Profile of Malaysian Polytechnic Lecturers

Malaysian polytechnic lecturers have academic qualifications and are well trained in their respectively technical disciplines, so they deliver quality education as well as accommodate changes and innovation in education (Wan Kamaruddin & Ibrahim, 2010). In the Malaysian polytechnic system, 57% of the lecturers are female while 43% are male. 56% of them held a Bachelors degree, 34% had a Masters degree, 9% are PhD holders, and only 1% had a basic (undergraduate-level) diploma (Malaysian Ministry of Higher Education [MOHE], 2010). For summary data about the lecturers who participated in this study, refer to the Demographic Information under Chapter 4.

Data Collection Methods

Survey on Malaysian Polytechnic Lecturers' Teaching Experiences and Practices

The research instrument was designed for cross-sectional survey methodology. It suited the purpose of the study to measure the experience and practices of the participants with ICT to promote HOTs in their teaching at a specific point in time. Moreover, a survey was an appropriate instrument because the information gathered was related to perceptual experience that should be examined directly from the participants' own responses (Fink, 2009). Additionally, a survey was cost effective since many questions could be asked to a large population in a short timeframe (Fink, 2009). Surveys are also defined as systematic attempts of collecting data through standardized questions that provide uniform definitions to and receive similar responses from the participants. Thus, the measurements can be more precise and aligned to the research questions. Using a survey helps ensure that comparable data will be collected and interpreted.

A survey instrument was employed for this research study (See Appendix B). Individual self-administered surveys were used as a data-gathering technique. It was important to design questions carefully to ensure that the survey was a useful measurement for the intended constructs of the study. Thus, the researcher adapted a combination of existing surveys (Croxall, 2002; Neumann, 2004) to develop the question set for this study. Using the existing validated surveys from previous research to develop the survey questions helped ensure that the desired constructs were adequately measured.

This study used surveys adapted from *Technology Survey for Family and Consumer Science Educator* (Croxall, 2002) and *A Survey of Higher-Level Learning* (Neumann, 2004). These two surveys were used because they were relevant to the purpose of this study. Croxall (2002) checked both the validity and the reliability of the scores generated by the instrument and determined Cronbach's Alpha; however, the statistic result was not reported. Croxall's instrument was used with teacher educators and their preparation of pre-service teachers. Neumann (2004) developed his survey based on literature in the field of higher-order learning and instructional practice. The survey instrument's content validity was made by literature support through systematic methods and procedures used for handling the data (Neumann, 2004).

An adaption of Bloom's taxonomy of learning objectives and constructivist approach were used as the key concept and theoretical background to create the survey used in this study. This survey exhibited a five-point Likert-type scale format with close-ended questions. It is divided into three sections areas addressing: (1) teaching methods, teaching strategies, and barriers, (2) the use of ICT in promoting HOTs in polytechnic courses, and (3) demographic information. An open-ended question requested a short description of lecturers' lesson plans where they used ICT to promote HOTs in their teaching and learning process.

Survey Content

This survey was organized into three sections based on the research and theory of learning and contained 75 items. At the beginning of the first section, a definition of terms (e.g., higher-order thinking skills) was provided to ensure that all participants understood the terms used throughout the survey. Section I was answered on a five-point Likert-type scale rated in the following manner: 1= not important; 2= minimally important; 3= moderately important; 4= important; and 5= very important. An option for not applicable (NA) was made available with the assumption that some of the participants could be unfamiliar to some of the practices. Section I included 32 items regarding Malaysian polytechnic lecturer experiences:

- A1-A6 asked for lecturers' feedback on factors that influence their teaching methods.
- B7-B20 examined the importance of teacher-centered and learner-centered teaching methods.
- C21-C28 related the importance of teaching strategies to promote HOTs.
- D29-D32 explored the barriers that lecturers might perceive to their promoting HOTs in their classes.

Section II was answered on a five-point Likert-type scale rated in the following manner: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, and 5= strongly agree. The NA= not applicable option was available for participants to indicate practices that might not apply to them. Section II included 36 items regarding Malaysian polytechnic lecturer practices with ICT utilization:

- Item 1 – Item 5 asked demographics-type questions on the lecturers' training in ICT and HOTs.
- Item 6 (Tools: a-f) and (Application: a-i) asked which hardware and software applications were used in their teaching to promote HOTs.
- Item 7(a-e) – Item 8(a-j) inquired what ICT support and training were received from institutions and what ICT practices promoted HOTs.
- Open-Ended Question requested lecturers to provide a short description of their lesson plan that requires HOTs: analysis, synthesis, or evaluation and use of ICT.

Section III consisted of seven items regarding lecturer demographic information and required checking off items.

Survey Development

The survey was intended to learn current teaching practices and ICT utilization, based on Malaysian polytechnic lecturers' self-reports. The paper survey was developed using Microsoft Office Word 2007 and was printed in a booklet form. The survey was 15 pages, including the cover letter (in English and Malay) printed on the first and second pages (See

Appendix B), with pages 3-13 having questions about teaching methods, teaching strategies, barriers, the use of ICT in promoting HOTs, and demographics. The last page was intentionally blank.

This study was conducted in Malaysia with polytechnic lecturers who were already teaching in a polytechnic environment. The organization of the survey instrument and some of the wording needed to be modified and changed in order for the questions to be applicable. The survey was prepared in two languages - English and Malay. The questions were incorporated on the same page with the English version before the Malay language version. The researcher translated the English version of the survey into a Malay language version and had two Malaysian native speakers check the accuracy and consistency of the wording. More importantly, experts from the researcher's dissertation committee also reviewed the survey. The researcher introduced the study to the participants with a cover letter (in English and Malay languages) to the Malaysian polytechnic lecturers completing the survey instrument.

Survey Administration

The study procedures were as follows:

(1) Formal approval for conducting the revised survey was obtained from the Director of the DPE (See Appendix D). Three polytechnics were included in the study. The number of participants depended on the current academic staff record list of the selected polytechnics. It was anticipated to contact approximately 700 lecturers and to receive about 350 participants.

(2) The researcher made an initial courtesy contact via a telephone call with the director or deputy director of three selected polytechnics to ask for willingness to participate in this study and sought assistance to increase the participation rates from their members. The purpose of the study and the confidentiality for participating in this study were explained. A final report of the study was offered as a token of participation to these three polytechnics. The researcher personally hand delivered the packet of surveys to the polytechnics and collected the surveys after completion in order to increase the response rate. A study by Brown (2008) indicated that personally hand delivered and collected surveys helped increase the response rate.

(3) The researcher contacted the liaison officers of the chosen polytechnics to explain the process and instructions related to the study once permission was granted to conduct the research from the director or deputy director of each polytechnic.

(4) The survey (See Appendix B) in a sealed envelope, the letter of introduction (See Appendix E and F), the supporting letter from the major professor (See Appendix G), and an envelope for the submission were distributed to lecturers during a scheduled meeting through their Head of Departments (HODs). Lecturers were informed that the purpose of the study was to explore their feedback on experiences and the use of ICT in promoting HOTs in their teaching classroom.

(5) Instructions in both languages on how to complete the survey were given and each lecturer was requested to put the completed survey in a provided self- adhesive envelope before he/she submitted it to his or her head of department. Return of the

survey implied consent of the participants. Participants were also assured that the results would be reported for group analysis; no individuals would be identified. It took approximately twenty to thirty minutes to complete the survey. The survey was given out during November 2011 and data collection lasted for six weeks.

Analysis of Existing Documents

Documents were included in this study, such as materials and/or records that would advance understanding of HOTs and ICT utilization practices in relation to the research setting and participants (Lincoln & Guba, 1985). Collecting data from documents needs minimal cooperation from persons within the setting being studied (Fetterman, 1989). Therefore, lecturer-made lesson plans were useful for document analysis. Lesson plan review provided further insight into how Malaysian polytechnic lecturers used ICT to promote HOTs into their course curriculum. According to Fielding and Fielding (as cited in Maxwell, 2005), the triangulation of data in this manner reduced the possibility of drawing false or misleading interpretations of the data.

Lesson plans are prior decisions about the teaching-learning process to be conducted in a given educational situation. Lesson planning is the initial step in the teaching-learning process in which teachers design their students' activities, and prepare and decide which methods and materials/resources will be employed in interactions with their students (Borich, 1988). When teachers plan a lesson, they have good background knowledge about the content, the learner, the standard, and the materials/resources to be utilized in the teaching-learning process. The lesson plans specify the overall process in the learning situation.

Lesson plans should specify not only the activities to be done but also solutions or options for possible problems and failures to carry out the activities as planned.

For the purpose of this study, lecturer-made lesson plans in engineering mathematics courses were collected. Analyses of these lesson plans facilitated understanding and descriptions of general Malaysian polytechnic lecturers' instructional practices and ICT utilization to promote HOTs in their teaching. Since there were five engineering mathematics courses in the polytechnic educational system, only three engineering mathematics courses (basic level, intermediate level, and advanced level of mathematics courses) were collected. These three levels represented variation in the course level and the increased complexity of the course content.

Presently, in the Malaysian polytechnic setting, for each engineering mathematics course level, there are two to four lecturers teaching the course. For document analysis, 35 lesson plans, from all the lecturers who taught these three engineering mathematics courses were obtained from the Quality Manager's office or the person responsible for quality in the 3 selected polytechnics. The copies of the polytechnic course lesson plans were kept at the Quality Manager's office and available for access/reference. The standardized course syllabus and lesson plan format provided by the DPE (2011) were used by all of the Malaysian polytechnic lecturers in all polytechnics courses. The format was very compact horizontally and indicated the specific components that needed to be carried out by both lecturers and learners. There were five components in a lesson plan: learning outcomes, content, teaching and learning activities, assessment techniques, and implementation status.

All the lesson plans collected closely followed the same structure; what varied were the course learning outcomes and content (e.g., basic level, intermediate level, and advanced level of mathematics courses). Other than that, the way the lecturers stated the content, the language they used to formulate the objectives, the procedures they followed, and the assessment techniques they applied were similar.

Why Engineering Mathematics?

Engineering mathematics courses were selected because the scenarios in mathematics teaching and learning today deal with routine procedural skills and basic concepts (Noor Azlan, 1987). Textbooks and worksheet schemes are important sources for teaching (Haggarty & Pepin, 2002). Teachers are still practicing a teacher-centered approach in mathematics classes. Teacher-centered learning approach is effective in transferring facts and prompting basic knowledge; however, it is not particularly effective in promoting students' higher-order thinking and problem-solving abilities (Amundsen, Weston, Abrami, & McAlpine, 2003).

According to Carpenter, Lindquist, Matthews, and Silver (1983), students consider their role in mathematics classes as passive since they spent much time listening to teachers lecture, seeing teachers solve problems on the whiteboard, and solving problems in textbooks alone. This type of teaching and learning environment can hinder the development of HOTs among students in mathematics education (Marzano et al., 1988). Similar scenarios also occur in Malaysian polytechnics. Almost half of the polytechnic engineering students who had average achievement in mathematics at the Malaysian Certificate of Education (MCE-certificate is an entry requirement for polytechnic institutions) find engineering mathematics very challenging. The current approach of lectures and tutorials has not been as successful as hoped. Polytechnic engineering students need to have a very good understanding of mathematics applications, as they are important in engineering work. Moreover, mathematics shapes the basis of analytical problem solving that is necessary in many technical-oriented work sectors.

The use of ICT in teaching and learning of mathematics has been one of the major challenges in the Malaysian education system. Teachers are strongly encouraged to utilize ICT to assist students comprehend major mathematical ideas and related concepts in-depth and to allow them to examine abstract mathematical ideas (Curriculum Development Centre [CDC], 2005). This emphasis is in agreement with the NCTM's Technological Principle (National Council of Teachers of Mathematics [NCTM], 2000). The attention on integrating ICT in the teaching and learning of mathematics is parallel with the goal of the mathematics curriculum, which is to develop individuals who are able to face challenges in work and everyday life concerning the advancement of science and technology (Curriculum Development Centre [CDC], 2005). Hence, ICT utilization is required to support students' focus on the mastering of mathematical concepts, reasoning, and knowledge instead of solely performing computing.

ICT tools have proven to be a very important aspect of the teaching-learning process. Various studies show that the students learning quality can be greatly improved when ICT tools are incorporated with teaching. Research has shown that ICT can serve as a tool to promote higher-level learning – for in-depth understanding of concepts and problem solving capacity (Abu Bakar, Tarmizi, Ayub, & Yunus, 2008). Promising ICT tools are supposed to add value to education and to support more effective pedagogy by providing knowledge for students and by enhancing communication that promotes students' HOTs and learning (Bakar & Mohamed, 2008). Thus, the engineering mathematics lesson plans were used and analyzed to study how polytechnic lecturers used ICT to promote HOTs in their teaching.

Pilot Study

The survey used in this research study was based on an initial pilot study conducted during October 2011. A pilot study refers to a small-scale version of a full-scale study and can also be the pre-testing or "trying out" of a particular research instrument (Baker, 1994). A pilot study was conducted to establish not only reliability, but also to identify defective items and get an idea of the expected response rate. This pilot test's purpose was to seek feedback on the clarity of statements in the survey, total time needed to complete the survey, and to test survey reliability and content validity before administering it to the actual study participants.

The survey instrument (See Appendix C) was pilot-tested to several different groups of experts to ensure they were understandable, readable, free of grammatical errors, and fulfilled the purpose of this study in the United States and Malaysia. First, two Malaysian doctorate graduates, who had experience working in Malaysian polytechnic institutions, reviewed the survey to ensure the questions were readable, easy to understand, and translations were accurate and carried the same meaning as the English version.

Second, two practitioners in Malaysian education system, one research methods expert and one leadership expert, reviewed the content and clarity of the survey instrument. Experts also were asked for suggestions about possible additional questions needed or to be removed. Finally, the survey was pilot tested with a group of 40 Malaysian polytechnic lecturers who were not a part of the sample used on the main research study. These lecturers were from Polytechnic D. The response rate for the pilot study was 75% (30 participants). Additionally, all participants in the pilot test were supplied with the Pilot Testing Evaluation Form (See Appendix H) to gain their feedback about the survey. Significant suggestions were incorporated to improve the quality of the survey in terms of content coverage, format, and content validity of the survey.

A reliability analysis was conducted and this analysis allowed for finding out to what extent the items in the survey were related to each other and for deciding which items to keep and to exclude. Cronbach's alpha, the measure of internal consistency, was used to determine the reliability of the measuring instruments (Gliner & Morgan, 2000). The reliability scales (Cronbach's alpha) for the seven subsections of the survey ranged from *.76* to *.94,* and *.93* for the overall scale (See Appendix I). The widely accepted Cronbach's alpha cut-off is that alpha should be *.70* or higher for a set of items to be considered a scale and established measures used in research (Nunnally & Bernstein, 1994). Since the obtained value was greater than *.70*, the survey showed good internal consistency for each subsection.

Based on the reliability test and to improve the Cronbach's alpha value, three items were dropped from the survey that was used in the pilot study: (1) Item 2: *Modeling other* *lecturer colleagues*, (2) Item 11: *Discussing course content with the classes*, and (3) Item 34: *Low expectations for lower achievers*. With the exclusion of three items in the survey, the results of the pilot study and the expert opinions proved the survey to be consistent with the research questions. Eventually, the survey was found to be valid and reliable.

Data Analysis

Quantitative Data

A total of 389 responses from three technical institutions provided the response rate of 56% were received in the study. The survey responses collected from the participants were coded, entered, and analyzed using STATA/IC 11.0 for Windows statistical package software. Data coding and entry followed the procedures recommended by Dilman (2007). “Not applicable” responses were coded as missing data. Data were cleaned and a frequency analysis was run to ensure that data were correctly coded.

Survey data were analyzed by descriptive and inferential statistical methods to answer the research questions. Descriptive analyses including frequencies, percentages, means, standard deviations, skewness, and kurtosis were used to summarize the distribution of the data. Inferential statistics, including an independent sample *t*-test, analyses of variance (*ANOVAs*), and *Scheffe post-hoc* comparison tests were performed for data analysis. The *.05* level of significance was used for inferential statistics. Classical assumptions (normality, homogeneity of variance, and independent sample) for parametric statistical tests were considered in this study, and most items were within a tolerable range for assuming a normal distribution (Tabachnick & Fidell, 2007). However, the normality assumption is less important, especially with large sample size (*N*=389) (Gravetter & Wallnau, 2009).

For differences in Malaysian polytechnic lecturers' perceptions of level of support and training and confidence level in promoting HOTs using ICT into their teaching practices, *t*-tests were used. The *t*-test was used to identify group differences. The groups were re-coded into low and high based on the average of all means for each survey item (Section II: Item 8a – 8j) as an independent variable. The independent variable was whether the lecturers used ICT to promote HOTs. The dependent variables were: (1) whether the lecturers had enough ICT support and training (Section II: Item 7a – 7c) and (2) if the lecturers felt confident using ICT (Section II: Item 7d – 7e) (See Appendix B).

The importance of various teaching methods, teaching strategies used to enhance HOTs, critical success factors, and barriers faced to promote HOTs were answered by computing means and standard deviations to determine the highest and lowest scores.

Differences existing in Malaysian polytechnic lecturers' perceptions of the factors that influence their teaching practices to promote HOTs based on demographic factors (gender, years of academic service, age, academic degree, and institution) were tested using *t*-tests and one-way analyses of variance (*ANOVAs*). The demographic items were the independent variables and lecturers' responses (teaching method, teaching strategies, critical success factors, and barriers) for promoting HOTs were the dependent variables. A *t*-test for independent means was used to compare the mean scores between two groups (gender and years of academic service). All other differences were determined using one-way *ANOVA*.

Scheffe multiple comparison test to determine which groups differ from the others followed all significant ANOVAs. The *.05* level was used for all *t*-tests, *ANOVAs*, and *Scheffe* multiple comparison tests.

Qualitative Data

This part of the data collection sought the views of Malaysian polytechnic lecturers on the use of ICT to promote HOTs. The purpose for having document analysis (lesson plans) and one open-ended question in the research survey was to obtain a clearer and deeper understanding of what was really going on and how Malaysian polytechnic lecturers use ICT in their teaching practices for promoting HOTs in the participating institutions. Moreover, this type of data played the role of validity check of the responses given by the research participants (Schuman, 1970). The qualitative data contributed to a greater understanding of the survey findings in this study.

Analysis of Existing Documents and Open-Ended Question Data

The lecture-made lesson plan documents were in English format. Since the open-ended question responses were in Malay language, the data needed to be translated into English. Verification of data was done in several ways. First, an individual fluent in both languages validated the translated data with the open-ended question responses. Second, a different individual, also fluent in both languages, reviewed it and ensured accurate translations. Finally, all qualitative data (lesson plan documents and open-ended question responses) were coded by level of HOTs and were analyzed pertained to the element of

HOTs level and the use of ICT. The researcher invited a third party to triangulate the data to increase trustworthiness. Themes and codes were agreed upon for use during the analysis (Creswell, 2008). A total of 42 out of 70 open-ended question responses and 35 lecturer-made lesson plans (14 from Polytechnic A, 10 from Polytechnic B, and 11 from Polytechnic C institutions) were used and further analyzed in this research study.

Support for Validity and Reliability

Several strategies to support the validity and reliability of the scores generated by the survey have been mentioned under data collection methods section. Examples of such efforts were: (1) expert review, (2) consistency of survey administration, and (3) pilot study.

Table 3.1: *Reliability Coefficients for Subsections*

Subsection	**Cronbach's Alpha**	***N* of Items**	***N* of Cases**
Critical Success Factors	.722	6	389
Teaching Method	.857	14	389
Teaching Strategies	.852	7	389
Barriers	.709	3	389
ICT Support and Training	.805	3	389
ICT Confidence Level	.722	2	389
Use of ICT	.950	10	389

Moreover, reliability of the final survey (See Appendix B) used to collect the data was measured using Cronbach's alpha internal consistency test. The instrument was tested in its entirety and the seven individual subsections of the survey were tested independently (See Appendix J). The Cronbach's alpha for the seven subsections scores ranged from *.71* to *.95,* and *.93* for the overall scale, indicating a moderate to excellent internal consistency of the scales (Tabachnick & Fidell, 2007). Table 3.1 provides the Cronbach's alpha coefficients for the each subsection.

Protection of Human Participants

The Iowa State University Human Subjects Institutional Review Board reviewed and approved the research study proposal before data collection started. This process ensured the participants' health, rights, and safety was protected (See Appendix A). To ensure the participants were free from risks or discomfort, the cover letter to participants explicitly explained the purpose of this study and assured confidentiality of their responses (See Appendices E and F). The researcher completed the Human Subjects Research Assurance Training by Iowa State University on May 21, 2009.

Summary

The study involved lecturers in three selected polytechnic institutions in Malaysia. The purpose was to determine from a selected group of Malaysian polytechnic lecturers' experiences how much emphasis they placed on teaching students to use HOTs while using ICT in the classroom. The selected three polytechnics were chosen for convenience of the researcher due to time, logistical, and financial constraints. Data collected from the study survey were analyzed using descriptive statistics (frequencies, percentages, means, standard deviations, skewness, and kurtosis) and inferential statistics (*t*-test and one-way *ANOVA*). Additionally, open-ended question data analysis and lecturer-made lesson plans were used for document analysis to supplement the quantitative findings.

CHAPTER 4: FINDINGS OF THE STUDY

This chapter presents the findings of the study under two sections: (i) descriptive information about participants' profiles and ICT utilization, and (ii) findings related to the research questions. The purpose of the study was to investigate Malaysian polytechnic lecturers' teaching experiences and practices with ICT utilization to promote HOTs and to determine how much emphasis they were able to place on teaching students to use HOTs while using ICT in the classroom.

The surveys were sent to 700 lecturers at three polytechnic institutions in Malaysia. A total of 389 completed surveys were kept for analysis, resulting in a 56% return rate. Table 4.1 presents participants' return rate from the three polytechnic institutions; all three participating institutions in central Malaysia had response rates above 40%: Polytechnic A with a 63%, Polytechnic B with 53%, and Polytechnic C with a 45% valid response rate respectively.

Table 4.1: *General Response Rate*

Institutions	Surveys Sent	Surveys Returned	Valid Percent (%)
Polytechnic A	300	189	63%
Polytechnic B	250	132	53%
Polytechnic C	150	68	45%
Total	700	389	56%

The existing documents (lecturer-made lesson plans of three engineering mathematics courses) and the responses of the open-ended question on survey were analyzed alongside the findings of the statistical analysis to elucidate the major findings. Seventy written responses were received but only 42 were used for analysis purposes. Written responses were not used if it did not relate to ICT and did not demonstrate HOTs elements. Meanwhile, thirty-five lesson plans of three engineering mathematics courses (14 from Polytechnic A, 10 from Polytechnic B, and 11 from Polytechnic C) were obtained and further analyzed in this research study.

Participants' Profile and Information and Communication Technology Utilization

Section III of the survey instrument (Appendix B) contained seven items: gender, age, highest academic degree, academic rank (position grade), years in academic service, academic department, and institution. As shown in Table 4.2, of the 389 participants, 65.3% (*n* =254) were female. This figure is almost similar to the percentage of female lecturers at all Malaysian polytechnic institutions. The largest participant group of lecturers was within the age range of 25-35 years, with 60.15% (*n* = 234), and the smallest group was above age 55 with 0.51% (*n*=2). Concerning the academic degree levels of polytechnic lecturers ranged from diploma level to doctorate degree, the largest participant group was in the bachelor's group with 52.7% (*n*=205), and the smallest group was pursuing doctorate group with 0.77% (*n*=3). For academic rank, the largest participant group was the lecturer (DH41 grade) with 66.84% (*n*=260), and the smallest group was a senior lecturer (DH54 grade) with 0.26% (*n*=1). Participants were asked to state the number of years they have been teaching as polytechnic lecturers. Forty-two percent (*n*=165) of the lecturers, who formed the majority, have been teaching for 1 to 5 years, while 28.5% (*n*=111) have been teaching for 6 to 10 years, and 19.8% (*n*=77) between 11 and 15 years. There were 5.7% (*n*=22) participants with teaching experience within 16 to 20 years and 3.6% (*n*=14) indicated they have been teaching for over than 20 years. Lecturer distribution by teaching experience analysis showed that participants had relatively little teaching experience. The academic departments were categorized into nine areas. Participants were requested to indicate the department in which they teach. The largest group of participants belonged to the Mechanical Department (25.35%, *n*=99), while the smallest group was the participants who taught in Aircraft Department (1.54%, *n*=6). These numbers were proportional to the actual number of polytechnic lecturers in each department.

Section II of the survey instrument (See Appendix B) contained six items: computer skills, ICT training prior graduation from college and since becoming a lecturer, HOTs-related courses and training, and type of ICT tools and application in their teaching. The majority of participants (more than 95%) reported their computer skills were average (44.7%) or advanced/very advanced (51.2%). Several questions focused on the ICT training were asked. Seventy-eight percent of participants reported that they were required to take an ICT course prior to graduating from university/college. More than 80% of them took ICT related training, courses, workshops, seminars, or online sessions since becoming a lecturer. The majority of participants (55.5%) reported taking one-to-two classes, course, training, workshop, etc., 31.4% have taken three-to-five classes, and 13.1% have taken six or more. Furthermore, the participants were asked about their HOTs-related training, courses, workshop, or seminars since becoming a lecturer and, interestingly, most of the participants (61.7%) responded “No”.

Table 4.2: *Demographic Characteristics of Participants*

Characteristics		**Frequency (*n*)**	**Percentage Response (%)**
Gender			
	Male	135	34.70%
	Female	254	65.30%
Age			
	Below 25	22	5.66%
	25 – 35	234	60.15%
	36 – 45	104	26.74%
	46 – 55	27	6.94%
	Over 55	2	0.51%
Academic Degree			
	Diploma	19	4.88%
	Bachelors	205	52.70%
	Pursuing Masters	6	1.54%
	Masters	156	40.10%
	Pursuing Doctorate	3	0.77%
Academic Rank (Position Grade)			
	DH28-DH36 (Assistant Lecturer)	25	6.43%
	DH41 (Lecturer)	260	66.84%
	DH44 (Senior Lecturer)	79	20.31%
	DH48 (Senior Lecturer)	22	5.65%
	DH52 (Senior Lecturer)	2	0.51%
	DH54 (Senior Lecturer)	1	0.26%
Years in Academic Service			
	Below 5 years	165	42.42%
	6 – 10 years	111	28.53
	11 – 15 years	77	19.79
	16 – 20 years	22	5.66
	Over 20 years	14	3.60
Department			
	Commerce	34	8.74%
	Civil Engineering	31	7.97%
	Electrical Engineering	57	14.65%
	Mechanical Engineering	99	25.45%
	Aircraft Maintenance	6	1.54%
	Information Technology	43	11.05%
	Tourism & Hospitality	18	4.63%
	General Studies	53	13.62%
	Mathematics, Science & Computer	48	12.34%
Institution			
	Polytechnic A	189	48.59%
	Polytechnic B	132	33.93%
	Polytechnic C	68	17.48%

Other concerns not specifically covered by the research questions include the types of ICT tools and applications polytechnic lecturers and their students have been used in the classroom. Data regarding types of ICT use in lesson preparation and classroom teaching and learning are presented in Table 4.3. ICT tools used by participants were computer/computer-assisted instruction (57.3%), followed by a computer networking system (53.5%). These findings are consistent with student requirements; students were required to use computer/computer-assisted instruction (51.7%), followed by a computer networking system (51.9%).

Table 4.3: *Types of ICT Utilization in Teaching and Learning*

Type of ICT	**Used by the lecturer (%)**	**Required of the students (%)**
Tools		
Digital Cameras/Scanners	38.3%	29.6%
Video Conferencing//Telecommunication	23.9%	18.8%
Simulation Machine/Smart Board (Interactive White Board)	28.8%	20.6%
Computer/Computer Assisted Instruction (CAI)	57.3%	51.7%
Computer Networking System	53.5%	51.9%
Applications/Software		
Desktop Application (e.g., Word, Excel, Publisher)	75.6%	65.1%
Databases (e.g., Access)	47.8%	30.9%
Presentation Software (e.g., Power Point, etc.)	76.4%	69.6%
Hypermedia/Multimedia Software/Web Design	44.5%	37.5%
Internet	73.3%	70.7%
Course/Campus Management System (e.g., Blackboard, WebCT, Angle, etc.)	47.1%	40.1%
Media Communication (email)	69.7%	60.7%
Web 2.0 (Blog, Wikis, YouTube etc.)/Social Networking (Facebook/Twitter)	54.8%	54.5%

In terms of specific applications or software, the following applications/software was reported as used by over 50% of participants: Presentation Software (76.4%), Desktop

Applications (e.g., Word, Excel, Publisher) (75.6%), the Internet (73.3%), Media Communication (69.7%), and Web 2.0/Social Networking (54.8%). Students who were required to use the Internet were 71% of participants, Presentation Software were 69.6% of participants, Desktop Applications (e.g., Word, Excel, Publisher) (65.1%), Media Communication (60.7%), and Web 2.0/Social Networking (54.8%) of participants.

Research Questions Addressed

The following analyses of quantitative and qualitative findings are reported for the five research questions that guided this study. Data are presented in narrative and tabular forms. For the quantitative findings, a Likert-type scale was used; the individual survey items that showed significant differences in means were followed by *Scheffe* multiple comparison tests to determine where the differences existed. Categories and themes in line with the focus of this research study and research questions were developed to make meaning of the qualitative data obtained through open-ended survey question responses and existing documents (lecturer-made lesson plans).

***RQ 1*: How do Malaysian polytechnic lecturers perceive: (a) level of support and training and confidence level in promoting HOTs using ICT and (b) the use of ICT to promote HOTs in their teaching-learning process?**

Quantitative Findings

The independent variable was whether the Malaysian polytechnic lecturers utilized ICT to promote HOTs. The variable was the average of all means for each item from question 8 *(8a-8j)* in Section II of the survey (See Appendix B). For interpretation purposes and in accordance with the Likert scale used in the survey, the independent variable - lecturers' ICT utilization to promote HOTs - was subsequently divided into two categories/groups representing high and low ICT utilization:

(1) High: Lecturers with a high ICT utilization were those whose ratings among the items related to HOTs averaged at least 4.0.

(2) Low: Lecturers who in the low level of ICT utilization were those whose ratings among the items related to HOTs averaged less than 4.0.

For the purpose of this study, two categories/groups (high and low) were used for the comparison. These two categories/groups were used to better answer the research question and to see if there was a difference between a high and low group of polytechnic lecturers' use of ICT to promote HOTs.

The dependent variables were: (1) whether the lecturers had enough ICT support and training and this was the average of all means for each item from question 7 *(7a-7c)* in Section II of the survey, and (2) whether lecturers felt confident to use ICT and this was the average of all means for each item from question 7 *(7d-7e)* in Section II of the survey (See Appendix B).

The *t*-test was used to compare the lecturers' ICT utilization to promote HOTs between high and low groups (independent variable) on each dependent variable (level of support and training and the lecturers' confidence level). Findings of the *t*-test, as shown in Table 4.4, indicate that there were significant statistical differences regarding the mean scores between the two groups (level of support and training *t* (387)= -4.33, *p*<.05 and the lecturers' confidence level *t* (145.2)= -6.33, *p*<.05). The high group had higher scores on both instances with mean agreement scores of 3.3 (*SD*=0.83, *n*=283) and 4.4 (*SD*=0.52, *n*=283) compared to the low group who had mean agreement scores of 2.9 (*SD*=0.78, *n*=106) and 3.9 (*SD*=0.74, *n*=106) for level of support and training and the lecturers' confidence level, respectively. The high group were relatively neutral in the extent to which they thought there was support and training and they indicated more agreement with the statement about their own confidence level with the mean score above 4.0 (*agree*). Meanwhile, the low group disagreed with the statement that there was support and training, but interestingly, they had relatively high agreement with the statement about their own confidence level with the mean score above 3.5.

Table 4.4: *Comparisons between High and Low (use of ICT to promote HOTs) groups' perceptions about level of support and training, and lecturers' confidence level*

Variables	**ICT Utilization to promote HOTs**						
	Low (*n*=106)		**High** (*n*=283)		***t* value**	***df***	***p* value**
	Mean	***SD***	***Mean***	***SD***			
Level of Support and Training	2.9	0.78	3.3	0.83	-4.33	387	***<0.00****
Lecturers' Confidence Level[a]	3.9	0.74	4.4	0.52	-6.33	145.2	***<0.00****

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*****= *p* <.05 (two-tailed tests)
Scale for items: 1=*Strongly Disagree*, 2=*Disagree*, 3=*Neutral*, 4=*Agree*, 5=*Strongly Agree*

In both instances, the difference was in favor of the high group. The high group perceived level of support and training and confidence level in promoting HOTs using ICT as higher than the low group did. Thus, it seems that perceived level of support and training and the lecturers' confidence level influenced polytechnic lecturers' use of ICT to promote HOTs in their teaching and learning.

Qualitative Findings

Responses to the Open-Ended Question. Data were coded and analyzed according to the course the participants mentioned and by the levels of HOTs and the use of ICT. As presented in the survey (See Appendix B), one open-ended question was asked: "*In brief, please describe one of your best lesson plans that have shown the use of ICT (if any) in your teaching to promote higher-order thinking skills (analysis, synthesis, and/or evaluation).*" There were eight examples of a lesson in Mechanical Engineering, six examples in Civil Engineering, eight examples from Electrical Engineering, eight lessons from Information Technology, eight from General Studies, three from Tourism and Hospitality studies, and one from Commerce studies. Data regarding frequency of the analysis of 42 open-ended survey question responses based on the levels of HOTs and the use of ICT are presented in Table 4.5. For the complete list of all 42 open-ended survey question responses and lesson plans of three engineering mathematics courses, refer to Appendix L.

Table 4.5: *Frequency of the Analysis of Open-Ended Survey Question Responses*

Category	**Total**	**Percentage**
Analysis	40/42	95%
Synthesis	35/42	83%
Evaluation	35/42	83%
ICT Utilization	42/42	100%

Higher-Order Thinking Skills. The written examples of a lesson (from the open-ended survey question responses) were categorized according to the levels of HOTs. To be included, the written example of a lesson had to demonstrate HOTs elements (analysis, synthesis, and evaluation), as discussed below.

Analysis: In this category, the written examples of a lesson had to demonstrate the use of comparing and contrasting ideas, relating between concepts, and proving a theory. Students gather data and decipher the meaning of the information (Huitt, 2011). The following pieces of course lesson require the skill of analysis.

- Mechanical Engineering (*Packaging Design*): The students are required to work in a 'designer team' and they have to seek information through the Internet to get some ideas of new packaging design/products. They need to analyze information gathered as to whether it complies with packaging concept and principles from the class.
- Civil Engineering (*Environmental Sciences*): Students will be given a case study (using a block of buildings in the polytechnic). Students have to study the impact and the effectiveness of sun-shading devices in that building block at three different times (morning, afternoon, and evening) through analyzing the form of shadows (if any).
- Tourism and Hospitality (*Excellent Hospitality & Customer Service*): Students need to analyze information from online articles and identify values required in the

customer service area. They have to analyze using the method of an end-of chapter problem.

- Information Technology (*Programming Fundamentals*): Students will be given one problem, and they have to analyze that problem. Then they are required to produce one algorithm and pseudo code before developing one computer program.
- Electrical Engineering (*Occupational Safety and Health [OSHA]*): Students are required to find articles about OSHA. They have to analyze and state their views and comments with reasonable arguments based on the OSHA principles they have learned in class.

Synthesis: Huitt (2011) explains that synthesizing includes designing a presentation or project, creating or combining ideas, or hypothesizing a proposal. Students compile and use information to propose ideas/solutions. Examples of the pieces of course lesson plans are:

- Mechanical Engineering (*AUTOCAD Drawing*): Students are given a product, and they have to draw in the CAD design form (solid model) with precise measurement. The end product will be in the engineering drawing form.
- Civil Engineering (*Environmental Sciences*): Students are required to take photos, draw, and write the findings of the form of shadows. In a group of three or four, students have to discuss the advantages and disadvantages of sun-shading devices in terms of functional, practicality, and aesthetic values.

- Electrical Engineering (*C++ Programming*): Students are required to develop a medium-size computer program that will include consideration of the programming concepts and SDLC cycle that they have learned in class.
- Civil Engineering (*Engineering Science*): Students have to prepare a precise and concise report regarding one principle that they have chosen. For example: Archimedes's principle. They need to elaborate what Archimedes's principle is and explain how it is applicable in everyday life and more.

Evaluation: Students judging or critiquing issues/ideas/work in order to justify their answers or applying standards such as a rubric to assess information. Students must justify and defend their answers by making judgments about information and the validity of ideas (Huitt, 2011). Examples of course lesson where students need to use evaluation are:

- Mechanical Engineering (*Project Management*): Students need to apply the concept of *PLAN-DO-CHECK-ACTION* in completing their final project design.
- Tourism and Hospitality (*Excellent Hospitality & Customer Service*): Students need to be able to justify their thoughts and suggestions on how to solve certain problems or situations using an end-of-chapter problem method. Evaluation through a reflective journal.
- General Studies (*Communicative English*): Students watch a video on a current issue. Then they share their opinions on Facebook. In class, students will have the discussion on that particular issue, which helps students speak, and generate and justify ideas among themselves.

- General Studies (*Communicative English*): They should be able to support the importance of their own surveys through literature review and to ask valid questions to obtain data from other polytechnic students.
- Electrical Engineering (*Industrial Safety*): Students are required to justify their opinions on how a particular industry/company practices the concepts of safety, based on their practical industrial experiences.

ICT Utilization. ICT and HOTs are combined in the course lesson plan. The following examples of lessons (from open-ended question responses) show where the students used ICT to promote HOTs:

- Civil Engineering (*Forestry and Forest Product*): Students need to use the Internet to gather information regarding forest products such as pulp and paper technology. They have to create a short video clip with duration of 5 to 10 minutes using Video Maker software and publish it via YouTube. The video is to summarize information that they have found via the Internet.
- General Studies (*Communicative English*): There is an assessment called a 'Reaction Paper'. Students need to write a response based on the videos uploaded by the lecturer or other students in the form of comments on the course's Facebook wall. They need to share their opinions on the issues brought up for discussion.
- General Studies (*Communicative English*): Students are assigned to search topics and do a literature review from the Internet for their project survey. They also

need to use IT tools to present in PowerPoint and to provide valid source citations from the Internet.

- Mechanical Engineering (*Industrial Robotics*): Students are required to come up with their own robotic design based on the criterion given to them. They need to seek and analyze the latest design and technology using the Internet and YouTube. They have to synthesize the information collected, and write and present reports on their project using 3D drawing AUTOCAD or Inventors.
- Civil Engineering (*Building Services Drawing*): Students are required to draw a house floor plan and analyze it. Then, students will equip it with the piping, electrical, and water systems. Students are asked to design it using CADD drawing software. Then, students need to explain and rationalize the system that they have designed, using PowerPoint.

In summary, the analysis of the open-ended survey question showed that Malaysian polytechnic lecturers established a supportive classroom environment and achieved higher student progress by improving their students' HOTs within their teaching and learning process. Furthermore, they identified themselves as having ICT skills and a significant level of computer competence. Malaysian polytechnic lecturers pointed to the importance of collaborative learning methods, not only between students, but also between lecturers. These were viewed to impact the development of students' HOTs while using ICT.

As part of their answer to the open-ended question, variations in teaching methods, choice of instructional materials, and the level of professional practice with regard to both

ICT knowledge and skills and their understanding of HOTs were identified. This shows the difference between well managed and effective classrooms where students reached the HOTs outcomes and those classrooms where ICT use was minimal and students learned at the lower level of HOTs.

Existing Documents (Lecturer-Made Lesson Plans). All components in a standard lesson plan (learning outcomes, content, teaching and learning activities, assessment techniques, and implementation status) were found in lecturer-made lesson plans for three engineering mathematics courses. Furthermore, the analysis demonstrated that most of the learning outcomes used key words (performance terms) for critical thinking, which are foundational for the development of HOTs. The analysis of the lesson plans for three engineering mathematics courses (thirty-five lesson plans) produced certain themes in relation to the use of ICT to promote HOTs.

The findings are presented under each identified theme. These themes emerged from the data analysis, which was aligned with the purposes of the study and literature review. The themes are described and discussed based on the researcher’s interpretations and current literature.

ICT Tools and Resources. The polytechnic mathematics lessons have utilized ICT, including both hardware such as computers and calculators, as well as education-related software (e.g., computer-assisted learning, course management systems, and learning packages). These have the potential to enhance students’ understanding of mathematics concepts, provide visual representation, and make complex calculation easier. Presentation software such as PowerPoint, laptops, LCD projectors, and whiteboards were used to present the lectures. These ICT tools in the polytechnic learning environment exposed lecturers to using technology in their teaching and at the same time promoted mathematical reasoning and HOTs learning among their students.

Lecturers' ability to choose appropriate ICT tools is an important component of the success of effectively integrating ICT into classroom teaching. Haughland (2000) wrote how ICT is used is more important than if ICT is used. However, the analyzed data only provided minimal information to what extent the ICT is being integrated in mathematics lessons in polytechnics education. The lesson plan data showed that the lecturers apparently recognized the usefulness of ICT in their mathematics lessons. They were striving to use ICT where it is appropriate and where it enhances learning, but whether they definitely monitored or assessed the outcome on progress is unsure. How can we equip polytechnic lecturers with the knowledge for selecting the appropriate software and relevant ICT tools that will encourage students to think mathematically and promoting HOTs? These are questions that need immediate attention.

Higher-Order Thinking Skills. From the analyzed lesson plans, polytechnic mathematics lecturers generally provide opportunities for their students to apply existing knowledge to generate new ideas, products, or processes. Students solve problems and construct basic mathematical concepts. Nevertheless, the analyzed data also suggests that mathematics teaching in a polytechnic depends more on rote and procedural knowledge acquisition. With this type of learning, students only need to memorize and practice routinely without a much deeper understanding of mathematical concepts. With rote and procedural skills, if students do not practice frequently, the knowledge learned may be easily forgotten, compared to the knowledge obtained through in-depth understanding (that goes beyond rote/recall and procedural knowledge/skills).

To promote HOTs among students, teaching should consist of various components such as problem-solving strategies, reflective thinking, and active learning. According to Howell and Dunnivant (2000), factual and procedural skills are critical and provide a basic level at a learning stage, with each progressive level of learning building upon all lower levels. However, solely focusing on memorization and drill-and-practice is inadequate for students to move on to higher-level learning. Polytechnic mathematics lecturers could figure out where it is appropriate to introduce students to more advanced concepts and provide the learning of connections between facts and concepts, which will not only open students' mathematical thinking but also give students opportunities to apply the knowledge they have learned in the real-world context. Knowledge is not just confined to what is learned in the classroom since students these days have information at their fingertips through a variety of technologies.

Teaching and Learning Methods. The students were exposed to inquiry learning and strategies for improving students researching skills, and assessment strategies tailored to improving the mathematics classrooms. Conversely, there was little group work and little evidence of student-centeredness. The lesson plans analyzed seemed to show that polytechnic mathematics lessons were solely teacher-centered, with the majority of the mathematics class activities initiated by lecturers with students acting in accordance. A typical mathematics lesson began with lecture-style presentations followed by students individually working on a form of questions/exercises and the lecturer providing answer-checking and feedback. The teacher-centric learning approach is effective in disseminating facts and prompting basic knowledge; however, it is not effective in promoting students HOTs and problem-solving abilities (Amundsen et al., 2003). In order to promote HOTs, both lecturers and students need to contemplate their roles in the mathematics classroom: lecturers as facilitators to help students in enhancing their learning and students taking responsibilities for monitoring their own learning as suggested in a constructivist learning approach.

***RQ2*: How do Malaysian polytechnic lecturers perceive the importance of teaching methods to promote HOTs in their classrooms?**

Teaching methods can be categorized into teacher-centered and learner-centered. The classroom environment is teacher-centered when students are less active in classroom activities and more attention is focused on factual/rote memorization-based learning. In order to support a HOTs atmosphere in the classroom, teaching methods may be shifted from teacher-centered to learner-centered or constructive learning through students' active involvement in activities such as questioning and collaborative learning. Table 4.6 presents Malaysian polytechnic lecturers ranked teaching methods in the order of importance based on their teaching preferences while promoting HOTs.

Oral presentation was the top teaching method reported by participants, with the mean score of 4.5 (*SD*=0.58), followed closely by *think beyond reading* (*M*=4.4, *SD*=0.59) and *student engagement in dialogue* (*M*=4.4, *SD*=0.61). Asking a student to *memorize content accurately* (*M*=3.7, *SD*=0.86) and *objective testing* (*M*=3.9, *SD*=0.79) were ranked last. Interestingly, a common traditional teacher-centered, *lecturing* (*M*=4.2, *SD*=0.68) was ranked fifth-to-the-last from the 14 teaching methods listed.

The difference in the mean scores between all teaching methods was very small ($\approx$0.1). Although *memorize content accurately* and *objective testing* were perceived to be the least important, the mean scores were still higher than 3.0.

Table 4.6: *Teaching Methods and Ranks on All Items (14)*

Items	***N***	***Mean***	***SD***
Oral presentation skills ^{LC}	389	4.5	0.58
Think beyond reading ^{LC}	389	4.4	0.59
Student engagement in dialogue ^{LC}	388	4.4	0.61
Experiences reflection ^{LC}	389	4.3	0.59
Small group activities ^{LC}	389	4.3	0.66
Explorations of ideas ^{LC}	387	4.3	0.67
Find varied correct answer ^{LC}	389	4.3	0.51
Career preparation ^{LC}	389	4.3	0.68
Reflect meaning for life ^{LC}	389	4.3	0.66
Lecturing ^{TC}	389	4.2	0.68
Cover the syllabus content ^{TC}	389	4.1	0.72
Concrete to abstract questions ^{LC}	387	4.0	0.68
Objective testing ^{TC}	389	3.9	0.79
Memorize content accurately ^{TC}	389	3.7	0.86

Notes: ^{TC}= Teacher-Centered Teaching Method
^{LC}= Learner-Centered Teaching Method
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Oral presentation activities, *think beyond reading*, and *student engagement in dialogue* are a common practice in the polytechnic teaching-learning environments and probably would result in achievement of higher-levels of learning through the interactions between students and lecturers.

Noticeably, *lecturing* continues to be a preferred way of teaching among Malaysian polytechnic lecturers, who have large volumes of material to teach. Lecture-based teaching method seems to be an appropriate way to engage their students in learning and at the same time cover all the content. Thus, an important challenge in their profession is how to improve the effectiveness of teaching while incorporating techniques/approaches that would enhance HOTs among students.

The above table shows that Malaysian polytechnic lecturers rated all teaching methods above 3.5 on a five-point Likert-type scale with mean scores ranging from 3.7 to 4.5. This seems to show that both teacher-centered and learner-centered teaching methods were considered important to promote HOTs in their teaching.

***RQ3*: What teaching strategies are considered important to enhance students' HOTs outcomes among Malaysian polytechnic lecturers?**

Teaching strategies can help students understand and take more responsibility for their own pace of learning and improve the teaching and learning processes. There are seven items about teaching strategies, as demonstrated in Table 4.7. The responses tended toward strong agreement for all strategies (mean scores between 3.9 and 4.5). *Problem solving* (*M*=4.5, *SD*=0.62) was rated as the most important teaching strategy that encouraged students to reach HOTs outcomes. The second and third highest mean scores were *brainstorming* (*M*=4.4, *SD*=0.63) and *class discussion* (*M*=4.3, *SD*=0.67) that assisted polytechnic lecturers to promote HOTs in their teaching and learning classroom. *Guest speaker* (*M*=3.9, *SD*=0.80) was placed as the least important strategy to enhance students' HOTs.

Table 4.7: *Teaching Strategies and Ranks on All Items (7)*

Items	*N*	*Mean*	*SD*
Problem solving	389	4.5	0.62
Brainstorming	389	4.4	0.63
Discussing questions	389	4.3	0.66
Project-based Learning	389	4.1	0.69
Case study analysis	389	4.1	0.69
Field trips	389	4.0	0.79
Guest speakers	389	3.9	0.80

Notes: Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

As seen in the above table, *problem-solving*, *brainstorming*, and *discussing questions* were the most important teaching strategies used to enhance students' HOTs outcomes. Malaysian polytechnic lecturers were likely to believe that all these teaching strategies were important to promote HOTs in their course instruction delivery.

***RQ4*: What are the critical success factors and barriers for Malaysian polytechnic lecturers who are using teaching methods to promote HOTs in their teaching?**

Critical Success Factors

Table 4.8 presents the responses of polytechnic lectures about factors that influence their preference of teaching methods. Six factors were perceived to influence participants' current teaching methods. They were: *effective teaching method training* with the highest mean score (*M*=4.5, *SD*=0.62), followed closely by *teaching experience* (*M*=4.4, *SD*=0.65), *current ICT changes* (*M*=4.4, *SD*=0.70), and *personal belief (M*=4.4, *SD*=0.65); *class size* (*M*=4.1, *SD*=0.66) and *institutional requirement* (*M*=4.1, *SD*=0.65) had the least influence on the lectures' current teaching practices. All the critical success factors mean scores were higher than 4.0 (with mean agreement scores between 4.1 and 4.5).

Barriers

Table 4.8 provides data on the barriers to promote HOTs in the polytechnic classrooms. *Time consuming* (*M*=4.2, *SD*=0.71) and *lack of preparation* (*M*=4.2, *SD*=0.73) were rated as the most important barrier that hindered polytechnic lecturers from supporting HOTs in their teaching. *Traditional lecture and testing approach* (*M*=3.9, *SD*=0.82) was reported as the least important barrier to using HOTs in teaching and learning.

Table 4.8: *Critical Success Factors and Barriers and Ranks on All Items*

Items	***N***	***Mean***	***SD***
Critical Success Factors			
Effective teaching method training	389	4.5	0.62
Teaching experience	389	4.4	0.65
Current ICT changes	389	4.4	0.70
Personal beliefs	389	4.4	0.65
Class size	381	4.1	0.66
Institutional requirement	388	4.1	0.65
Barriers			
Time consuming	388	4.2	0.71
Lack of preparation	387	4.2	0.73
Traditional lecture and testing approach	388	3.9	0.82

Notes: Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

As shown in the above table, the mean scores for each critical success factor are very close to each other, which means that Malaysian polytechnic lecturers considered all these factors as important elements that could influence their teaching methods to promote higher-order learning outcomes among students. On the other hand, barriers such as, lack of adequate class preparation time and students' under-preparedness appeared as the main constraints or obstructions to polytechnic lecturers' use of HOTs approaches in the classroom. With all the mean scores above 3.5 on a five-point Likert-type scale, the findings indicate a strong perception among the participants of the obstacles that hindered them from promoting HOTs.

***RQ5*: How do demographic factors (gender, years of professional service in teaching, age, highest academic degree level, and institution) influence Malaysian polytechnic lecturers' teaching practices to promote HOTs?**

Teaching Methods

Table 4.9 provides an overview of Malaysian polytechnic lecturers' perceptions of teaching methods when promoting HOTs compared to their demographic factors.

Gender: Data analysis using *t* test revealed seven significant differences in the mean scores of the importance of teaching methods between genders. First, the use of traditional *lecturing* teaching method showed a significant difference between male and female, t (387) =1.97, $p<.05$. Male polytechnic lecturers (M=4.3, SD=0.63, n=135) perceived that *lecturing* was more important than perceived by female polytechnic lecturers (M=4.2, SD=0.69, n=254). Secondly, the importance of *oral presentation skills* was significantly different, t (387) = -2.43, $p<.05$. Female polytechnic lecturers (M=4.5, SD=0.55, n=254) perceived that *oral presentation skills* were more important than male polytechnic lecturers did (M=4.3, SD=0.63, n=135). The third significant difference related to the importance of *encourage students to reflect on their experiences,* t (387) = - 2.06, $p<.05$. This showed that female polytechnic lecturers (M=4.4, SD=0.57, n=254) perceived that *encourage students to reflect on their experiences* was more important than male polytechnic lecturers did (M=4.2, SD=0.63, n=135).

The forth significant difference related to the importance of *small-group activities*, *t* (387) =-2.57, *p*<.05. The difference indicates that female polytechnic lecturers (*M*=4.4, *SD*=0.60, *n*=254) perceived that *small-group activities* were more important than male polytechnic lecturers did (*M*=4.2, *SD*=0.73, *n*=135). Fifth, the importance of *think beyond the reading* was significant, *t (*387) =-2.35, *p*<.05. Female polytechnic lecturers (*M*=4.5, *SD*=0.57, *n*=254) perceived that *think beyond the reading* were more important than male polytechnic lecturers did (*M*=4.3, *SD*=0.63, *n*=135). Sixth, the importance of *sequencing concrete to abstract question* was significant, *t* (387) =-2.31, *p*<.05. Female polytechnic lecturers (*M*=4.1, *SD*=0.68, *n*=254) perceived that *sequencing concrete to abstract question* was more important than male polytechnic lecturers did (*M*=3.4, *SD*=0.67, *n*=135). Lastly, there was a significant difference between males and females regarding *reflecting of how content has meaning for life*, *t* (387) = -2.39, *p*<.05. This evidence shows that female polytechnic lecturers (*M*=4.3, *SD*=0.64, *n*=254) perceived that *reflecting of how content has meaning for life* was more important than male polytechnic lecturers did (*M*=4.1, *SD*=0.69, *n*=135). There was no significant difference between male polytechnic lecturers and female polytechnic lecturers regarding other items. (See Table K1 in Appendix K for more detailed information on the mean scores for each item).

Years of Academic Service: Years in academic service were grouped into two categories: the least experienced group (participants with teaching experience less than 10 years) and experienced group (participants have been teaching for over than 10 years). A data analysis using *t*-tests revealed three significant differences in the mean scores of the importance of teaching methods between the least experienced group and the experienced group. The first significant difference related to the importance of *asking students to memorize content accurately*, t (387) = 2.27, $p<.05$. The difference shows that the least experienced group of polytechnic lecturers (M=3.8, SD=0.83, n=276) perceived that *asking students to memorize content accurately* was more important than the experienced group of polytechnic lecturers did (M=3.6, SD=0.92, n=113). Second, *cover the syllabus content* was significant difference, t (387) = 2.08, $p<.05$. The least experienced group of polytechnic lecturers (M=4.1, SD=0.72, n=276) perceived that *cover the syllabus content* was more important than perceived by experienced group of polytechnic lecturers (M=4.0, SD=0.69, n=113).

The third significant difference related to the importance of *assessing students' learning with objective testing*, t (181.1) = 2.21, $p<.05$. This result shows that the least experienced group of polytechnic lecturers (M=4.0, SD=0.74, n=276) perceived that *assessing students' learning with objective testing* was more important than the experienced group of polytechnic lecturers did (M=3.8, SD=0.88, n=113). No significant differences were found between the mean scores of the least experienced group of polytechnic lecturers and the experienced group of polytechnic lecturers in respect of the other items. Additionally, it was interesting to note that the experienced group of polytechnic lecturers (M=4.3, SD=0.75) perceived *lecturing* teacher-centered method was more important than the least experienced group did (M=4.1, SD=0.65). (See Table K2 in Appendix K for more detailed information on the mean scores for each item).

<u>*Age:*</u> Age was group into four different categories: below 25 years, 25 to 35 years, 35 to 45 years, and over 45 years. A one-way analysis of variance (*ANOVA*) as presented in Table 4.9 revealed four significant differences in polytechnic lecturers of different ages. The first significant difference was on *lecturing* teaching method, F (3, 385) = 3.48, p <.05. In order to determine between which ages the differences in a mean score were significant, a *Scheffe post-hoc* test was conducted. The result of the post-hoc comparison indicated that polytechnic lecturers of age 36 to 45 years (M=4.3, n=104) perceived that *lecturing* was significantly more important than perceived by polytechnic lecturers of age over 45 years (M=3.9, n=29, p=.03). The second significant difference related to the perceptions of *asking students to memorize content accurately*, F (3, 385) = 4.49, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers of age 25 to 35 years (M=3.8, n=234) perceived that *asking students to memorize content accurately* was significantly more important than perceived by polytechnic lecturers of age over 45 years (M=3.2, n=29, p=< .00).

The third significant difference regarded perceptions of *covering all the syllabus content*, F (3, 385) = 3.39, p <.05. A *Scheffe post-hoc* test found that polytechnic lecturers of different ages perceptions of *covering all the syllabus content* was not significantly different (p > 0.05). Lastly, the significant difference among different ages of polytechnic lecturers was on *assessing students' learning with objective testing* teaching method, F (3, 385) = 3.42, p <.05. A *Scheffe post-hoc* test found that the difference in the mean scores of different ages on *assessing students' learning with objective testing* teaching method was not statistically significant ($p > 0.05$). The other items showed no significant difference. (See Table K3 in Appendix K for more detailed information on the mean scores for each item).

Academic Degree: Academic degree was grouped into three groups: diploma, bachelor (bachelor's group and pursuing master's group), and master (master's group and pursuing doctorate's group). A one-way *ANOVA* revealed one significant difference was on *student engagement in dialogue*, F (2, 386) = 7.43, p <.05. A *Scheffe post-hoc* test indicated that bachelor's group of polytechnic lecturers (M=4.5, n=211) perceived that *student engagement in dialogue* was significantly more important than diploma's group of polytechnic lecturers did (M=3.9, n=19, p=< .00). Additionally, polytechnic lecturers who had master's degree (M=4.4, n=159) perceived that *student engagement in dialogue* was significantly more important than diploma's group of polytechnic lecturers did (M=3.9, n=19, p=< .00). The other items showed no significant difference. (See Table K4 in Appendix K for more detailed information on the mean scores for each item).

Institution*:* Three polytechnics were used in this study: Polytechnic A, Polytechnic B and Polytechnic C. One-way *ANOVA* testing revealed five significant differences based on three different institutions. The first significant difference regarded perception of *student engagement in dialogue*, F (2, 386) = 3.68, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic C (M=4.5, n=68) perceived that *student engagement in dialogue* was significantly more important than perceived by polytechnic lecturers at Polytechnic A (M=4.3, n=189, p =.036). The second significant difference related to *oral presentation skills* as perceived by polytechnic lecturers to influence the use of teaching method, F (2, 386) = 6.59, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic B (*M*=4.6, *n*=132) were significantly more positive about the influence of *oral presentation skills* than polytechnic lecturers at Polytechnic A were (*M*=4.3, *n*=189, *p* =.002).

The third significant difference regarded *stretching students to think beyond reading*, F (2, 386) = 7.28, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic B (*M*=4.6, *n*=132) perceived that *stretching students to think beyond reading* was significantly more important than lecturers at Polytechnic A did (*M*=4.3, *n*=189, *p* =.001). The fourth significant difference regarded *creating an atmosphere for exploration ideas*, F (2, 386) = 5.73, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic B (*M*=4.4, *n*=132) perceived that *creating an atmosphere for exploration ideas* was significantly more important than lecturers at Polytechnic A did (*M*=4.2, *n*=189, *p* =.012).

Additionally, polytechnic lecturers at Polytechnic C (*M*=4.4, *n*=68) perceived that *creating atmosphere for exploration ideas* was significantly more important than lecturers at Polytechnic A did (*M*=4.2, *n*=189, *p* =.04). The fifth significant difference related to *discussing how content may relate to career preparation* as perceived by polytechnic lecturers to influence use of teaching method, F (2, 386) = 4.03, p <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic B (*M*=4.4, *n*=132) were significantly more positive about the influence of *discussing how content may relate to career preparation* than lecturers at Polytechnic A were (*M*=4.2, *n*=189, *p* =.039). The other items showed no significant difference. (See Table K5 in Appendix K for more detailed information on the mean scores for each item).

Table 4.9: *Comparison of Teaching Methods with Demographic Factors*

Item	Gender			Years of Academic Service			Age		Academic Degree		Institution	
	t	*df*	*p value*	*t*	*df*	*p value*	*F*	*p value*	*F*	*p value*	*F*	*p value*
Lecturing [TC]	**1.97**	**387**	***0.04****	-1.13[a]	183.6	0.25	**3.48**	***0.01****	0.20	0.81	0.14	0.87
Memorize content accurately. [TC]	0.73	387	0.46	**2.27**	**387**	***0.02****	**4.49**[a]	***0.01****	0.08	0.93	0.01	0.99
Cover the syllabus content. [TC]	-0.02	387	0.98	**2.08**	**387**	***0.03****	**3.39**	***0.01****	0.97	0.37	2.84	0.06
Student engagement in dialogue. [LC]	-0.39	387	0.69	1.75	387	0.08	1.72	0.16	**7.43**[a]	***<0.00****	**3.68**	***0.02****
Oral presentation skills. [LC]	**-2.43**	**387**	***0.02****	-0.58	387	0.56	0.33	0.80	0.62	0.53	**6.59**	***<0.00****
Experiences reflection. [LC]	**-2.06**	**387**	***0.04****	0.41	387	0.68	0.19	0.91	0.48	0.61	2.01[a]	0.13
Find varied correct answer. [LC]	-1.43	387	0.15	-0.31	387	0.76	0.87	0.45	0.25	0.77	0.50	0.61
Small group activities. [LC]	**-2.57**	**387**	***0.01****	0.71	387	0.48	0.45[a]	0.71	0.94	0.39	1.73[a]	0.18
Think beyond reading. [LC]	**-2.35**	**387**	***0.02****	-0.17[a]	181.2	0.86	0.33	0.80	0.87	0.42	**7.28**	***<0.00****
Objective testing. [TC]	-0.72	387	0.47	**2.21**[a]	**181.1**	***0.02****	**3.42**[a]	***0.01****	0.35	0.71	0.44	0.64
Concrete to abstract questions. [LC]	**-2.31**	**387**	***0.02****	-1.05	387	0.29	1.26	0.85	0.26	0.76	1.18	0.31
Explorations of ideas. [LC]	-1.42	387	0.16	-0.99	387	0.31	2.35	0.07	0.95	0.38	**5.73**	***<0.00****
Career preparation. [LC]	-0.64	387	0.52	0.99	387	0.32	0.49	0.69	0.87	0.42	**4.03**	***0.02****
Reflect meaning for life. [LC]	**-2.39**	**387**	***0.02****	0.61	387	0.54	0.49	0.68	0.07	0.93	1.54	0.21

Notes: *= p <.05 (two-tailed tests)

[a] = Robust test in STATA indicates items where variances are not equal.

[TC]= Teacher-Centered Teaching Method

[LC]= Learner-Centered Teaching Method

Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

In summary, as shown in Table 4.9, female polytechnic lecturers generally had a stronger perception of the importance of *oral presentation skills, experience reflection, small group activities, think beyond reading, concrete to abstract question,* and *reflect meaning for life* compared to their male counterparts. All these methods are considered as learner-centered teaching methods. This study also showed that female polytechnic lecturers were more positive using learner-centered method in promoting HOTs in their classrooms than male polytechnic lecturers.

The least experienced group of polytechnic lecturers generally had a stronger perception of the importance of *memorizing content accurately, covering the syllabus content,* and *objective testing* compared to the experienced group of polytechnic lecturers. All these methods are considered as teacher-centered teaching methods.

There were four significant differences regarding teaching method and age ($p<.05$). Different ages of polytechnic lecturers influenced perceptions of teaching methods. Younger polytechnic lecturers generally have a stronger perception of the importance of teacher-centered teaching methods *(lecturing, memorize content accurately, and cover the syllabus content)* compared to the older polytechnic lecturers.

Bachelor's group and master's group of polytechnic lecturers have a stronger perception of the importance of learner-centered teaching method compared to diploma's group of polytechnic lecturers. Presumably, most of the older and more experienced polytechnic lecturers were in the diploma's group.

Lectures at Polytechnic B and Polytechnic C were likely to have a stronger perception of the importance of learner-centered teaching methods compared to Polytechnic A for promoting HOTs in their teaching-learning process.

Teaching Strategies

Table 4.10 provides an overview of Malaysian polytechnic lecturers' perceptions of teaching strategies based on demographic factors when promoting HOTs in their teaching practices.

Gender: A data analysis using *t*-test revealed that polytechnic lecturers showed no significant difference in perceptions of the importance of teaching strategies (p>.05). (See Table K6 in Appendix K for more detailed information on the mean scores for each item).

Years of Academic Service: Years in academic service were grouped into two categories: the least experienced group (participants with teaching experience less than 10 years) and experienced group (participants have been teaching for over than 10 years). A data analysis using *t*-tests revealed no significant difference in perceptions of the importance of teaching strategies in promoting HOTs between the least experienced group and the experienced group (p>.05). (See Table K7 in Appendix K for more detailed information on the mean scores for each item).

Age: Age was group into four different categories: below 25 years, 25 to 35 years, 35 to 45 years, and over 45 years. A one-way analysis of variance (*ANOVA*) revealed one significant difference regarding polytechnic lecturers of different ages. The only significant difference among different ages of polytechnic lecturer was on *project-based learning* teaching strategy, *F* (3, 385) = 3.02, *p* <.05. However, there were no significant differences (*p*>.05) among these four groups using a *Scheffe post-hoc* test with the mean scores of 4.1 *(SD=0.92)* for polytechnic lecturers of age below 25 years, 4.2 *(SD=0.66)* for polytechnic lecturers of age 25 to 35 years, 4.0 *(SD=0.70)* for polytechnic lecturers of age 36 to 45 years, and 4.3 *(SD=0.63)* for polytechnic lecturers of age over 45 years. The other items showed no significant difference. (See Table K8 in Appendix K for more detailed information on the mean scores for each item).

Academic Degree: Academic degree was grouped into three groups: diploma, bachelor (bachelor's group and pursuing master's group), and master (master's group and pursuing doctorate's group). One-way *ANOVA* testing revealed that different academic degree qualifications of polytechnic lecturers made no significant difference on perceptions of the importance of teaching strategies (*p*>.05). (See Table K9 in Appendix K for more detailed information on the mean scores for each item).

Institution: Three polytechnics were used in this study: Polytechnic A, Polytechnic B and Polytechnic C. According to Table 4.10, there was one significant difference based on polytechnic institutions. The significant difference pertained to perceptions on using *brainstorming* teaching strategy, *F* (2, 386) = 6.59, *p* <.05. A *Scheffe post-hoc* test indicated that polytechnic lecturers at Polytechnic B (*M*=4.5, *n*=132) were significantly more positive about the use of *brainstorming* than polytechnic lecturers at Polytechnic A were (*M*=4.3, *n*=189, *p* =< .00). The other items showed no significant difference. (See Table K10 in Appendix K for more detailed information on the mean scores for each item).

Table 4.10: *Comparison of Teaching Strategies with Demographic Factors*

Item	Gender			Years of Academic Service			Age		Academic Degree		Institution	
	t	***df***	***p value***	***t***	***df***	***p value***	***F***	***p value***	***F***	***p value***	***F***	***p value***
Discussing questions.	-1.73	387	0.08	-0.91	387	0.36	1.68	0.17	1.01	0.36	2.49	0.08
Brainstorming	-1.54	387	0.13	-1.31	387	0.19	0.50	0.68	1.48	0.22	**6.59**	**_<0.00*_**
Problem solving	-1.23	387	0.22	1.33[a]	163.9	0.18	1.96[a]	0.12	0.28	0.75	0.25	0.78
Case study analysis.	-1.66	387	0.09	1.81	387	0.07	2.26	0.08	0.82	0.44	0.16	0.85
Project-Based Learning.	-0.91	387	0.37	1.15	387	0.24	**3.02**	**_0.02*_**	0.73	0.48	0.14	0.87
Field Trips	-0.89	387	0.37	0.86	387	0.39	1.21	0.30	1.30	0.27	0.45	0.64
Guest Speakers	-1.37	387	0.17	1.41	387	0.15	2.02	0.11	1.03	0.35	0.24	0.78

Notes: *= p <.05 (two-tailed tests)
[a] = Robust test in STATA indicates items where variances are not equal.
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

In summary, as shown in Table 4.10, no significant perceptions of teaching strategies were observed based on gender of polytechnic lecturers (p>.05). Although there were no significant differences regarding teaching strategies and gender, female polytechnic lecturers recorded slightly higher mean scores than male polytechnic lecturers in all teaching strategies listed.

None of the teaching strategies obtained a statistical significance even though the least experienced group of polytechnic lecturers recorded slightly higher mean scores compared to the experienced group of polytechnic lecturers.

There was one significant difference regarding teaching strategies and age (p<.05). Apparently, from the recorded mean scores for each item, it would suggest that young polytechnic lecturers have a stronger perception of the importance of teaching strategies used to enhance students' HOTs outcomes compared to the older polytechnic lecturers.

There was no significant difference in teaching strategies based on academic degree qualification (p>.05). The mean scores for each item showed not so much difference perceptions among the different academic degree qualification groups of polytechnic lecturers.

There was one significant difference between institutions regarding teaching strategies (p<.05). Lecturers at Polytechnic B are likely to have a stronger perception of the importance of *brainstorming* teaching strategy compared to the other two polytechnics for promoting HOTs in their teaching-learning process. From the recorded mean scores for other items, it shows that these three institutions had almost equal perceptions of teaching strategies used to enhance students' HOTs outcomes.

Critical Success Factors

Table 4.11 provides an overview of Malaysian polytechnic lecturers' perceptions of critical success factors when promoting HOTs compared to their demographic factors.

Gender: A data analysis using t-tests revealed no significant difference between genders regarding the mean scores of the factors influencing polytechnic lecturers' teaching methods (p>.05). (See Table K11 in Appendix K for more detailed information on the mean scores for each item).

Years of Service: Years in academic service were grouped into two categories: the least experienced group (participants with teaching experience less than 10 years) and experienced group (participants have been teaching for over than 10 years). A data analysis using *t*-tests shown in Table 4.11 found one significant difference among factors influencing polytechnic lecturers' teaching methods between the least experienced and the experienced group. *Teaching experiences* influenced the use of teaching methods, $t\,(301.6) = -3.06$, $p<.05$. The difference shows that experienced polytechnic lecturers (M=4.6, SD=0.52, n=113) perceived that *teaching experiences* were more important than the least experienced group did (M=4.3, SD=0.76, n=276). No significant differences were found regarding the other items. (See Table K12 in Appendix K for more detailed information on the mean scores for each item).

Age: Age was group into four different categories: below 25 years, 25 to 35 years, 35 to 45 years, and over 45 years. One-way *ANOVA* testing found no significant differences on perceptions of the factors influencing polytechnic lecturers' teaching methods based on different ages ($p>.05$). (See Table K13 in Appendix K for more detailed information on the mean scores for each item).

Academic Degree: Academic degree was grouped into three groups: diploma, bachelor (bachelor's group and pursuing master's group), and master (master's group and pursuing doctorate's group). A data analysis using *ANOVA* revealed no significant differences in each item score for success factors influencing teaching methods regarding academic degree qualifications ($p>.05$). (See Table K14 in Appendix K for more detailed information on the mean scores for each item).

Institution: Three polytechnics were used in this study: Polytechnic A, Polytechnic B and Polytechnic C. A one-way *ANOVA* analysis showed no significant differences in each item score for success factors influencing teaching methods based on institution (p>.05). (See Table K15 in Appendix K for more detailed information on the mean scores for each item).

Table 4.11: *Comparison of Critical Success Factors with Demographic Factors*

Item	Gender			Years of Academic Service			Age		Academic Degree		Institution	
	t	*df*	*p value*	*t*	*df*	*p value*	*F*	*p value*	*F*	*p value*	*F*	*p value*
Teaching experience.	-1.05	387	0.29	**-3.06**[a]	**301.6**	***<0.00****	1.64[a]	0.17	2.26[a]	0.10	0.65	0.52
Personal beliefs	-1.54	387	0.12	-1.22	387	0.22	0.56	0.64	2.73	0.06	0.04	0.96
Current ICT changes.	0.82	387	0.41	-1.96	387	0.06	0.85	0.47	0.66	0.51	0.28	0.76
Class size	-2.03	387	0.14	0.46	387	0.64	5.42[a]	0.09	0.05	0.96	0.02	0.98
Institutional requirement.	-0.88	387	0.38	-0.73	387	0.46	0.15	0.93	1.48	0.22	2.08	0.13
Effective teaching method training.	-1.59	387	0.11	0.03	387	0.96	1.40	0.24	0.36	0.69	0.65[a]	0.52

Notes: *= p <.05 (two-tailed tests)
[a] = Robust test in STATA indicates items where variances are not equal.
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

In summary, and as shown in Table 4.11, no significant perceptions of critical success factors were observed based on gender (p>.05). Although there were no significant gender differences, female polytechnic lecturers recorded slightly higher mean scores than male polytechnic lecturers in all critical success factors influencing polytechnic lecturers' teaching methods to promote HOTs. Experienced group of polytechnic lecturers apparently have a stronger perception of the effect of *teaching experiences* on the use of teaching methods compared to the least experienced group. Comparing the mean scores for both groups, experienced polytechnic lecturers perceived *current ICT changes* as one of the very important factors that could influence their teaching practices. Overall, both groups agreed that all critical success factors were considered important to enhance students' HOTs outcomes.

The perceptions of Malaysian polytechnic lecturers about critical success factors were not significantly different by their age group ($p>.05$). From the reported mean scores, older and more experienced polytechnic lecturers have a stronger perception of the importance of these factors that could influence their teaching preferences compared to the younger polytechnic lecturers. However, both groups agreed that *effective teaching method* was considered a very important factor to promote HOTs.

The perceptions of polytechnic lecturers about critical success factors were not significantly different by their academic degree qualifications ($p>.05$). However, the reported mean scores for each factor showed that the diploma's group perceived all these factors as important while the bachelor and master's groups did not. Presumably, most of the older and more experienced polytechnic lecturers were in the diploma's group.

The perceptions of polytechnic lecturers about critical success factors were not significantly different by institutions ($p>.05$). The recorded mean scores for each factor would suggest that the different institutions had almost equal perceptions of all critical success factors influencing teaching method to promote HOTs.

Barriers

Table 4.12 provides an overview of Malaysian polytechnic lecturers' perceptions, based on their demographic factors, of barriers when promoting HOTs in their teaching practices as follows:

Gender: A data analysis using *t*-tests revealed no significant difference between genders regarding the mean scores of the barriers that hindered polytechnic lecturers from supporting HOTs teaching (p>.05). (See Table K16 in Appendix K for more detailed information on the mean scores for each item).

Years of Service: Years in academic service were grouped into two categories: the least experienced group (participants with teaching experience less than 10 years) and experienced group (participants have been teaching for over than 10 years). A data analysis using *t*-tests shown in Table 4.12 found one significant difference in the mean scores of the barriers to promote HOTs between the least experienced group and the experienced group. The only significant difference was perception of *traditional lecture and testing approach*, t (194.9) = 3.22, p<.05. The difference shows that the least experienced group of polytechnic lecturers (M=3.9, SD=0.79, n=276) perceived that *traditional lecture and testing approach* was more important than the experienced group of polytechnic lecturers did (M=3.6, SD=0.85, n=113). No significant differences were found in respect of the other items. (See Table K17 in Appendix K for more detailed information on the mean scores for each item).

Age: Age was group into four different categories: below 25 years, 25 to 35 years, 35 to 45 years, and over 45 years. A one-way analysis of variance (*ANOVA*) found one significant difference based on polytechnic lecturers of different ages. The only significant difference related to the perceptions of *traditional lecture and testing approach*, F (3, 385) = 3.44, p <.05. However, a *Scheffe post-hoc* test found that there were no significant differences (p>.05) between polytechnic lecturer age groups with the mean scores of 4.0 *(SD=0.93)* for polytechnic lecturers of age below 25 years, 3.9 *(SD=0.78)* for polytechnic lecturers of age 25 to 35 years, 3.7 *(SD=0.79)* for polytechnic lecturers of age 36 to 45 years, and 3.6 *(SD=0.98)* for polytechnic lecturers of age over 45 years. The other items showed no significant difference. (See Table K18 in Appendix K for more detailed information on the mean scores for each item).

Academic Degree: Academic degree was grouped into three groups: diploma, bachelor (bachelor's group and pursuing master's group), and master (master's group and pursuing doctorate's group). A data analysis using *ANOVA* revealed no significant differences in each item score for barriers to HOTs teaching based on academic degree qualifications (p>.05). (See Table K19 in Appendix K for more detailed information on the mean scores for each item).

Institution: Three polytechnics were used in this study: Polytechnic A, Polytechnic B and Polytechnic C. A one-way *ANOVA* analysis showed no significant differences in each item score for barriers toward HOTs teaching based on institutions (p>.05). (See Table K20 in Appendix K for more detailed information on the mean scores for each item).

In summary and as shown in Table 4.12, no significant perceptions of barriers were observed based on gender of polytechnic lecturers (p>.05). Both genders had almost equal perceptions of all barriers that hindered polytechnic lecturers from supporting HOTs teaching. The least experienced group of polytechnic lecturers apparently had a stronger perception of *traditional lecture and testing approach*, as a barrier, compared to the experienced group of polytechnic lecturers. There was one significant difference regarding *traditional lecture and testing approach* and age (p<.05). Young polytechnic lecturers had a stronger perception of the obstacles that hindered them from promoting HOTs teaching and learning processes compared to the older ones.

Table 4.12: *Comparison of Barriers with Demographic Factors*

Item	**Gender**			**Years of Academic Service**			**Age**		**Academic Degree**		**Institution**	
	t	***df***	***p* *value***	***t***	***df***	***p* *value***	***F***	***p* *value***	***F***	***p* *value***	***F***	***p* *value***
Time consuming	0.01	387	0.99	-0.96	387	0.33	0.15	0.93	1.48	0.22	0.69	0.50
Lack of preparation.	0.08	387	0.94	1.49	387	0.13	0.77	0.51	0.38	0.68	0.38[a]	0.68
Traditional lecture and testing approach.	-0.17	387	0.87	**3.22**[a]	**194.9**	***<0.00****	**3.44**	***0.01****	0.68	0.51	2.41[a]	0.09

Notes: *= p <.05 (two-tailed tests)
[a] = Robust test in STATA indicates items where variances are not equal.
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Results of the One-Way ANOVA for three barrier items revealed that none of the items was different among diploma, bachelor, and master’s groups. *Traditional lecture and testing approach* were identified as the least important barrier for diploma’s group. Presumably, most of the older and more experienced polytechnic lecturers were in the diploma’s group and considered traditional lecture to be a preferred way of teaching among them. The perceptions of polytechnic lecturers about barriers were not significantly different by their institutions (p>.05).

CHAPTER 5: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter is organized into five sections. The first section consists of the summary of the findings. The second discusses the major findings and results and links to the literature. The third section provides conclusions derived from the study findings followed by the limitations of the study. Finally, the last section includes recommendations, further research, and implications of the study.

Summary of the Findings

The purpose of study was to determine from a selected group of polytechnic lecturers' how much emphasis they had been able to place on teaching students to use HOTs while using ICT in the classroom at their technical polytechnic institution in Malaysia. Another goal of this study was to analyze the Malaysian polytechnic lecturers' teaching practices with ICT utilization to promote HOTs.

In regards to the question "how do Malaysian polytechnic lecturers perceive: (a) level of support and training and confidence level in promoting HOTs using ICT and (b) the use of ICT to promote HOTs in their teaching-learning process?", the quantitative findings indicated that there were significant statistical differences between lecturers with a high level of ICT utilization and lecturers with low ICT utilization. The high group had higher scores compared to the low group for both levels of support and training and lecturers' confidence. It can be said that the level of support and training, and lecturers' confidence level influenced polytechnic lecturers' use of ICT to promote HOTs in their teaching and learning. On the other hand, qualitative findings revealed that Malaysian polytechnic lecturers were using ICT to teach and also to have their students learn through HOTs. These polytechnic lecturers pointed to the importance of collaborative learning methods. Further, they reported perceptions of having ICT skills and significant levels of computer competence. Malaysian polytechnic lecturers recognized the importance of HOTs when describing their lessons. Classroom teaching at the HOT level of Bloom's Taxonomy and the evidence of students' self-learning and development were the two most promising outcomes of the Malaysian polytechnic education. However, the findings also shown that these positive perceptions and practices were not evident for all polytechnic classrooms.

Additionally, the qualitative data analyses of lecturer-made lesson plans in engineering mathematics courses revealed that the mathematics lecturers were likely to use teacher centric strategies in delivering course content and to dominate classroom interaction. There was little group work and little evidence of student-centeredness. ICT was not thoroughly utilized in ways that would facilitate the development of HOTs among students and their ICT use was only to support the existing learning process rather than to use its transformative potential. Hence, there seems to be "incongruence" between teaching practices intended by the Malaysian polytechnic curriculum and Malaysia's ICT policy in education and those actually practiced in the polytechnic mathematics classroom.

In regards to the importance of teaching methods to promote HOTs in their classrooms, o*ral presentation activities* was the top learner-centered method practiced by participants, followed closely by *think beyond reading* and *student engagement in dialogue*.

Surprisingly, the most common teaching methods, traditional teacher-centered *lecturing* was ranked fifth-to-the-last from the listed teaching methods practiced by participants. Malaysian polytechnic lecturers rated all teaching methods at the level of above 3.5 on a five-point Likert-type scale with mean scores ranging from 3.7 to 4.5, implying that these methods were considered important to promote HOTs in their teaching practices.

Problem solving, brainstorming, and *discussing questions* were perceived by polytechnic lecturers as the most important teaching strategies to enhance students' HOTs outcomes. These three teaching strategies were highly ranked on the survey.

In response to the question regarding, polytechnic lecturers' perceptions of important success factors for the use of teaching methods in classrooms, *effective teaching method training* was identified as the most important. As far as barriers lecturers face, *time consuming* and *lack of preparation* were perceived as the most important obstructions preventing polytechnic lecturers from supporting HOTs teaching.

In relation to the demographic factors influencing Malaysian polytechnic lecturers' teaching practices to promote HOTs, gender, years of academic service, age, academic degree and institution showed significance differences regarding teaching methods. For instance, female polytechnic lecturers gave more importance to learner-centered methods, such as *oral presentation skills, experience reflection, small group activities, think beyond reading, concrete to abstract question,* and *reflect meaning for life* compared to their male counterparts. In addition, the least experienced group of polytechnic lecturers identified teacher-centered methods such as, *memorizing content accurately, covering the syllabus* *content*, and *objective testing* as more relevant than the experienced group. Similarly, younger lecturers showed a stronger perception of the importance of teacher-centered methods compared to the older lecturers. Conversely, bachelor's group and master's group of polytechnic lecturers also identified learner-centered methods as effective to promote HOTs in teaching and learning compared to diploma's group of lecturers. And finally, lectures at Polytechnic B and Polytechnic C exhibited a stronger perception of the importance of learner-centered methods compared to Polytechnic A.

In relation to teaching strategies, critical success factors and barriers, hardly any demographic factors, meaning gender, years of academic service, age, academic degree and institution showed significance differences, with a few exceptions. For example, *project-based learning* is perceived as an effective to teach HOTs among over 45 years age group. *Teaching experience* as a critical success factor to promote HOTs in teaching and learning was found significant between the least experienced group and the experienced one (years of academic service). Similarly, *traditional lecture and testing approach* was identified as a barrier that able to prevent polytechnic lecturers from promoting HOTs teaching in polytechnic classrooms from younger lecturers.

Discussion

The overall purpose of the study was to evaluate a selected group of Malaysian polytechnic lecturers' experiences related to how much emphasis they had been able to place on teaching students to use HOTs and to analyze their teaching practices using ICT to promote HOTs. Malaysian polytechnic lecturers recognized the use of ICT in their course instruction and the importance of HOTs outcomes. However, their teaching practices with ICT utilization in mathematic classrooms were not thoroughly carried out in ways that would facilitate HOTs among students. The “incongruence” between polytechnic lecturers’ perceptions and their teaching practices as intended by the Malaysian polytechnic curriculum and Malaysia’s ICT policy in education might affect the success of promotion HOTs outcomes in polytechnic educational settings.

According to Pelgrum (2001), the success or failure of ICT integration is found to depend largely on educator’s skills and knowledge. Most of the polytechnic lecturers in this study had moderate and advanced levels of ICT knowledge and skills. They were familiar with application software such as desktop applications, presentation software, Internet applications, and media communication. These findings are not consistent with those captured from an older study investigating the level of ICT skills of vocational and ICT teachers to integrate ICT, conducted by Bakar and Mohamed (1998) in Malaysia. The study found that teachers were not literate in the use of computers or computer software. A USA study by Kotrlik, Harrison, and Redmann (2000) on vocational teachers, reported that vocational education teachers had moderate to low levels of general information, technology knowledge, and skills. These findings inconsistencies are due to the rapid development and advancement in ICT that is a part of everyone’s life since we now live in an increasingly digital world.

Teachers are not fully prepared to utilize ICT when they do not have adequate skills, knowledge, and confidence (Russell, Finger, & Russell, 2000). Similarly, the results of this study showed that formal ICT support and training, and level of confidence influenced the Malaysian polytechnic teachers' use of ICT into their teaching practices. Hence, lecturers, particularly the older ones and with more teaching experience needed to be supported with specially designed training programs, in multiple aspects of ICT integration, such as, courses, seminars, workshops and one-on-one consultations focusing on pedagogical skills. Jennings and Onwuegbuzie (2001) stated that younger educators are generally more ICT literate than the experienced educators. Rakes et al. (2006) wrote that teachers need appropriate and satisfactory training to support them to utilize ICT in their classroom teaching. Previous studies supported that ICT readiness and confidence and sufficient training are needed for effective ICT utilization in teaching and learning (Abd Rahman et al., 2003; Abdul Razak, 2003; Abdul Razak & Abdul Rashid, 1997; Pak & Punyapinyophol, 1988).

Teachers' perceptions and confidence level had a strong influence on the effective integration of ICT in classrooms (Drent & Meelissen, 2008). Malaysian polytechnic lecturers had exhibited that they were supportive about the use of ICT in the classroom. Although they have positive perceptions, that does not necessarily transform into action, as reported in the Wan Ali (2008) and Mohd Nor (2005) studies in Malaysia and Cuban, Kirkpatrick, and Peck (2001), about low ICT utilization among teachers. There are several obstructions to educators integrating ICT in the classroom. A successful integration of ICT in schools is influenced by interdependent factors such as educators, institutions, and the particular ICT (Zhao, Pugh, Sheldon, & Byers, 2002). It could be that lecturers do have the least experience on how to integrate ICT in teaching, even if they are competent in using ICT. It could be they do not know how to integrate ICT in teaching because there is no model for them. Probably the teachers of the lecturers did not use ICT in teaching and as a result, the lecturers were not exposed to ICT integration classes during their teacher-training program. If lecturers are not confident employing ICT in their teaching practices, it would hamper the effort by the Malaysian Ministry of Higher Education to utilize ICT as a catalyst for change in teaching and learning. In this study, it is proven that Malaysian polytechnic lecturers become more effective in utilizing ICT to promote HOTs when they have adequate and proper training and support, and high levels of confidence. This agrees with the findings of Tella, Toyobo, Adika, and Adeyinka (2007), which reported that inadequate ICT knowledge to assess the role of ICT in teaching and learning and a lack of skills in the use of ICT tools and software had resulted in a low confidence in utilizing ICT to promote HOTs.

ICT Utilization and Higher-Order Thinking Skills

Analyses of data collected in this study were intended to help in formulating a clearer and updated picture of bringing ICT in the classroom and promotion of HOTs in polytechnic teaching and learning. From the open-ended answers to the survey, it can be concluded that lecturers were using ICT to promote HOTs in their teaching. The frequency of ICT tools and application/software used in different courses was reported in terms of utilization by the lecturer and/or use required of the students. In other words, if lecturers were not comfortable in using a particular tool or software/application, they would not require their students to use them.

Malaysian polytechnic lecturers considered themselves to be proficient in the use of desktop applications, presentation software, information retrieval via the Internet, computer-assisted instruction (teaching courseware), and media communication. These findings suggest that lecturers' ICT competency likely pertained to their frequent use of word processing, presentation tools, and teaching courseware in preparing their teaching materials and presenting lessons. This finding is consistent with Jegede, Odusola, and Ilori (2007) who discovered educators are well versed in desktop applications compared to other applications. Collectively, these results are consistent with the findings of Slaouti and Barton (2007) who concluded that the ICT most frequently used by teachers was word processing, PowerPoint, and the Internet searching. Furthermore, it is apparent that polytechnic lecturers' attitudes toward ICTs were promising, since most of them demonstrated positive perceptions of ICT utilization to promote HOTs into their teaching practices.

It is concluded that polytechnic lecturers are aware of the effects of ICT in improving teaching and learning of HOTs among students and they are positive towards integration of ICT into their classroom. However, the qualitative data analyses of lecturer-made lesson plans in engineering mathematics courses revealed an "inconsistency" between lecturers' perceptions on promoting HOTs and their teaching practices regarding ICT use. Most of the polytechnic lecturers reported fairly moderate to high levels of agreement on HOTs teaching and ICT utilization, but the collected lesson plans tended to show that the lecturers' instruction remained teacher-centered and based mainly on lectures and that their ICT use was only to support the existing learning process more than to use its transformative potential. Malaysian polytechnic mathematic lecturers were promoting HOTs in their teaching practices through the use of teacher-centered methods. Even though they were using, for example, lectures as teaching method, they were still enabling HOTs as the analyses of lecturer-made lesson plans showed that they were planning to aim at upper level at Bloom's Taxonomy such as analysis, synthesis, and evaluation. It appeared that the three typical and common kinds of course design structures in engineering mathematics classrooms were answer-checking, class lecturing, and students doing individual work such as tutorial assignments, which were all teacher-centered approaches.

Noticeably, the lesson plan analyses revealed that mathematics classrooms aligned more strongly with the teacher-centered perspective and mathematics lecturers were the major source of authoritative knowledge for students' learning. Pertaining to knowledge dissemination, it was shown that mathematics classrooms frequently and routinely dealt with basic mathematical concepts, memorizing facts, and procedures. Regularly, the knowledge the lecturer disseminated to students was directly aligned with the information in the textbooks/modules. Students were presented with only one fixed answer/view of complex issues and one set of truths. Despite the fact that there was an interest in cooperative learning, polytechnic mathematics classrooms encouraged less cooperation and required students to work individually. When lecturers asked students questions they wanted the right answer rather than encouraging students to think through complex issues in mathematic learning. These findings support previous studies conducted by Noor Azlan (1987) and Haggarty and Pepin (2002) that reported that textbook and worksheets are the important sources for teaching. In fact, mathematics classes are still practicing teacher-centered methods where teaching and learning too often deal with declarative and procedure knowledge. The findings are the same even though this present study was conducted 10 to 20 years later.

Higher-order thinking skills cannot be learned vigorously unless lecturers emphasize it and use it on a continuing basis (Howe & Warren, 1989). To achieve higher-order thinking learning, students should be engaged in the transformation of knowledge and understanding. The design of mathematics lessons may create a climate for students' effective interaction, encouraging them to classify, justify, investigate, criticize, and evaluate others' arguments, engaging in constructing knowledge through different processes and generating new knowledge through self-exploration (Ingram, 1998). As students, they need to be aware that they must be an active learner through creating their own elaborations and responsibilities in their personal learning. All these attributes are held in a constructivist teaching and learning environment. In fact, many studies over the years have shown that higher-order thinking can be taught, developed, and cultivated (Lumsdaine & Lumsdaine, 1994). Thus, if lecturers were to purposely embed and teach thinking skills and also provide opportunities for interaction, then the implementation and practice of higher-order thinking could be tremendously improved in polytechnic mathematics classrooms.

Learner-centered methods can enable HOTs as well as teacher-centered methods. Both teaching methods have the potential to foster open exploration of ideas, provide active modeling of thinking processes, develop thinking skills, and motivate students to learn. Without it, students will not advance in higher-level thinking skills processes (Mahiroglu, 2007). The engineering mathematics lesson plan is a very good place to embed the modeling of thinking skills and examples of how thinking outside the box can be applied to the engineering line of work. The engineering profession uses and justifies different estimation strategies in real-world problem situations and also determines the reasonableness of the results of calculations for given problems or tasks. Scaffolding, which provides students support at the beginning of a lesson until they become independent and self-regulating learners (Hartman, 2002), can aid students with higher-order thinking and learning skills (McKenzie, 1999). Malaysian polytechnic lecturers also need to determine which applications have added value for learning in their content area. While doing this, the lecturer needs to be aware that this is not a one-time activity, as the information environment is continuously changing. Lessons need to be particularly designed to teach the content using appropriate learning strategies. Learner-centered strategies may be embedded within teacher-centered practices. A lecturer should balance between lecturing (presenting knowledge concisely and precisely) and several practices to teach mathematics knowledge concepts and reasoning skills (such as providing students activities to apply and relate what they have learned to their lives).

Polytechnic mathematics lecturers used ICT in their mathematics lessons; however, they were not fully utilized in ways that would facilitate the development of HOTs among students in an effective way. The primary use of ICT in mathematics lesson has been to deliver computer-assisted learning (CAL), including drill-and-practice programs. These applications are used to teach students in the same way that lecturers always do. Drills are based on behaviorist notions about the reinforcement of stimulus-response associations (Mayer, 1998) and they fall within the teacher-centered focus. Unfortunately, the behaviorist principles underlying drill and practice are incapable of developing complex thinking skills (Jonassen, 1996). What students acquire from such applications is “passive” knowledge because they are not applying it.

Furthermore, word-processing software, spreadsheets, computer-aided design (CAD) tools, and graphics packages were used as productivity tools. However, they were not being used as tools to learn with. ICT tools and applications need to be utilized as smart partners, which promote students’ HOTs. For instances, the Internet does not necessarily help to improve learning. Searching the Internet may offer learners various perspectives or information; however, Internet use has to be associated with other ICT tools to facilitate critical thinking and higher-order learning. In addition, information searching with no purpose would not necessarily lead to significant learning. Students are learning to access the Internet to download material easily and quickly instead of constructing and representing their own ideas. The role of ICT should be shifted from that of technology-as-teacher to technology-as-partner in the learning process (Jonassen, 1996). As asserted by Jonassen (1996), ICT should be utilized as a facilitator of thinking and knowledge construction. This is consistent with Kerrigan’s (2002) study, who found the benefits of using mathematics software and websites included promoting students’ HOTs, developing and maintaining their computational skills, introducing them to data collection and analysis, facilitating their algebraic and geometric thinking, and showing them the role of mathematics in an interdisciplinary setting.

There are several objectives of ICT utilization for supporting student mathematical learning and the development of declarative, procedural, and conceptual knowledge as noted by Hasselbring, Lott, and Zydney (2005): (1) building computational fluency, (2) converting symbols, notations, and text, (3) building conceptual understanding, (4) making calculations and creating mathematical representations, (5) organizing ideas, and (6) building problem-solving and reasoning. Clearly, these findings provide valid evidence that it is vital for Malaysian polytechnic mathematics lecturers to employ ICT in their teaching practices since this instructional strategy has proved that it will improve students' performance and their level of metacognitive awareness while solving problems in mathematical learning. The utilization of ICT in the mathematics classroom can range from simple information delivery and drill-and practice exercises to an environment of authentic practices and problem solving (Papert, 1992). As a result of such research that showed that the integration of ICT gave positive effects on the students' learning, Malaysian polytechnic lecturers must be able to integrate ICT in their lessons and use ICT as a teaching and learning tool.

Higher-Order Thinking Skills: The Importance of Teaching Methods and Strategies

Lecturers who teach in predominantly teacher-centered settings around the world, such as Malaysia, might be marginally committed to HOTs strategies and expectations. However, surprisingly, this was not the case in this study. Although polytechnic lecturers varied strongly on the survey items, the mean scores of each item showed that Malaysian polytechnic lecturers were informed and cognizant on HOTS and promoted these skills in their courses. Even though polytechnic lecturers usually had classes of over 30 students, they had not viewed class size as a main hindrance in promoting HOTs. HOTs could be supported in a large class, but it required moving beyond the traditional lecture and examinations as ways to encourage the development of HOTs (Bonwell & Eison, 1991). In reality, a learner-centered approach is applicable to large classes. Students can be divided into several small groups and given the opportunity to work together. When students are discussing issues/topics in groups or explaining their answers to others, they are more likely to use skills at the more advanced levels of Bloom's taxonomy. Having the opportunities to pause, reflect, analyze, discuss, justify, and assess processes and concepts is a key to higher-order learning (Jones, 2007).

The teacher-centered, lecture-based approach was rated as an important method of teaching in most classrooms in the polytechnic settings. Traditional lectures can be a salient tool for disseminating of information to students yet, lecture-based lessons usually transmit low-level information and assessments of learning that require only the recall and comprehension of concepts (Gardiner, 1998). It is interesting to note that more learner-centered teaching methods were rated as the most essential methods of teaching compared to teacher-centered methods. Oral presentation skills and group activities that entail student interaction and discussion were rated as important. Teaching methods that facilitate student thinking beyond reading and reflecting on their experiences were also perceived as critical. There was a major focus on teaching methods that promote HOTs among polytechnic students. These findings support previous study, which researched the importance of higher-level learning in doctoral education programs (Neumann, 2004).

Effective teaching methods training and professional teaching experiences were rated high as critical success factors in promoting HOTs. These experiences impacted on lecturers' teaching decisions. Rapid change of ICT was also considered as an important success factor and this could indicate lecturers' positive attitudes in bringing ICT into their classroom. The least influential factor was institutional requirements to promote HOTs in teaching and learning. This seems to indicate that Malaysian polytechnic lecturers were aware of and valued the importance of HOTs in polytechnic education. In terms of barriers when trying to teach toward HOTs, Malaysian polytechnic lecturers pointed out time commitment and students lack of preparation in these skills.

Brainstorming for problem solving, project-based learning, and case study analysis were perceived by the Malaysian polytechnic lecturers to be primary teaching strategies to the optimum use of HOTs in classrooms. However, opportunities for engaging students in project-based learning, small group discussion, brainstorming, problem solving, and other constructivist teaching and learning approaches are likely restricted by 50 minutes to one hour teaching periods. Further study should be focused on the appropriate class size and time period that will permit for extended discussion and critical-thinking activities, mentoring, and the building of learning community, as aspects of higher-order learning environments and constructivist learning.

Comparisons were done on Malaysian polytechnic demographic factors: gender, years of academic service, age, academic degree, and institution. It is interesting to note that gender, years of academic service, age, and institution influenced the importance of HOTs teaching. Male polytechnic lecturers viewed lecturing as a more important teaching method than female lecturers did. This finding is in line with Schwerdt and Wuppermann's (2011) study that investigated the relative effects of lecture-style presentations and in-class problem solving in math and science classrooms. These authors reported that teachers who spent more time lecturing were more likely to be male and under age 50.

In the present study, male polytechnic lecturers perceived teacher-centered teaching methods as more important than female polytechnic lecturers did. In addition, male polytechnic lecturers perceived learner-centered methods as less important, which was quite a different perception from their female counterparts. These findings are somewhat corroborated by Talis's (2009) study who reported that "female teachers are less likely than male teachers to view teaching as the direct transmission of knowledge and are more likely to adopt structuring and student-oriented practices as well as to co-operate more with colleagues" (p. 88). The least experienced group of polytechnic lecturers generally had a stronger perception of the importance of teacher-centered methods (e.g., memorizing content accurately, covering the syllabus content, and objective testing) compared to the experienced group of polytechnic lecturers.

Overall, although only 38% the Malaysian polytechnic lecturers had received some training on teaching HOTs and the rest (62%) had not received any training related to HOTs, this did not seem to have significantly influenced their perceptions of the pedagogical skills and knowledge for promoting HOTs. They seemed to accept teacher-centered teaching methods as equally important to learner-centered approaches in infusing HOTs in their classroom. Additionally, they were knowledgeable about HOTs strategies such as brainstorming and critical-thinking activities, project-based learning, problem-solving with hands-on experiences, and questioning strategies as characteristics of constructivist learning environments. This evidences Malaysian polytechnic lecturers' strong awareness of developing HOTs among their students.

Critique to the Constructivist Approach

Constructivist approach has gained a significant amount of support in the learning and teaching literature; however, the question of how to implement classroom teaching that is consistent with a constructivist view of learning is still a matter of concern.

Sink (1997) stresses the importance of training teachers before fully deploying the constructivist learning approaches. He states that the assumptions, processes, and mechanisms required to create knowledge must be accurately outlined and comprehensively researched. Other concerns such as, selecting curriculum, developing standards for assessment, deploying a pedagogical method for 30 or more highly diverse students in a classroom, were also highlighted as needing further research.

Teaching is one of the most demanding and charismatic occupations that require spontaneity, inspiration, and highly adaptability (Baines & Stanley, 2000). Baines and Stanley (2000) noted that classrooms lead to a desire for knowledge and described constructivist teaching approaches as taking away from the learner the opportunity to receive complex knowledge directly from the teacher. They also criticized the notion of teacher as a facilitator and stated the worthlessness of not communicating with the learners about factual knowledge. They insisted that lecture and discussions with the teacher are powerful pedagogical methods, especially if they are charismatic, knowledgeable, and “skilful” teachers (Baines & Stanley, 2000).

Another critique targeted at constructivist approaches to teaching and learning is their lack of strictness and rigorousness. In order to become self-directed learners, teachers are likely to abandon their curriculum to fulfill the desires of their students (Brooks & Brooks, 1999).

In short, constructivist approaches in learning and teaching raise several concerns among the community of educators. These concerns range from goal setting, beliefs, and diverse students to charismatic teachers and self-directed learners.

Links to Literature

ICT Utilization in a Constructivist Approach

With the advent of new teaching and learning technologies, students are encountering new challenges concerning perceiving knowledge and setting goals to manage up-to-date global knowledge. Hence, it is a salient for students to learn various uses of ICT (Voogt & Pelgrum, 2005). This study’s findings revealed that more than 95% of Malaysian polytechnic lecturers from three polytechnics are currently competent in utilizing ICT. In general, the lecturers are teaching HOTs using ICT even though lecturers are not fully optimizing on what ICT has to offer. Thus, students enrolling in Malaysian polytechnic programs are likely to learn ICT skills, which may help them in preparing their future careers. Lesson plans that utilize ICT might consist of researching information online or using computer-assisted instruction (teaching courseware) (ChanLin, 2008). An example of this is the following answer to the open-ended survey question:

> "Mechanical Engineering (*Industrial Robotics*): Students are required to come up with their own robotic design based on the criterion given to them. They need to seek and analyze the latest design and technology using the Internet and YouTube. They have to synthesize the information collected, and write and present reports on their project using 3D drawing AUTOCAD or Inventors."

Lessons related to real-life application were discovered from this study's responses. For example, the following lesson plan shall encourage a student to be a draftsman:

> "Civil Engineering (*Building Services Drawing*): Students are required to draw a house floor plan and analyze it. Then, students will equip it with the piping, electrical, and water systems. Students are asked to design it using CADD drawing software. Then, students need to explain and rationalize the system that they have designed, using PowerPoint."

There are many factors that foster an educator to utilize ICT in their classroom. However, using ICT in the classroom by itself is not effective unless an educator has a theory to model their instruction with. Rakes et al. (2006) have questioned whether educators need to know an appropriate learning theory as a frame of reference in which educational outcome can be more creative and productive. The utilization of ICT should be embedded within a learning theory to support the methodology. Most of today's classroom instruction is based on traditional learning theories where ICT is being used only as a tool in replacement of traditional tools (Muniandy et al., 2007). These two aspects must come together to create a more productive classroom environment.

A constructivist learning theory is the most popular among all the learning theories and major schools of thought for developing thinking skills and integrating ICT into a curriculum (Jonassen, Peck, & Wilson, 1999; Lave & Wenger, 1991; Wilson, 1996). According to Rakes et al. (2006), the student-centered learning and collaborative approaches of constructivism encourage the teaching-learning process in order to increase the level of students' learning. Judson (2006) showed that constructivist educators were more likely to utilize ICT in their classrooms in general and to integrate ICT into their lessons more often than educators who follow other philosophies of learning. The consolidation of constructivist learning theory and the utilization of ICT are anticipated to produce promising applications of ICT to facilitate course design, and seem to change every dimension of instruction, from course design to delivery approaches and even evaluation (Rakes et al., 2006).

Astleitner (2002) explains the positive aspects of giving students opportunities to learn through ICT in a constructivist learning environment. The most important piece of an activity is the educator who works with their students on evaluating a lesson. Evaluation is Bloom's highest level of thinking of his taxonomy of skills. Thus, what information students learn through ICT is not what matters; it is making the connection to something authentic and being able to apply and evaluate what they have learned that is most important. That is where the educator's role takes place.

Teaching through YouTube, blogs, and wikis is a trend used in some classes (Kupetz, 2008). There were several lesson plan responses to the open-ended survey question that mentioned using YouTube and Facebook. These were probably due to lecturers starting to know the potential for using video and social-networking applications even though some institutions do not support this use of the Internet (Levin & Wadmany, 2008). Several institutions have blocked these types of websites or applications. Blocked websites are a challenge that limits ICT utilization in polytechnic institutions since these applications are potential tools to be used in teaching and learning to promote HOTs. Another frequently reported concern is the limited knowledge and lack of self-confidence on integrating ICT in course contents (Abdul Razak, 2003; Almekhlafi & Almeqdadi, 2010; Andoh, 2012; Dawes, 2000; Dussick, 1998; Espinosa & Chen, 1996; Koh & Frick, 2009; Larner & Timberlake, 1995; Russell & Bradley, 1997; Wong, 2002). This current study also revealed that inadequacy of ICT integration knowledge and lack of confidence in teaching and learning processes among Malaysian polytechnic lecturers contributes to the low utilization of ICT to promote students' HOTs learning outcomes.

Most of the participants (84%) in this study indicated that they have taken ICT-related classes, courses, workshops, and seminars since becoming a lecturer. This is a positive finding that lecturers are continuing to learn the latest ICT tools and applications. In addition, the current study supports the finding that ICT training and support should be done along with or as a supplement to constructive teaching methods in order for successful ICT integration within a constructivist approaches to occur (Battista & Borrow, 1998; Christensen & Knezek, 2009; Kanowith-Klein, Burch, & Stevens, 1998; Russell et al., 2003; Ullman, 2007).

One of the biggest challenges in the progress of mathematics teaching and learning is integrating the power of ICT. Teaching in a systematic way is required and in the process of developing knowledge through appropriate methods, they need to induce effective learning, with the emphasis on the process of learning activity that happened in the classroom. Both the teaching and the learning play pivotal roles in mathematics education. Generally, the teacher-centered method is being used in the most of the mathematic classes and this method is influenced by traditional methods (Haggarty & Pepin, 2002; Tengku Zainol, 2002). Similar findings were reported in the present study because the polytechnic mathematics lecturers were likely to use teacher-centric strategies as the dominant method for classroom interaction. With this type of teaching approach, students are likely to memorize mathematical formulas and concepts without understanding the concepts behind them. However, Malaysian polytechnic lecturers should be able to improvise teaching when and where necessary. Various approaches can be used to heighten students' mathematical knowledge and reasoning skills (Marzano, Norford, Paynter, Pickering, & Gaddy, 2001; Noor Azlan, 1987; Zakaria, Harun, & Tahar, 2007). The emergence of ICT provides a platform that could help teachers in teaching of mathematical concepts and reasoning skills (Abu Bakar et al., 2008; Oldknow & Taylor, 2000). ICT utilization in mathematics education could make the teaching and learning methods of the course content more current and intriguing, in contrast to the traditional method (Mohd Nordin & Zakaria, 2007).

Research on mathematics teachers' use of ICT has established a wide range of factors influencing its implementation and curriculum integration. These include: (1) skill and previous experience in utilizing ICT, (2) time and opportunities to learn, (3) accessibility to facilities, (4) availability of appropriate teaching and learning materials, (5) technical support, (6) support from colleagues and administration, (7) curriculum and assessment requirements, (8) how teachers interpret these for students perceived to have different mathematical abilities, (9) knowledge of how to integrate ICT into mathematics teaching, (10) beliefs about mathematics and how it is learned, and (11) beliefs about the role of ICT in mathematics education (Fine & Fleener, 1994; Forgasz & Prince, 2001; Manoucherhri, 1999; Norton & Cooper, 2001; Simmt, 1997; Simonsen & Dick, 1997).

In the present study, polytechnic mathematics lecturers recognized the use of ICT in their mathematics lessons, but they did not fully utilized ICT in ways that would facilitate HOTs among their students. They were striving to utilize ICT where it was fitting and where it enhanced learning. Factors like, low levels of knowledge and skills for selecting the appropriate software/ applications and access to ICT tools that could encourage students to think mathematically and promoting HOTs were the main deterrent factors for successful ICT utilization. This is important to stress as, inappropriate adoption of ICT can lead to negative effects in learning and teaching because if not properly used it can be a distraction (Johnson & Aragon, 2003; Russell, 1999). These are concerns that need to be addressed in order to support polytechnic mathematics lecturers' efforts to incorporate ICT into classroom practices. With this in mind, the role of ICT in the constructivist classroom is an indicator of changes in Malaysian polytechnic education. Integrating ICT across the curriculum is one way by which technology has transformed the way students learn by interacting among themselves and the instructor, and engaging with the content.

Higher-Order Thinking Skills

Constructivist learning theory recognizes that students need to be exposed to learning experiences that allow them to construct their own knowledge and promote their thinking skills (Cobb, 1994; Driver et al., 1994). The promotion of students' thinking has been the focus in educational landscapes for decades (Boddy et al., 2003; De Bono, 1976; Ennis, 1989; Kuhn, 1999). The design and implementation of teaching-learning that promotes higher-order thinking among students is clearly not a simple project; it defies even the most expert educators (Tobin, Kahle, & Fraser, 1990).

According to Pagrow (1994), educators need to provide the thinking strategies that permit their students to think critically, make decisions, and solve problems in preparing them to face the real-world challenges. Miller (2001) and Rumble (2001) revealed that a shift in pedagogy has been occurring in today's classroom, moving from a transmission approach to constructivist, sociocultural, and metacognitive models. These models use ICT-based learning and are focusing on students' responsibility for their individual learning. Additionally, ICT allows students to work at their own pace and encourages them to take initiative and learn independently. In Asian teacher-centered methods, due to large-sized classes with passive learners and less dialogue in classrooms, it has not been common for educators to engage their students in figuring out the reasons for learning or the anticipated outcomes, because teaching toward testing has been the norm (Dooley, 2003).

Scholars have been offering multiple versions of higher-order thinking definitions; generally they agree that higher-order thinking or learning means the ability to go beyond the information provided, to inculcate a creative and critical-thinking, to possess metacognitive intelligence, and to solve problems (McLoughlin & Luca, 2000). The most frequently concepts used throughout the literature of higher-order thinking are independent thinking skills and moderate judgment qualities (Lipman, 1991; Paul, 1993). Using Bloom's taxonomy as their basis, Newcomb and Trezf's (1987) model for higher-order thinking consists of four cognitive levels: remembering, processing, creating, and evaluating. According to Edwards and Briers (2000), there are different terminologies have been used to elucidate the thinking process: remembering and processing levels were categorized as lower-order thinking, and creating and evaluating levels were identified as HOTs.

Malaysian polytechnic lecturers are expected to teach students at higher-order thinking standards as one of the Malaysian education system objectives is to "develop and enhance students' intellectual capacity with respect to rational, critical, and creative thinking" (Curriculum Development Center [CDC], 1993, p.2). One of the research questions was to determine exactly how lecturers are utilizing ICT and HOTs in their teaching practices. In order to answer the question, polytechnic lecturers were asked their perceptions about the importance of teaching methods and strategies, to provide their brief written lesson plan (in the survey) that used a combination of levels of HOTs and ICT utilization, and the lecturer-made lesson plan in engineering mathematics courses was analyzed.

The use of HOTs or critical-thinking has been recognized to increase student success (Astleitner, 2002; Bissell & Lemons, 2006; Howe, 2000; Johnson & Lamb, 2011; Miri et al., 2007). The following example is an extract from a lecturer-made lesson on civil engineering that required the use of HOTs, meaning students should be capable of evaluate a situation, solving a problem, finding alternative solutions, and being able to support and justify their solutions:

> "Civil Engineering (*Environmental Sciences*): Students will be given a case study (using a block of buildings in the polytechnic). Students have to study the impact and the effectiveness of sun-shading devices in that building block at three different times (morning, afternoon, and evening) through analyzing the form of shadows (if any). Students are required to take photos, draw, and write the findings of the form of shadows. In a group of three or four, students have to discuss the advantages and disadvantages of sun-shading devices in terms of functional, practicality, and aesthetic values."

Several related studies have reported that educators' conceptualization of teaching-learning is mostly that of the traditional instructional model instead of a constructivist instructional model (Barak & Dori, 2005; McKeachie & Svinicki, 2010; Niederhauser & Stoddart, 2001; Tobin & Fraser, 1989; Tobin et al., 1990; Tobin, Tippins, & Hook, 1994; Windschitl, 2003). Although the present study reported that polytechnic lecturers' perceptions of teaching to promote of HOTs appear to be an important issue, the qualitative analysis of lecturer-made lesson plans in engineering mathematics did not fully suggest that various strategies were used effectively to promote HOTs among students, with the exception of problem-solving strategies. Miri et al. (2007) noted that there is a “hole between theory and practice…(among) teachers who claimed to purposely teach for the promotion of HOTs.” (p. 355). If the polytechnic lecturers’ perceptions are “not congruent” with their teaching practices in combination with the Malaysian education system expectations, then the impact of such a mismatch can affect the degree of success of promoting students HOTs outcomes in polytechnic educational settings.

Numerous related research studies on pedagogical approaches that promote thinking skills have concluded that both teacher-centered and learner-centered approaches can develop and promote HOTs (Bourke, 2004; Chelliah, 2001; Lee, 1999; Taylor, 2001). On the other hand, in order to develop a more independent and self-directed learner, learner-centered approaches tend to be more suitable. This study showed that Malaysian polytechnic lecturers seemed to accept that teacher-centered is as important as learner-centered in fostering students’ HOTs learning.

Conclusions

Based on this study, a model to consider possible major factors for teaching practices that support the promotion of students’ HOTs in Malaysian polytechnic institution environment is proposed in Figure 5.1. The polytechnic lecturers’ perceptions are shown to be related to their tendency to optimum use of HOTs instructions. This model essentially incorporates the major factors that are grounded in the constructivist approach and higher-order learning research literature and all are considered to have a significant influence on promoting HOTs teaching and learning.

The model was developed by taking issues/concerns that are grounded in the literature and in the study results, which are sufficient and valid as lenses to capture an overall understanding of the implementation of an innovation in an institution (Hasenfeld, Hill, & Weaver, 2002). Following these, this study proposed this model as a lens to understand the promotion of HOTs in teaching and learning using ICT at Malaysian polytechnic institutions.

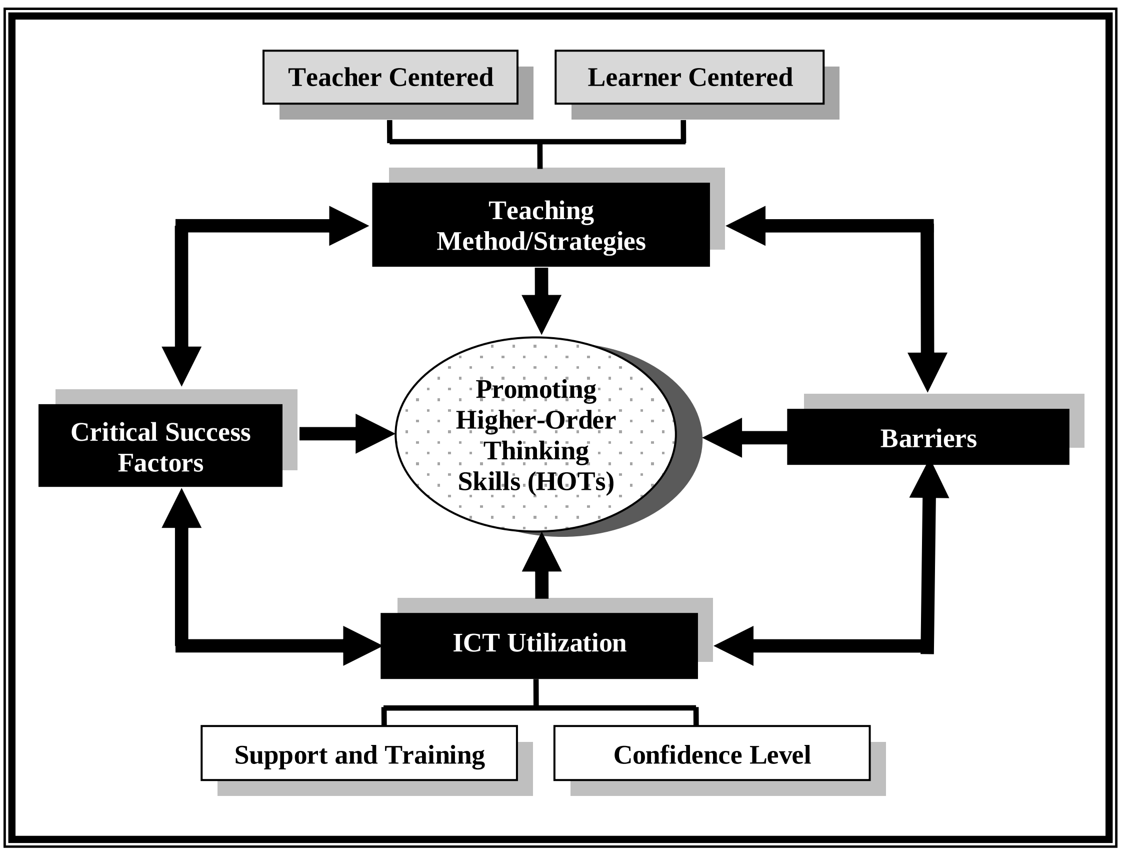

Figure 5.1: Proposed model for the teaching practices with ICT utilization in promoting higher-order thinking skills.

Based on a 389 sample of polytechnic lecturers from three polytechnic institutions in central Malaysia, the following conclusions can be drawn:

1. Polytechnic lecturers believe that higher-order thinking skills for analyzing, synthesizing concepts, and using knowledge to apply to problem solving are important in their course teaching.

2. Most polytechnic lecturers have a positive perception and attitude toward teaching HOTs and they apply HOTs methods and strategies in their course teaching. Again, they believe that teacher-centered teaching methods are as important as learner-centered methods while promoting HOTs.

3. Malaysian polytechnic lecturers believe that problem solving, brainstorming, and use of class discussion of higher-level questions are fruitful strategies to maximize higher-order learning outcomes.

4. Malaysian polytechnic lecturers are aware of HOTs concepts, regardless of the extent to which they actually teach toward HOTs learning.

5. Malaysian polytechnic lecturers across demographic factors of gender, age, academic degree level, years of academic service, and institution acknowledge that promoting HOTs in the classroom is influenced by a variety of teaching methods (teacher-centered and learner-centered) and teaching strategies.

6. Most polytechnic lecturers are positive about ICT utilization in their classroom and they value the use of ICT in promoting HOTs among their students. However, they need appropriate training on ICT integration focusing on pedagogical skills in order to support appropriate ICT utilization in the classroom.

7. Malaysian polytechnic lecturers are using teacher-centered teaching methods. Based on the findings, even though they are using lecture-based methods, they are still enabling HOTs. For example, the open-ended survey responses and lecture-made lesson plans showed that lecturers were planning to aim at upper level at Bloom's Taxonomy such as analysis, synthesis, and evaluation.

Limitations of the Study

There are a few recognized limitations to this study. This study only represents portraits of a convenient group of polytechnic lecturers' teaching practices with the use of ICT to promote HOTs. It does not claim to have captured and related the entire reality about Malaysian polytechnic lecturers' perceptions on that matter, nor does it attempt to discuss teaching practices that represent the entire educational landscapes of Malaysia.

The sample was limited to full-time Malaysian polytechnic lecturers in 2011 that chose to complete the survey. The major limitation of the survey method is that it relies on a self-report response of participants. Misunderstanding of the survey questions or issues of participants could affect the quality of the data. Since the survey was based on the participants' own perceptions, the results might be biased due to their own beliefs and understanding.

The surveys were delivered to 700 polytechnic lecturers at the three polytechnic institutions located in the central area of Malaysia and there were only 389 returned usable survey. There is no reason to assume that these 389 were representative of the 311 who did not respond. That could be a problem in attempting to interpret means and frequencies. For example, more than 75% of those responding said they used HOTs teaching practices and having use of ICT into their course delivery. Would we have done as well with the other 311? This fact limits the generalization of the results. It would generally be assumed that 389 participants from three polytechnics were too small a population to allow the results to be representative of all lecturers in all the different educational institutions.

In terms of survey instrument, the lecturer's perceptions, experiences, and ICT utilization for promoting HOTs were measured using a Likert scale format. Participants might interpret the scale differently from one another, such that one person's four might be equal to another's 5, and still another's 3. They might answer according to what they feel was expected of them as participants, and base answers on feelings toward the subject. The scale also requires a great deal of decision-making. However, according to Tittle and Hill (1967), Likert scales are the most widely used method of scaling in the social sciences discipline as they are much easier to construct and they tend to be more reliable than other scales with the same number of items.

Additionally, since the survey instrument was created in two languages, English and Malay, some meaning might be lost when translating the instrument from English to Malay. The survey instrument was created in English for a USA audience, which might have a different interpretation when used by a Malaysian audience.

Another limitation of this study concerns the fact that it focuses mainly on polytechnic lecturers' perceptions related to their teaching practices to promote HOTs and ICT utilization into teaching and learning at a particular point in time, instead of on the appropriate teaching methods preferences and ICT integration decision process, which takes place over time. For this reason, the significant concerns for lecturer inclinations to utilize or not to utilize ICT for teaching and learning were not investigated in this study.

There was a possibility that the survey used in this study was not sensitive enough to address the research questions adequately. As a way to overcome this limitation, existing documents analysis (lecturer-made lesson plans) was conducted. It is believed that the qualitative data collected from these lesson plans would represent the information that could be attained from other courses and to counter check the response provided by the participants on the survey. Presumably, to get more comprehensive understanding and in-depth pictures of the Malaysian polytechnic lecturers teaching practices with ICT utilization into their teaching and learning, lesson plan analysis from other subjects, class observations and interviews might help in analyzing lecturer's teaching-learning processes and experiences, and exploring their opinion and readiness in using ICT to promote HOTs.

Recommendations

Based on the findings of the study, the following recommendations for improving teaching practices are proposed:

1. Malaysian polytechnic lecturers need to be continuously knowledgeable on HOTs strategies and to adopt them for optimum teaching and learning outcomes. Although the present complexities of teaching large classes in short time periods challenge the use of HOTs strategies, the optimal quality teaching instruction can

produce independent critical and innovative thinking and requires close attention in promoting of HOTs strategies and goals.

2. Polytechnic lecturers should explore how policies for promotion and for teaching and learning evaluation may be designed to recognize and reward teaching and learning that engages students in HOTs activities.

3. Polytechnic institutions should explore and provide professional development opportunities to enhance lecturers' competence in adopting HOTs through the use of ICT. Administrators can offer leadership by involving lecturers in collaborating with policies re-design and curriculum review to further develop HOTs teaching and learning.

4. Polytechnic lecturers need to be aware of the changing expectations of ministry and polytechnic education toward learning, since they are emphasizing optimum learning outcomes instead of meeting minimum standards. With the advent of teaching and learning technology and today's global knowledge, polytechnic lecturers should continue to respond to pressures of students and colleagues to delve into higher-order learning goals, beyond teaching toward factual and procedural routine knowledge.

5. Polytechnic lecturers should be offered thorough professional development programs and training in ICT utilization and constructivist practices that move beyond literacy skills to address more thoroughly application and curriculum integration issues. Training should be provided on a continuous instead of a one-time

only basis, in order to heighten their ICT knowledge and skills. It is expected that the benefits from the use of ICT can be fully realized and optimized in polytechnic teaching and learning. Certain mechanisms need to be put in place to make sure that polytechnic lecturers utilize ICT in teaching and learning delivery, and the training need to be designed to increase lecturers' familiarity with a wider range of ICT applications. They should also be provided the chance and space, and encouraged to reflect on and take decisions about their own ICT growth needs on an ongoing basis.

6. TPACK, the total package required for integrating technology, pedagogy, and content knowledge, offers the dynamic framework for determining lecturers' knowledge necessary in the design of curriculum and instruction and emphasized in the preparation of their students for learning thinking and learning with ICT (Niess, 2008; Mishra & Koehler, 2006, Thompson & Mishra, 2007). Based on the TPACK model, the following dimensions are recommended to be the primary focuses in Malaysian polytechnic professional development programs and training: (1) traditional and modern view of learning, role of ICT in lifelong learning, shift from teaching to learning and constructivism, and (2) pedagogical adaption of ICT, such as specific use of application software in different course contents, appropriate ICT tools and pedagogy, lesson plans integrating ICT, approaches to managing ICT-based learning groups, assessment of learning formulas, and creating teacher and student teaching and learning support resources.

7. As suggested by North Central Regional Educational Laboratory [NCREL] and Metiri Group (2003), three significant mechanisms are needed in order to be successful in promoting HOT skills among polytechnic students. First, the Malaysian public must acknowledge 21st century skills are vital to the education of today's students. Second, polytechnic institutions must embrace new designs for learning based on emerging research about how people learn, information processing, effective uses of ICT, and the 21st century skills in the context of vigorous academic content, and third, the Malaysian Ministry of Higher Education (MOHE), the Department of Polytechnic Education (DPE), and policy makers must base institutions' accountability on assessments that gauge both academic achievement and 21st century skills.

Further Research

Based on this study's results and conclusions, the following recommendations are proposed:

1. This study was focused on Malaysian polytechnic lecturers at three polytechnic institutions regarding their perceptions of promoting HOTs and infusing ICT in their course teaching. Further study should extend to compare polytechnic lecturers who teach engineering program and non-engineering program students in broader populations and with broader program goals to enhance the generalization of the findings in a Malaysian context and investigate potential differences due to varying academic programs among students. Additionally, an analysis of lesson plans

from other courses, class observations and interviews with lecturers should be included as part of the data collection plan.

2. Further studies should be conducted to understand student perceptions of learning HOTs and the use of ICT in their learning and compare the importance of lower-order thinking and higher-order thinking teaching practices for students.

3. Further studies should gauge higher-order learning outcomes in polytechnic institutions that have polytechnic lecturers who demonstrate commitment to HOTs goals. The effect of classroom time scheduling limitations on higher-order learning needs to be further explored.

4. Further studies should investigate the barriers or constraints to integrating ICT into teachers' HOTs teaching. Seeking the relationships between barriers and the possible solutions for decreasing these barriers would be important.

5. Further studies should be carried out, using mixed method research, on how Malaysian polytechnic lecturers practice higher-level instruction and how students view the benefits and drawbacks of HOTs learning and ICT integration. This should examine the relationships among demographic factors and constructivist teaching and learning variables to better understand how these factors affect students' HOTs outcomes.

6. Further studies should assess how Malaysian polytechnic lecturers' and institutions' commitment to utilize ICT and to promote HOTs strategies and goals may affect student learning motivation and retention and how education may be

perceived to provide students with the skills, knowledge, and understanding to lead more fulfilling and productive lives in a rapidly changing world.

Implications of the Study

This study was designed to gain a deeper insight into the reality of ICT utilization and HOTs teaching and learning practices in Malaysian polytechnic institution settings. It is encouraging to find that the majority of polytechnic lecturers are already utilizing ICT and are embedding HOTs into their course teaching lessons. However, there is still a long way to go before they become fully established. The pieces of the study survey can be used as a self-assessment of lecturer's teaching methods. If there are certain pieces that a lecturer is in disagreement with that he/she does anyway, then those are pieces they may wish to learn more about or may wish to try to include in future lessons.

In order to redesign pedagogical approaches in integrating ICT and higher-order thinking culture in the polytechnic classroom, the following should be taken into account: (1) course lessons planning, (2) thinking-based learning, (3) lecturer's initiative, creativity, and innovation, (4) ICT knowledge and skills competencies, (5) thoughtful curriculum, and (5) teaching thinking skills across the curriculum. As our life is becoming more complex, skills, knowledge, and information are the vital inputs in a modern productive system, so critical and creative thinking skills are much required in the Malaysian educational system. So, in accord with the notion of Wilson (2000) that HOTs needs to be incorporated in teaching and learning due to insufficient knowledge storage in student's memory, factual and rote learning has its limitations. Individual students require transferable skills to permit them to address different issues in distinctive contexts at different times throughout their lives (Fisher, 2006).

Shifting the instruction methods progressively, from teacher-centered to learner-centered, in the polytechnic classroom setting is possible. There are four possible implications: (1) polytechnic lecturers should be well equipped with the myriad of methods and approaches of teaching, (2) polytechnic lecturers should be well trained in the culture of thinking in the classroom, (3) institutions and relevant authorities involved in technical education should have goals and directions for developing independent students and thinkers, and (4) institutions and relevant authorities involved in technical education should encourage the implementation of teaching approaches that create thinking students and thinking culture in a continuous manner.

The implications outlined above should serve as practical tools to enhance HOTs among polytechnic students, specifically, and other educational institution students, in general. Furthermore, this study may contribute to the body of literature in both HOTs and in utilization of ICT in teaching-learning areas. Only a few previous studies address this issue directly, especially in the Malaysian polytechnic educational setting. Incorporating the administrators' and communities' viewpoint, and students' perspectives and learning experiences could enhance the literature in understanding and gaining a whole landscape on this issue from a Malaysian polytechnic perspective. The study findings, which supported studies conducted worldwide, can be used by educators and administrators to develop a more holistic and global perspective for a future 21st century technical workforce.

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APPENDIX A: HUMAN SUBJECTS APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Resear
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 7/13/2011

To: Siti Noridah Ali
62C Schilletter Village
Ames, IA 50010

CC: Dr. Ana-Paula Correia
N165B Lagomarcino Hall

From: Office for Responsible Research

Title: Malaysian Polytechnic Lecturers' Teaching Experience and Practices with Information & Communication Technology (ICT) to Promote Higher-Order Thinking Skills (HOTS)

IRB Num: 11-310

Submission Type: New

Exemption Date: 7/10/2011

The project referenced above has undergone review by the Institutional Review Board (IRB) and has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b). The IRB determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as proposed in the IRB application**, including obtaining and documenting informed consent if you have stated in your application that you will do so or if required by the IRB.
- **Any modification of this research should be submitted to the IRB on a Continuing Review and/or Modification form, prior to making any changes**, to determine if the project still meets the federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

Please be sure to **use only the approved study materials** in your research, including the **recruitment materials and informed consent documents that have the IRB approval stamp**.

Please note that you must submit all research involving human participants for review by the IRB. **Only the IRB may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

APPENDIX B: RESEARCH INSTRUMENT (FINAL VERSION)

A Survey on Malaysian Polytechnic Lecturers' Teaching Experience and Practices with Information and Communication Technology (ICT) Utilization to promote Higher-Order Thinking Skills (HOTs)

Kajiselidik Pengalaman Mengajar dan Amalan Pengunaan Teknologi Maklumat dan Komunikasi (TMK) Pensyarah Politeknik Malaysia dalam meningkatkan Kemahiran Berfikir Aras Tinggi (KBAT)

Section I: Polytechnic Lecturer's Experience
Seksyen I: Pengalaman Pensyarah Politeknik

Definition/*Definisi*
Higher-order thinking skills (HOTs) - focuses on the last three levels of Bloom's Taxonomy:

- ability to **analyze** (emphasize the breakdown of the material into its constituent parts and detection of the relationship of the parts)
- ability to **synthesize** (putting together elements and parts of ideas and concepts so as to form a whole)
- ability to **evaluate** (making judgments about the value of something for some purpose as related to ideas, works, solutions, methods, or materials)

This thinking skill is similar to critical thinking, creative thinking, and problem-solving which is in contrast to memorize the series of facts.

Kemahiran Berfikir Aras Tinggi: fokus kepada tiga aras terakhir Taxonomy Bloom:

- *kemahiran dan kemampuan **menganalisa** (menklasifikasikan maklumat kepada beberapa bahagian kecil supaya boleh mencari hubungkait antara bahagian-bahagian tersebut)*
- *kemahiran dan kemampuan **mensistesis** (maklumat dikumpul dan membina struktur baru yang berbeza daripada keadaan yang asal)*
- *kemahiran dan kemampuan **menilai** (membuat penilaian berkaitan dengan idea, kerja, penyelesaian, kaedah, dan bahan)*

Kemahiran ini mirip kepada pemikiran kritis, pemikiran kreatif, dan penyelesaian masalah dan ianya berbeza dengan hanya menghafal fakta.

Directions: Please **circle** the importance of the following statement based on your experience in promoting Higher-Order Thinking skills (HOTs) in your teaching. Use the following scale: (1) = Not Important, (2) = Minimally Important, (3) = Moderately Important, (4) = Important, (5) = Very Important, and (NA) = Not Applicable (if this method is not apply in your teaching).

*Arahan: Sila **bulatkan** kepentingan pernyataan-pernyataan berikut berdasarkan kepada pengalaman anda dalam meningkatkan Kemahiran Berfikir Aras Tinggi yang diamalkan dalam proses pengajaran mengikut skala berikut: (1) = Tidak Penting, (2) =Agak Penting, (3) = Sederhana Penting, (4) = Penting, (5) = Sangat Penting, dan (NA) = Tidak berkenaan (sekiranya kaedah tersebut tidak digunakan dalam proses pengajaran anda).*

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
Teaching Methods & Approaches/*Kaedah dan Pendekatan Pengajaran*								
A.	**How do you rate the importance of the following factors influence your current teaching methods?** ***Bagaimanakah anda menilai kepentingan faktor-faktor di bawah mempengaruhi kaedah pengajaran anda pada masa kini?***							
	1.	Teaching experience. *Pengalaman mengajar*	1	2	3	4	5	NA
	2.	Personal beliefs about effective teaching methods. *Kepercayaan mengenai kaedah pengajaran yang berkesan.*	1	2	3	4	5	NA
	3.	Current ICT changes. *Perubahan ICT semasa.*	1	2	3	4	5	NA
	4.	Class size *Saiz kelas*	1	2	3	4	5	NA
	5.	Requirement by institution to promote higher-order thinking skills in teaching learning process. *Keperluan institusi politeknik untuk meningkatkan kemahiran berfikiran aras tinggi dalam proses pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	6.	Training on effective teaching methods. *Latihan/Kursus terkini berkenaan kaedah pengajaran terkini berkesan.*	1	2	3	4	5	NA
B.	**How do you rate the importance of using of the following teaching methods/approaches?** ***Bagaimanakah anda menilai kepentingan penggunaan kaedah/pendekatan pengajaran berikut dalam proses pengajaran dan pembelajaran anda?***							
	7.	Lecturing. *Memberi syarahan/kuliah.*	1	2	3	4	5	NA
	8.	Asking students to memorize content accurately. *Meminta pelajar mengingati kandungan kursus dengan tepat.*	1	2	3	4	5	NA
	9.	Covering all of the syllabus content in class *Mengajar keseluruhan silibus kursus di dalam kelas.*	1	2	3	4	5	NA
	10.	Engaging students in dialogue. *Melibatkan pelajar dalam sesi dialog.*	1	2	3	4	5	NA
	11.	Building student oral presentation skills in class. *Membina kemahiran penyampaian/persembahan lisan pelajar dalam kelas.*	1	2	3	4	5	NA

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
	12.	Encouraging students to reflect on their experiences. *Menggalak pelajar membuat refleksi tentang pengalaman pembelajaran mereka.*	1	2	3	4	5	NA
	13.	Encouraging students to find varied correct answer. *Menggalak pelajar memberi pelbagai jawapan yang tepat.*	1	2	3	4	5	NA
	14.	Using student small group activities. *Menggunakan aktiviti latihan dalam kumpulan bersaiz kecil.*	1	2	3	4	5	NA
	15.	Stretching students to think beyond the reading. *Memberi penekanan supaya pelajar berfikir lebih daripada bacaan yang dicadangkan.*	1	2	3	4	5	NA
	16.	Assessing students' learning with objective testing. *Menilai pembelajaran pelajar berdasarkan penilaian secara objektif.*	1	2	3	4	5	NA
	17.	Sequencing questions from concrete to abstract. *Menyusunaturkan soalan dari konkrit ke abstrak.*	1	2	3	4	5	NA
	18.	Creating atmosphere for exploration of ideas. *Mencipta suasana untuk eksplorasi idea.*	1	2	3	4	5	NA
	19.	Discussing how content may relate to career preparation. *Berbincang bagaimana kandungan kursus boleh dikaitkan dengan persediaan karier.*	1	2	3	4	5	NA
	20.	Reflecting on how content has meaning for life. *Refleksi bagaimana kandungan kursus memberi makna di dalam kehidupan.*	1	2	3	4	5	NA
Teaching Strategies/*Strategi Pengajaran*								
C.	**How do you rate the importance of using the following teaching strategies to encourage students to reach higher-order thinking skills outcome?** ***Bagaimanakah anda menilai kepentingan penggunaan strategi pengajaran di bawah boleh mengalakkan pelajar mencapai hasil pembelajaran kemahiran berfikir aras tinggi?***							
	21.	Class discussion of increasing higher levels of questions. *Aktiviti perbincangan di dalam kelas meningkatkan soalan berbentuk aras tinggi.*	1	2	3	4	5	NA
	22.	Brainstorming to engage students in speculation. *Aktiviti sumbangsaran melibatkan pelajar untuk menghasilkan rumusan.*	1	2	3	4	5	NA

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
	23.	Problem solving for hands-on experiences. *Penyelesaian masalah secara 'hands-on'.*	1	2	3	4	5	NA
	24.	Case study analysis *Analisis kajian kes*	1	2	3	4	5	NA
	25.	Project-Based Learning *Pembelajaran Berasaskan Projek*	1	2	3	4	5	NA
	26.	Field trips *Lawatan ke Lapangan*	1	2	3	4	5	NA
	27.	Engagement with guest speakers. *Melibatkan penceramah jemputan.*	1	2	3	4	5	NA
	28.	Others (Please specify)/*Lain-lain, nyatakan* ______________________________ ______________________________						

Barriers/*Halangan*

D.	**How do the following factors prevent you from effectively promoting higher-order thinking skills in your teaching?** ***Bagaimana faktor-faktor di bawah menghalang anda dalam meningkatkan kemahiran berfikir aras tinggi dikalangan pelajar semasa proses pengajaran?***							
	29.	Time consuming *Memerlukan banyak masa.*	1	2	3	4	5	NA
	30.	Students lack of preparation *Pelajar kurang bersedia*	1	2	3	4	5	NA
	31.	Traditional lecture and objective testing approach *Kuliah/Pengajaran secara traditional dan pendekatan penilaian berasaskan objektif.*	1	2	3	4	5	NA
	32.	Others (Please specify)/*Lain-lain, nyatakan* ______________________________ ______________________________						

Section II: ICT Utilization Practices
Seksyen II: Amalan Penggunaan TMK

Information and Communication Technology (ICT): It includes hardware (computers, handheld devices, printer, digital cameras), software and system application (programming, productivity software), media (internet and videoconferencing), and the networks that tie computers together.

Teknologi Maklumat dan Komunikasi (TMK): merangkumi perkakasan (komputer, peranti bimbit, pencetak, kamera digital), perisian dan aplikasi sistem (pengaturcaraan, perisian produktiviti), media (internet dan video persidangan), dan sistem rangkaian komputer.

Directions: *Please* check ☑ *the best response*
Arahan: Sila tandakan ☑ *pada jawapan yang bersesuaian*

1. How would you rate your computer skills?
   Bagaimanakah anda menilai kemahiran penggunaan komputer anda?
   - ❑ Very Advanced/*Sangat Luas*
   - ❑ Limited/*Terhad*
   - ❑ Advanced/*Luas*
   - ❑ Very Limited/*Sangat Terhad*
   - ❑ Average/*Sederhana*

2. Were you required to take an ICT course prior to your graduation from college?
   Adakah anda perlu mengambil kursus berkaitan dengan TMK semasa di peringkat kolej/maktab/universiti?
   - ❑ Yes/*Ya*
   - ❑ No/*Tidak*

3. Have you taken any ICT related training, courses, workshops, seminars, or online sessions since becoming a lecturer?
   Adakah anda pernah mengikuti latihan, kursus, bengkel, seminar, atau sesi pembelajaran online berkaitan dengan TMK sepanjang perkhidmatan anda sebagai pensyarah?
   - ❑ Yes/*Ya*
   - ❑ No/*Tidak*

4. If you answer "**Yes**" to the above question, how many classes have you taken?
   Jika anda menjawab ***"Ya"*** *pada soalan di atas, berapa banyak kelas yang telah anda ikuti?*
   - ❑ 1-2
   - ❑ 3 -5
   - ❑ 6 or more/*6 atau lebih*

5. Have you taken any higher-order thinking skills related training, courses, workshops, or seminars since becoming a lecturer?
   Adakah anda pernah mengikuti latihan, kursus, bengkel, atau seminar berkaitan dengan pengajaran kemahiran berfikir aras tinggi sepanjang perkhidmatan anda sebagai pensyarah?
   - ❑ Yes/*Ya*
   - ❑ No/*Tidak*

6. What types of ICT tools and application do your students and you use in the teaching learning process? Please choose all that applies.
Apakah jenis peralatan dan aplikasi Teknologi dan Komunikasi Maklumat (TMK) yang telah anda dan pelajar anda gunakan dalam pengajaran dan pembelajaran anda? Sila pilih yang berkenaan.

		Modeled by Lecturer *Model oleh Pensyarah*	Required of the students *Keperluan Pelajar*	Not Available *Tidak Berkenaan*
Tools				
a.	Digital Cameras/Scanners *Kamera digital/Pengimbas*	❑	❑	❑
b.	Video Conferencing /Telecommunication *Video Persidangan /Telekomunikasi*	❑	❑	❑
c.	Simulation Machine/Smart Board (Interactive White Board) *Mesin Simulasi/ Papan Pintar Interaktif*	❑	❑	❑
d.	Computer/Computer Assisted Instruction (CAI) *Komputer/Komputer Berasaskan Pengajaran*	❑	❑	❑
e.	Computer Networking System *Sistem Rangkaian Komputer*	❑	❑	❑
f.	Others (Please specify)/*Lain-lain, nyatakan* ________________			
Application				
a.	Desktop Application (eg. Word, Excel, Publisher) *Aplikasi Meja (Word, Excel, Publisher)*	❑	❑	❑
b.	Databases (eg. Access) *Pangkalan Data (Access)*	❑	❑	❑
c.	Presentation Software (eg. Power Point etc.) *Aplikasi/Perisian Perbentangan (Power Point dll.)*	❑	❑	❑
d.	Hypermedia/Multimedia Software/Web Design *Perisian Hipermedia/Multimedia/ Rekabentuk Web*	❑	❑	❑
e.	Internet *Internet*	❑	❑	❑
f.	Course/Campus Management System (eg. Blackboard, WebCT, Angle, etc.) *Sistem Pengurusan Kursus/Kampus (cth: Blackboard, WebCT, dll)*	❑	❑	❑

		Modeled by Lecturer *Model oleh Pensyarah*	Required of the students *Keperluan Pelajar*	Not Available *Tidak Berkenaan*
g.	Media Communication (email)/ *Komunikasi Media (email)*	☐	☐	☐
h.	Web 2.0 (Blog, Wikis, YouTube etc)/Social Networking (Facebook/Twitter)/ *Web 2.0 (Blog, Wikis, YouTube dll)/ Rangkaian sosial (Facebook, Twitter dll.)*	☐	☐	☐
i.	Others (Please specify)/*Lain-lain, nyatakan* ____ ____			

Directions: Please **circle** your response using the following scale: (1) = Strongly Disagree, (2) = Disagree, (3) = Neutral, (4) = Agree, (5) = Strongly Agree, and (NA) = Not Applicable (if it does not apply in your teaching learning process).

*Arahan: Sila **bulatkan** respon anda megikut skala berikut: (1) = Sangat tidak setuju, (2) = Tidak setuju, (3) =Neutral, (4) = Setuju, dan (5) = Sangat setuju dan (NA) = Tidak berkenaan (sekira ianya tidak digunakan dalam proses pengajaran dan pembelajaran anda).*

			Strongly Disagree *Sangat tidak setuju*	Disagree *Tidak setuju*	Neutral *Neutral*	Agree *Setuju*	Strongly Agree *Sangat Setuju*	Not Applicable *Tidak Berkenaan*
7.	**How do you see ICT fitting into your teaching practices?** ***Bagaimanakah anda melihat kesesuaian penggunaan TMK dalam amalan pengajaran?***							
	a.	My polytechnic provides me the training I need so I confidently use ICT for teaching. *Politeknik menyediakan latihan yang saya perlukan supaya saya berkeyakinan menggunakan TMK dalam pengajaran.*	1	2	3	4	5	NA
	b.	My polytechnic provides me enough time to plan to use ICT for teaching and learning. *Politeknik memberi saya masa yang mencukupi untuk merancang penggunaan TMK dalam pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	c.	My polytechnic provides me sufficient ICT for teaching and learning. *Politeknik memberi saya kemudahan TMK yang mencukupi untuk tujuan pengajaran dan pembelajaran.*	1	2	3	4	5	NA

			Strongly Disagree *Sangat tidak setuju*	Disagree *Tidak setuju*	Neutral *Neutral*	Agree *Setuju*	Strongly Agree *Sangat Setuju*	Not Applicable *Tidak Berkenaan*
	d.	It is important for polytechnic lecturers to use ICT in their teaching. *Adalah penting untuk pensyarah politeknik menggunakan TMK dalam pengajaran dan pembelajaran mereka.*	1	2	3	4	5	NA
	e.	I am confident in my ability to use ICT in the classroom. *Saya yakin dengan kemampuan saya untuk menggunakan TMK dalam pengajaran dan pembelajaran saya.*	1	2	3	4	5	NA
8.	**As a polytechnic lecturer, I:** ***Sebagai pensyarah politeknik, saya:***							
	a.	Use ICT tools and resources to increase teaching productivity. *Menggunakan alatan dan sumber TMK untuk meningkatkan produktiviti pengajaran.*	1	2	3	4	5	NA
	b.	Use ICT tools and resources to promote creativity. *Menggunakan alatan dan sumber TMK untuk meningkatkan kreativiti pengajaran.*	1	2	3	4	5	NA
	c.	Use ICT tools and resources to facilitate student learning. *Menggunakan alatan dan sumber TMK untuk memudahkan pembelajaran pelajar.*	1	2	3	4	5	NA
	d.	Use ICT tools and resources to facilitate higher-order/ complex thinking skills, including problem solving, critical thinking, informed decision-making, knowledge construction, and creativity. *Menggunakan alatan dan sumber TMK untuk memudahcara kemahiran berfikir aras tinggi termasuk menyelesaikan masalah, pemikiran kritis, membuat keputusan, pembinaan pengetahuan, dan kreativiti.*	1	2	3	4	5	NA
	e.	Identify the benefits of ICT to maximize student learning. *Mengenalpasti kelebihan penggunaan TMK dalam memaksimakan pembelajaran pelajar.*	1	2	3	4	5	NA
	f.	Identify the benefits of ICT to facilitate higher-order thinking skills (HOTs). *Mengenalpasti kelebihan penggunaan TMK dalam memudahcara kemahiran berfikir aras tinggi.*	1	2	3	4	5	NA
	g.	Use ICT hardware and software specifically designed to meet specific teaching and learning objectives. *Menggunakan perkakasan dan perisian TMK yang direkabentuk atau dibangunkan khas untuk mencapai objektif pengajaran dan pembelajaran.*	1	2	3	4	5	NA

			Strongly Disagree *Sangat tidak setuju*	Disagree *Tidak setuju*	Neutral *Neutral*	Agree *Setuju*	Strongly Agree *Sangat Setuju*	Not Applicable *Tidak Berkenaan*
	h.	Plan/Teach student-centered learning activities and lessons in which students apply ICT tools and resources. *Merancang/Mengajar kandungan kursus dan aktiviti pembelajaran berpusatkan pelajar (pelajar mengaplikasikan alatan dan sumber TMK).*	1	2	3	4	5	NA
	i.	Use ICT to collect, analyze, interpret, represent, and report student performance data. *Menggunakan TMK dalam mengumpul, menganalisa, mentafsir, membentang, dan melaporkan data pencapaian pelajar.*	1	2	3	4	5	NA
	j.	Integrate ICT-based assessment strategies and tools into plans for evaluating specific learning activities. *Mengintegrasikan strategi dan alat penilaian berasaskan TMK dalam merancang penilaian aktiviti pembelajaran yang spesifik.*	1	2	3	4	5	NA

Open-Ended Question/*Soalan Terbuka*

1. In brief, please describe one of your best lesson plans that have shown the use of ICT (if any) in your teaching to promote higher-order thinking skills (analysis, synthesis, and/or evaluation). *Dengan ringkas, terangkan rancangan mengajar anda yang paling jelas menunjukkan penggunaan TMK dalam meningkatkan kemahiran berfikir aras tinggi (analisis, sinthesis, dan penilaian) semasa proses pengajaran dan pembelajaran anda.*

   Course/*Kursus:* ______________________________________

   Brief Description/*Deskripsi Ringkas*:

   Analysis/*Menganalisis*
   (eg. In my Marketing classes, my students are required to find online articles about marketing. They have to analyze if the information in the articles they read is valid based on the marketing principles they have learned in class /*Dalam kelas Pemasaran saya, pelajar dikehendaki mendapatkan artikel-artikel secara online mengenai pemasaran. Pelajar perlu menganalisa maklumat-maklumat dalam artikel tersebut dan menentukan ketepatan maklumat-maklumat tersebut berdasarkan kepada prisip pemasaran yang telah dipelajari*).

   ____
   ____
   ____
   ____
   ____
   ____
   ____

   Synthesis/*Mensinthesis*
   (eg. They have to write a summary paper of the articles that will include consideration of the marketing principles they have learned in class /*Pelajar dikehendaki menghasilkan ringkasan artikel-artikel tersebut dengan mengambilkira prinsip pemasaran yang telah dipelajari*)

   ____
   ____
   ____
   ____
   ____
   ____

Evaluate/*Menilai*
(eg. They need to be able to defend their point of view /*Pelajar juga dikehendaki memberi justifikasi yang jelas atas pandangan/pendapat yang diberikan*)

ICT Utilization to promote HOTs (*Please explain HOW you use ICT to promote HOTs)/Penggunaan TMK (Sila terangkan bagaimana anda menggunakan TMK dalam meningkatkan kemahiran berfikir aras tinggi pelajar)*
(eg. Use internet tools to search the articles, Ms Word to write a summary paper, and Ms Power Point for a class presentation /*Menggunakan internet untuk mencari/mendapatkan artikel, Menggunakan Ms Word untuk penulisan ringkasan, Menggunakan Ms Power Point untuk aktiviti perbentangan dalam kelas*)

Section III: Demographic Information
Seksyen III: Maklumat Demografi

Direction: Please check ☑ the appropriate response for each item
Arahan: Tandakan ☑ pada yang berkenaan untuk setiap item dibawah

1. Gender/*Jantina*:
   - ❑ Male/*Lelaki*
   - ❑ Female/*Perempuan*

2. Age/*Umur*:
   - ❑ Below 25 years/*25 tahun ke bawah*
   - ❑ 25- 35 years/*25 -35 tahun*
   - ❑ 36- 45 years/*36 -45 tahun*
   - ❑ 46- 55 years/*46 -55 tahun*
   - ❑ Over 55/*55 tahun ke atas*

3. Highest academic degree level/*Tahap pendidikan tertinggi*:
   - ❑ Diploma/*Diploma*
   - ❑ Bachelor's Degree/*Ijazah Sarjana Muda*
   - ❑ Master's Degree/*Ijazah Sarjana*
   - ❑ Doctorate/*Ijazah Kedoktoran*
   - ❑ Pursuing master/*Sedang melanjutkan pelajaran ke peringkat sarjana*
   - ❑ Pursuing doctorate/*Sedang melanjutkan pelajaran ke peringkat kedoktoran*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ____________________________

4. Position Grade/*Gred Jawatan*:
   - ❑ DH28-DH36 (Lecturer Grade) /*DH28-DH36 (Gred Pensyarah)*
   - ❑ DH41 (Lecturer Grade)/*DH41 (Gred Pensyarah)*
   - ❑ DH44 (Lecturer Grade)/*DH44 (Gred Pensyarah)*
   - ❑ DH48 (Lecturer Grade)/*DH48 (Gred Pensyarah)*
   - ❑ DH52 (Lecturer Grade)/*DH52 (Gred Pensyarah)*
   - ❑ DH54 (Lecturer Grade)/*DH54 (Gred Pensyarah)*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ____________________________

5. Length of service as a Polytechnic lecturer /*Tempoh tahun berkhidmat sebagai pensyarah Politeknik*
   - ❑ Below 3 years/*Kurang 3 tahun*
   - ❑ 3–5 years/*3-5 tahun*
   - ❑ 6–10 years/*6-10 tahun*
   - ❑ 11–15 years/*11-15 tahun*
   - ❑ 16–20 years/*16-20 tahun*
   - ❑ Over 21 years/*Melebihi 21 tahun*

6. Academic Department/*Jabatan Akademik* (Select One as Primary/*Pilih satu yang utama*)
   - ❑ Commerce/*Perdagangan*
   - ❑ Civil Engineering/*Kejuruteraan Awam*
   - ❑ Electrical Engineering/*Kejuruteraan Elektrik*
   - ❑ Mechanical Engineering/*Kejuruteraan Mekanikal*
   - ❑ Marine Engineering/*Kejuruteraan Perkapalan*
   - ❑ Aircraft Maintenance/*Penyenggaraan Pesawat*
   - ❑ Information Technology/*Teknologi Maklumat*
   - ❑ Tourism & Hospitality/*Pelancongan & Hospitaliti*
   - ❑ General Studies/*Pengajian Am*
   - ❑ Mathematics, Science & Computer/*Matematik, Sains & Komputer*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ______________________

7. Polytechnic/*Politeknik*:

   ❑ PUO ❑ PSA ❑ PSIS

Thank you. Your participation is highly appreciated.
Terima kasih. Kerjasama anda adalah sangat dihargai.

Thank you very much for your valuable time and your contribution to the polytechnic institutions!

APPENDIX C: RESEARCH INSTRUMENT (PILOT STUDY)

A Survey on Malaysian Polytechnic Lecturers' Teaching Experience and Practices with Information and Communication Technology (ICT) Utilization to promote Higher-Order Thinking Skills (HOTs)

Kajiselidik Pengalaman Mengajar dan Amalan Pengunaan Teknologi Maklumat dan Komunikasi (TMK) Pensyarah Politeknik Malaysia dalam meningkatkan Kemahiran Berfikir Aras Tinggi (KBAT)

Section I: Polytechnic Lecturer's Experience
Seksyen I: Pengalaman Pensyarah Politeknik

Definition/*Definisi*
Higher-order thinking skills (HOTs) - focuses on the last three levels of Bloom's Taxonomy:

- ability to **analyze** (emphasize the breakdown of the material into its constituent parts and detection of the relationship of the parts)
- ability to **synthesize** (putting together elements and parts of ideas and concepts so as to form a whole)
- ability to **evaluate** (making judgments about the value of something for some purpose as related to ideas, works, solutions, methods, or materials)

This thinking skill is similar to critical thinking, creative thinking, and problem-solving which is in contrast to memorize the series of facts.

Kemahiran Berfikir Aras Tinggi: fokus kepada tiga aras terakhir Taxonomy Bloom:

- *kemahiran dan kemampuan **menganalisa** (menklasifikasikan maklumat kepada beberapa bahagian kecil supaya boleh mencari hubungkait antara bahagian-bahagian tersebut)*
- *kemahiran dan kemampuan **mensistesis** (maklumat dikumpul dan membina struktur baru yang berbeza daripada keadaan yang asal)*
- *kemahiran dan kemampuan **menilai** (membuat penilaian berkaitan dengan idea, kerja, penyelesaian, kaedah, dan bahan)*

Kemahiran ini mirip kepada pemikiran kritis, pemikiran kreatif, dan penyelesaian masalah dan ianya berbeza dengan hanya menghafal fakta.

Directions: Please **circle** the importance of the following statement based on your experience in promoting Higher-Order Thinking skills (HOTs) in your teaching. Use the following scale: (1) = Not Important, (2) = Minimally Important, (3) = Moderately Important, (4) = Important, (5) = Very Important, and (NA) = Not Applicable (if this method is not apply in your teaching).

*Arahan: Sila **bulatkan** kepentingan pernyataan-pernyataan berikut berdasarkan kepada pengalaman anda dalam meningkatkan Kemahiran Berfikir Aras Tinggi yang diamalkan dalam proses pengajaran mengikut skala berikut: (1) = Tidak Penting, (2) =Agak Penting, (3) = Sederhana Penting, (4) = Penting, (5) = Sangat Penting, dan (NA) = Tidak berkenaan (sekiranya kaedah tersebut tidak digunakan dalam proses pengajaran anda).*

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
Teaching Methods & Approaches/*Kaedah dan Pendekatan Pengajaran*								
A.	**How do you rate the importance of the following factors influence your current teaching methods?** ***Bagaimanakah anda menilai kepentingan faktor-faktor di bawah mempengaruhi kaedah pengajaran anda pada masa kini?***							
	1.	Teaching experience. *Pengalaman mengajar*	1	2	3	4	5	NA
	2.	Modeling other lecturer colleagues. *Rakan pensyarah sebagai 'role model'.*	1	2	3	4	5	NA
	3.	Personal beliefs about effective teaching methods. *Kepercayaan mengenai kaedah pengajaran yang berkesan.*	1	2	3	4	5	NA
	4.	Current ICT changes. *Perubahan ICT semasa.*	1	2	3	4	5	NA
	5.	Class size *Saiz kelas*	1	2	3	4	5	NA
	6.	Requirement by institution to promote higher-order thinking skills in teaching learning process. *Keperluan institusi politeknik untuk meningkatkan kemahiran berfikiran aras tinggi dalam proses pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	7.	Training on effective teaching methods. *Latihan/Kursus terkini berkenaan kaedah pengajaran terkini berkesan.*	1	2	3	4	5	NA
B.	**How do you rate the importance of using of the following teaching methods/approaches?** ***Bagaimanakah anda menilai kepentingan penggunaan kaedah/pendekatan pengajaran berikut dalam proses pengajaran dan pembelajaran anda?***							
	8.	Lecturing. *Memberi syarahan/kuliah.*	1	2	3	4	5	NA
	9.	Asking students to memorize content accurately. *Meminta pelajar mengingati kandungan kursus dengan tepat.*	1	2	3	4	5	NA
	10.	Covering all of the syllabus content in class *Mengajar keseluruhan silibus kursus di dalam kelas.*	1	2	3	4	5	NA
	11.	Discussing course content with the classes. *Berbincang mengenai kandungan kursus dengan pelajar.*	1	2	3	4	5	NA

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
	12.	Engaging students in dialogue. *Melibatkan pelajar dalam sesi dialog.*	1	2	3	4	5	NA
	13.	Building student oral presentation skills in class. *Membina kemahiran penyampaian/persembahan lisan pelajar dalam kelas.*	1	2	3	4	5	NA
	14.	Encouraging students to reflect on their experiences. *Menggalak pelajar membuat refleksi tentang pengalaman pembelajaran mereka.*	1	2	3	4	5	NA
	15.	Encouraging students to find varied correct answer. *Menggalak pelajar memberi pelbagai jawapan yang tepat.*	1	2	3	4	5	NA
	16.	Using student small group activities. *Menggunakan aktiviti latihan dalam kumpulan bersaiz kecil.*	1	2	3	4	5	NA
	17.	Stretching students to think beyond the reading. *Memberi penekanan supaya pelajar berfikir lebih daripada bacaan yang dicadangkan.*	1	2	3	4	5	NA
	18.	Assessing students' learning with objective testing. *Menilai pembelajaran pelajar berdasarkan penilaian secara objektif.*	1	2	3	4	5	NA
	19.	Sequencing questions from concrete to abstract. *Menyusunaturkan soalan dari konkrit ke abstrak.*	1	2	3	4	5	NA
	20.	Creating atmosphere for exploration of ideas. *Mencipta suasana untuk eksplorasi idea.*	1	2	3	4	5	NA
	21.	Discussing how content may relate to career preparation. *Berbincang bagaimana kandungan kursus boleh dikaitkan dengan persediaan karier.*	1	2	3	4	5	NA
	22.	Reflecting on how content has meaning for life. *Refleksi bagaimana kandungan kursus memberi makna di dalam kehidupan.*	1	2	3	4	5	NA

		Item	Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
Teaching Strategies/*Strategi Pengajaran*								
C.	**How do you rate the importance of using the following teaching strategies to encourage students to reach higher-order thinking skills outcome?** ***Bagaimanakah anda menilai kepentingan penggunaan strategi pengajaran di bawah boleh mengalakkan pelajar mencapai hasil pembelajaran kemahiran berfikir aras tinggi?***							
	23.	Class discussion of increasing higher levels of questions. *Aktiviti perbincangan di dalam kelas meningkatkan soalan berbentuk aras tinggi.*	1	2	3	4	5	NA
	24.	Brainstorming to engage students in speculation. *Aktiviti sumbangsaran melibatkan pelajar untuk menghasilkan rumusan.*	1	2	3	4	5	NA
	25.	Problem solving for hands-on experiences. *Penyelesaian masalah secara 'hands-on'.*	1	2	3	4	5	NA
	26.	Case study analysis *Analisis kajian kes*	1	2	3	4	5	NA
	27.	Project-Based Learning *Pembelajaran Berasaskan Projek*	1	2	3	4	5	NA
	28.	Field trips *Lawatan ke Lapangan*	1	2	3	4	5	NA
	29.	Engagement with guest speakers. *Melibatkan penceramah jemputan.*	1	2	3	4	5	NA
	30.	Others (Please specify)/*Lain-lain, nyatakan* ____________________ ____________________						
Barriers/*Halangan*								
D.	**How do the following factors prevent you from effectively promoting higher-order thinking skills in your teaching?** ***Bagaimana faktor-faktor di bawah menghalang anda dalam meningkatkan kemahiran berfikir aras tinggi dikalangan pelajar semasa proses pengajaran?***							
	31.	Time consuming *Memerlukan banyak masa.*	1	2	3	4	5	NA
	32.	Students lack of preparation *Pelajar kurang bersedia*	1	2	3	4	5	NA
	33.	Traditional lecture and objective testing approach *Kuliah/Pengajaran secara traditional dan pendekatan penilaian berasaskan objektif.*	1	2	3	4	5	NA

			Not Important *Tidak Penting*	Minimally Important *Agak Penting*	Moderately Important *Sederhana Penting*	Important *Penting*	Very Important *Sangat Penting*	Not Applicable *Tidak Berkenaan*
	34.	Low expectations for lower achievers *Pensyarah membuat tanggapan yang rendah kepada pelajar yang mempunyai pencapaian akademik yang kurang memberangsangkan.*	1	2	3	4	5	NA
	35.	Others (Please specify)/*Lain-lain, nyatakan* ________________ ________________						

Section II: ICT Utilization Practices
Seksyen II: Amalan Penggunaan TMK

<u>Information and Communication Technology (ICT)</u>: It includes hardware (computers, handheld devices, printer, digital cameras), software and system application (programming, productivity software), media (internet and videoconferencing), and the networks that tie computers together.

<u>Teknologi Maklumat dan Komunikasi (TMK)</u>: merangkumi perkakasan (komputer, peranti bimbit, pencetak, kamera digital), perisian dan aplikasi sistem (pengaturcaraan, perisian produktiviti), media (internet dan video persidangan), dan sistem rangkaian komputer.

Directions: *Please* check ☑ *the best response*
Arahan: *Sila tandakan ☑ pada jawapan yang bersesuaian*

1. How would you rate your computer skills?
   Bagaimanakah anda menilai kemahiran penggunaan komputer anda?
   - ❑ Very Advanced/*Sangat Luas*
   - ❑ Limited/*Terhad*
   - ❑ Advanced/*Luas*
   - ❑ Very Limited/*Sangat Terhad*
   - ❑ Average/*Sederhana*

2. Were you required to take an ICT course prior to your graduation from college?
   Adakah anda perlu mengambil kursus berkaitan dengan TMK semasa di peringkat kolej/maktab/universiti?
   - ❑ Yes/*Ya*
   - ❑ No/*Tidak*

3. Have you taken any ICT related training, courses, workshops, seminars, or online sessions since becoming a lecturer?
Adakah anda pernah mengikuti latihan, kursus, bengkel, seminar, atau sesi pembelajaran online berkaitan dengan TMK sepanjang perkhidmatan anda sebagai pensyarah?
❑ Yes/*Ya* ❑ No/*Tidak*

4. If you answer "**Yes**" to the above question, how many classes have you taken?
Jika anda menjawab ***"Ya"*** *pada soalan di atas, berapa banyak kelas yang telah anda ikuti?*
❑ 1-2 ❑ 3 -5 ❑ 6 or more/*6 atau lebih*

5. Have you taken any higher-order thinking skills related training, courses, workshops, or seminars sin becoming a lecturer?
Adakah anda pernah mengikuti latihan, kursus, bengkel, atau seminar berkaitan dengan pengajaran kemahiran berfikir aras tinggi sepanjang perkhidmatan anda sebagai pensyarah?
❑ Yes/*Ya* ❑ No/*Tidak*

6. What types of ICT tools and application do your students and you use in the teaching learning proces Please choose all that applies.
Apakah jenis peralatan dan aplikasi Teknologi dan Komunikasi Maklumat (TMK) yang telah anda d pelajar anda gunakan dalam pengajaran dan pembelajaran anda? Sila pilih yang berkenaan.

		Modeled by Lecturer *Model oleh Pensyarah*	Required of the students *Keperluan Pelajar*	Not Available *Tidak Berkenaan*
Tools				
a.	Digital Cameras/Scanners *Kamera digital/Pengimbas*	❑	❑	❑
b.	Video Conferencing /Telecommunication *Video Persidangan /Telekomunikasi*	❑	❑	❑
c.	Simulation Machine/Smart Board (Interactive White Board) *Mesin Simulasi/ Papan Pintar Interaktif*	❑	❑	❑
d.	Computer/Computer Assisted Instruction (CAI) *Komputer/Komputer Berasaskan Pengajaran*	❑	❑	❑
e.	Computer Networking System *Sistem Rangkaian Komputer*	❑	❑	❑
f.	Others (Please specify)/*Lain-lain, nyatakan* ______ ______ ______			

		Modeled by Lecturer *Model oleh Pensyarah*	Required of the students *Keperluan Pelajar*	Not Available *Tidak Berkenaan*
Application				
a.	Desktop Application (eg. Word, Excel, Publisher) *Aplikasi Meja (Word, Excel, Publisher)*	❑	❑	❑
b.	Databases (eg. Access) *Pangkalan Data (Access)*	❑	❑	❑
c.	Presentation Software (eg. Power Point etc.) *Aplikasi/Perisian Perbentangan (Power Point dll.)*	❑	❑	❑
d.	Hypermedia/Multimedia Software/Web Design *Perisian Hipermedia/Multimedia/ Rekabentuk Web*	❑	❑	❑
e.	Internet *Internet*	❑	❑	❑
f.	Course/Campus Management System (eg. Blackboard, WebCT, Angle, etc.) *Sistem Pengurusan Kursus/Kampus (cth: Blackboard, WebCT, Angle, dll)*	❑	❑	❑
g.	Media Communication (email)/ *Komunikasi Media (email)*	❑	❑	❑
h.	Web 2.0 (Blog, Wikis, YouTube etc)/Social Networking (Facebook/Twitter)/ *Web 2.0 (Blog, Wikis, YouTube dll)/ Rangkaian sosial (Facebook, Twitter dll.)*	❑	❑	❑
i.	Others (Please specify)/*Lain-lain, nyatakan* ____________________ ____________________			

Directions: Please **circle** your response using the following scale: (1) = Strongly Disagree, (2) = Disagree, (3) = Neutral, (4) = Agree, (5) = Strongly Agree, and (NA) = Not Applicable (if it does not apply in your teaching learning process).

Arahan*: Sila* ***bulatkan*** *respon anda megikut skala berikut: (1) = Sangat tidak setuju, (2) = Tidak setuju, (3) =Neutral, (4) = Setuju, dan (5) = Sangat setuju dan (NA) = Tidak berkenaan (sekira ianya tidak digunakan dalam proses pengajaran dan pembelajaran anda)..*

			Strongly Disagree *Sangat tidak setuju*	Disagree *Tidak setuju*	Neutral *Neutral*	Agree *Setuju*	Strongly Agree *Sangat Setuju*	Not Applicable *Tidak Berkenaan*
7.	**How do you see ICT fitting into your teaching practices?** ***Bagaimanakah anda melihat kesesuaian penggunaan TMK dalam amalan pengajaran?***							
	a.	My polytechnic provides me the training I need so I confidently use ICT for teaching. *Politeknik menyediakan latihan yang saya perlukan supaya saya berkeyakinan menggunakan TMK dalam pengajaran.*	1	2	3	4	5	NA
	b.	My polytechnic provides me enough time to plan to use ICT for teaching and learning. *Politeknik memberi saya masa yang mencukupi untuk merancang penggunaan TMK dalam pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	c.	My polytechnic provides me sufficient ICT for teaching and learning. *Politeknik memberi saya kemudahan TMK yang mencukupi untuk tujuan pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	d.	It is important for polytechnic lecturers to use ICT in their teaching. *Adalah penting untuk pensyarah politeknik menggunakan TMK dalam pengajaran dan pembelajaran mereka.*	1	2	3	4	5	NA
	e.	I am confident in my ability to use ICT in the classroom. *Saya yakin dengan kemampuan saya untuk menggunakan TMK dalam pengajaran dan pembelajaran saya.*	1	2	3	4	5	NA
8.	**As a polytechnic lecturer. I:** ***Sebagai pensyarah politeknik, saya:***							
	a.	Use ICT tools and resources to increase teaching productivity. *Menggunakan alatan dan sumber TMK untuk meningkatkan produktiviti pengajaran.*	1	2	3	4	5	NA
	b.	Use ICT tools and resources to promote creativity. *Menggunakan alatan dan sumber TMK untuk meningkatkan kreativiti pengajaran.*	1	2	3	4	5	NA
	c.	Use ICT tools and resources to facilitate student learning. *Menggunakan alatan dan sumber TMK untuk memudahkan pembelajaran pelajar.*	1	2	3	4	5	NA

			Strongly Disagree *Sangat tidak setuju*	Disagree *Tidak setuju*	Neutral *Neutral*	Agree *Setuju*	Strongly Agree *Sangat Setuju*	Not Applicable *Tidak Berkenaan*
	d.	Use ICT tools and resources to facilitate higher-order/ complex thinking skills, including problem solving, critical thinking, informed decision-making, knowledge construction, and creativity. *Menggunakan alatan dan sumber TMK untuk memudahcara kemahiran berfikir aras tinggi termasuk menyelesaikan masalah, pemikiran kritis, membuat keputusan, pembinaan pengetahuan, dan kreativiti.*	1	2	3	4	5	NA
	e.	Identify the benefits of ICT to maximize student learning. *Mengenalpasti kelebihan penggunaan TMK dalam memaksimakan pembelajaran pelajar.*	1	2	3	4	5	NA
	f.	Identify the benefits of ICT to facilitate higher-order thinking skills (HOTs). *Mengenalpasti kelebihan penggunaan TMK dalam memudahcara kemahiran berfikir aras tinggi.*	1	2	3	4	5	NA
	g.	Use ICT hardware and software specifically designed to meet specific teaching and learning objectives. *Menggunakan perkakasan dan perisian TMK yang direkabentuk atau dibangunkan khas untuk mencapai objektif pengajaran dan pembelajaran.*	1	2	3	4	5	NA
	h.	Plan/Teach student-centered learning activities and lessons in which students apply ICT tools and resources. *Merancang/Mengajar kandungan kursus dan aktiviti pembelajaran berpusatkan pelajar (pelajar mengaplikasikan alatan dan sumber TMK).*	1	2	3	4	5	NA
	i.	Use ICT to collect, analyze, interpret, represent, and report student performance data. *Menggunakan TMK dalam mengumpul, menganalisa, mentafsir, membentang, dan melaporkan data pencapaian pelajar.*	1	2	3	4	5	NA
	j.	Integrate ICT-based assessment strategies and tools into plans for evaluating specific learning activities. *Mengintegrasikan strategi dan alat penilaian berasaskan TMK dalam merancang penilaian aktiviti pembelajaran yang spesifik.*	1	2	3	4	5	NA

Open-Ended Question/*Soalan Terbuka*

1. In brief, please describe one of your best lesson plans that have shown the use of ICT (if any) in your teaching to promote higher-order thinking skills (analysis, synthesis, and/or evaluation).
Dengan ringkas, terangkan rancangan mengajar anda yang paling jelas menunjukkan penggunaan TMK dalam meningkatkan kemahiran berfikir aras tinggi (analisis, sinthesis, dan penilaian) semasa proses pengajaran dan pembelajaran anda.

Course/*Kursus:* ____

Brief Description/*Deskripsi Ringkas*:

Analysis/*Menganalisis*
(eg. In my Marketing classes, my students are required to find online articles about marketing. They have to analyze if the information in the articles they read is valid based on the marketing principles they have learned in class /*Dalam kelas Pemasaran saya, pelajar dikehendaki mendapatkan artikel-artikel secara online mengenai pemasaran. Pelajar perlu menganalisa maklumat-maklumat dalam artikel tersebut dan menentukan ketepatan maklumat-maklumat tersebut berdasarkan kepada prisip pemasaran yang telah dipelajari*).

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Synthesis/*Mensinthesis*
(eg. They have to write a summary paper of the articles that will include consideration of the marketing principles they have learned in class /*Pelajar dikehendaki menghasilkan ringkasan artikel-artikel tersebut dengan mengambilkira prinsip pemasaran yang telah dipelajari*)

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Evaluate/*Menilai*
(eg. They need to be able to defend their point of view /*Pelajar juga dikehendaki memberi justifikasi yang jelas atas pandangan/pendapat yang diberikan*)

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____

ICT Utilization to promote HOTs (*Please explain HOW you use ICT to promote HOTs)/Penggunaan TMK (Sila terangkan bagaimana anda menggunakan TMK dalam meningkatkan kemahiran berfikir aras tinggi pelajar)*
(eg. Use internet tools to search the articles, Ms Word to write a summary paper, and Ms Power Point for a class presentation /*Menggunakan internet untuk mencari/mendapatkan artikel, Menggunakan Ms Word untuk penulisan ringkasan, Menggunakan Ms Power Point untuk aktiviti perbentangan dalam kelas*)

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Section III: Demographic Information
Seksyen III: Maklumat Demografi

Direction: Please check ☑ the appropriate response for each item
Arahan: Tandakan ☑ pada yang berkenaan untuk setiap item dibawah

1. Gender/*Jantina*:
   - ❑ Male/*Lelaki*
   - ❑ Female/*Perempuan*

2. Age/*Umur*:
   - ❑ Below 25 years/*25 tahun ke bawah*
   - ❑ 25- 35 years/*25 -35 tahun*
   - ❑ 36- 45 years/*36 -45 tahun*
   - ❑ 46- 55 years/*46 -55 tahun*
   - ❑ Over 55/*55 tahun ke atas*

3. Highest academic degree level/*Tahap pendidikan tertinggi*:
   - ❑ Diploma/*Diploma*
   - ❑ Bachelor's Degree/*Ijazah Sarjana Muda*
   - ❑ Master's Degree/*Ijazah Sarjana*
   - ❑ Doctorate/*Ijazah Kedoktoran*
   - ❑ Pursuing master/*Sedang melanjutkan pelajaran ke peringkat sarjana*
   - ❑ Pursuing doctorate/*Sedang melanjutkan pelajaran ke peringkat kedoktoran*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ___________________________

4. Position Grade/*Gred Jawatan*:
   - ❑ DH28-DH36 (Lecturer Grade) /*DH28-DH36 (Gred Pensyarah)*
   - ❑ DH41 (Lecturer Grade)/*DH41 (Gred Pensyarah)*
   - ❑ DH44 (Lecturer Grade)/*DH44 (Gred Pensyarah)*
   - ❑ DH48 (Lecturer Grade)/*DH48 (Gred Pensyarah)*
   - ❑ DH52 (Lecturer Grade)/*DH52 (Gred Pensyarah)*
   - ❑ DH54 (Lecturer Grade)/*DH54 (Gred Pensyarah)*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ____________________________

5. Length of service as a Polytechnic lecturer /*Tempoh tahun berkhidmat sebagai pensyarah Politeknik*
   - ❑ Below 3 years/*Kurang 3 tahun*
   - ❑ 3–5 years/*3-5 tahun*
   - ❑ 6–10 years/*6-10 tahun*
   - ❑ 11–15 years/*11-15 tahun*
   - ❑ 16–20 years/*16-20 tahun*
   - ❑ Over 21 years/*Melebihi 21 tahun*

6. Academic Department/*Jabatan Akademik* (Select One as Primary/*Pilih satu yang utama*)
   - ❑ Commerce/*Perdagangan*
   - ❑ Civil Engineering/*Kejuruteraan Awam*
   - ❑ Electrical Engineering/*Kejuruteraan Elektrik*
   - ❑ Mechanical Engineering/*Kejuruteraan Mekanikal*
   - ❑ Marine Engineering/*Kejuruteraan Perkapalan*
   - ❑ Aircraft Maintenance/*Penyenggaraan Pesawat*
   - ❑ Information Technology/*Teknologi Maklumat*
   - ❑ Tourism & Hospitality/*Pelancongan & Hospitaliti*
   - ❑ General Studies/*Pengajian Am*
   - ❑ Mathematics, Science & Computer/*Matematik, Sains & Komputer*
   - ❑ Other, please specify/*Lain-lain, nyatakan* ____________________________

7. Polytechnic/*Politeknik*:
   - ❑ PUO
   - ❑ PSA
   - ❑ PSIS

Thank you. Your participation is highly appreciated.
Terima kasih. Kerjasama anda adalah sangat dihargai.

Thank you very much for your valuable time and your contribution to the polytechnic institutions!

APPENDIX D: APPROVAL LETTER FROM THE DEPARTMENT OF POLYTECHNIC EDUCATION (MALAY VERSION)

JABATAN PENGAJIAN POLITEKNIK
PUSAT PENYELIDIKAN DAN PEMBANGUNAN POLITEKNIK
KEMENTERIAN PENGAJIAN TINGGI
Aras 10, Heritage Office Tower, Jalan SB Dagang,
43300 Seri Kembangan, Selangor Darul Ehsan
Tel: 03-8939 4443 Faks: 03-8939 4442
Laman Web: http://politeknik.gov.my

POLITEKNIK
Jabatan Pengajian Politeknik

Ruj Kami : KPT.JPP.PPPP.700-1/1 Jld. 2 (16)
Tarikh : 13 September 2011

Siti Noridah binti Ali
11C Schilletter Village
Ames, Iowa
50010 USA

Puan

KEBENARAN MENJALANKAN KAJIAN DI POLITEKNIK KEMENTERIAN PENGAJIAN TINGGI

Saya dengan hormatnya diarah merujuk kepada perkara di atas.

2. Sukacita dimaklumkan bahawa pihak kami tiada halangan untuk memberi kebenaran kepada puan untuk menjalankan penyelidikan bertajuk ***" Malaysian Polytechnic Lectures' Teaching Experiences and Practices with ICT Utilization to Promote Higher-Order Thinking Skills (HOTs) "*** seperti yang dijelaskan dalam cadangan penyelidikan yang disertakan.

3. Sila kemukakan ke Bahagian Penyelidikan & Inovasi (BPI), Jabatan Pengajian Politeknik senaskhah laporan akhir kajian tersebut. Dimaklumkan juga bahawa puan adalah diminta mendapatkan kebenaran terlebih dahulu daripada BPI sekiranya sebahagian atau sepenuhnya dapatan penyelidikan tersebut hendak dibentangkan di mana-mana persidangan atau seminar, atau untuk pengumuman di media massa.

Sekian untuk makluman dan tindakan seterusnya, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(HALIMAH BINTI CHE HASSAN)
b.p Pengarah
Bahagian Penyelidikan & Inovasi
Jabatan Pengajian Politeknik
Kementerian Pengajian Tinggi Malaysia

s.k. Pengarah, Politeknik Ungku Omar (PUO)
Pengarah, Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA)
Pengarah, Politeknik Port Dickson (PPD)
Pengarah, Politeknik Sultan Idris Shah (PSIS)

APPENDIX E: COVER LETTER FOR MALAYSIAN POLYTECHNIC LECTURER SURVEY (ENGLISH VERSION)

Date:

Dear Fellow Polytechnic Lecturers,
You are cordially invited to participate and provide your opinion in this study about Malaysian polytechnic lecturers' teaching experience and practices with ICT utilization to promote higher-order thinking skills. You have been selected from a list of polytechnic lecturers currently teaching polytechnic courses in the field of technical and vocational education.

The purpose of this study is to explore Malaysian polytechnics lecturers' experience in teaching students to use higher-order thinking skills (HOTs) and to utilize ICT to promote the development of these skills in their teaching. This survey has been developed to obtain your feedback on your teaching methods/approaches, teaching strategies, barriers, and the use of ICT in promoting higher-order thinking skills. Result of this study will contribute meaningful information towards improving our technical and vocational higher education, in particular polytechnic teaching and learning implementation for the benefit of Malaysian society as whole.

Your input is very valuable. Your participation in this study is completely on a voluntary basis and you may refuse to participate at any time. You may also skip any questions that you are not comfortably answering. Return of a completed survey indicates your consent to participate in this study.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: (1) survey responses will remain completely anonymous and no identifiers will be used, (2) the data will be stored in a secured database with password on the principle investigator's personal computer while printed data will be kept in a locked file cabinet, (3) surveys will be kept for one year, but other data will be kept for at least three years after completion of study, (4) only the principal investigator and the major professor will have access to the research records, and (5) if the results are published, your identity will remain confidential. There are no foreseeable risks at this time nor incur any cost for you to participate in this study.

You are encouraged to ask questions at any time during this study. For further information about the study, please do not hesitate to contact Siti Noridah Ali at (+603) 6038-6102/ (+6017) 3225271 or email: sna1672@iastate.edu. If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator at (+1515) 294-4566 or Director at (+1515) 294-3115, email: IRB@iastate.edu, Office of Research Assurances, Iowa State University, Ames, Iowa 50011 USA.

Please accept my sincere appreciation for your participation in the study. Thank you in advance for your support in this study.

Best regards,

Siti Noridah Ali
PhD. Candidate
Curriculum and Instructional Technology
Iowa State University

APPENDIX F: COVER LETTER FOR MALAYSIAN POLYTECHNIC LECTURER SURVEY (MALAY VERSION)

Tarikh:

Tuan/Puan yang dihormati,

KAJISELIDIK TENTANG PENGALAMAN MENGAJAR DAN AMALAN PENGGUNAAN TEKNOLOGI MAKLUMAT DAN KOMUNIKASI (TMK) PENSYARAH POLITEKNIK MALAYSIA DALAM MENINGKATKAN KEMAHIRAN BERFIKIR ARAS TINGGI (KBAT)

Tuan/puan dipelawa untuk menyertai kajian mengenai pengalaman mengajar dan amalan penggunaan TMK dalam meningkatkan kemahiran berfikir aras tinggi. Tuan/puan telah dipilih kerana tuan/puan adalah pensyarah politeknik yang sedang berkhidmat dan mengajar kursus-kursus politeknik dalam bidang pendidikan teknik dan vokasional.

Kajian ini bertujuan untuk mendapatkan maklumbalas dan pandangan tuan/puan mengenai kaedah dan pendekatan pengajaran, strategi pengajaran, halangan, dan amalan penggunaan TMK dalam meningkatkan penggunaan kemahiran berfikir aras tinggi di kalangan pelajar semasa proses pengajaran dan pembelajaran. Hasil kajian ini akan dapat membantu meningkatkan sistem pendidikan tinggi teknik dan vokasional terutamanya dalam pelaksanaan pengajaran dan pembelajaran politeknik untuk faedah masyarakat Malaysia secara keseluruhannya.

Maklumat tuan/puan adalah sangat penting dan berharga. Penyertaan tuan/puan untuk kajian ini adalah secara sukarela dan tuan/puan berhak memilih untuk tidak menyertai kajian ini pada bila-bila masa. Tuan/puan juga berhak untuk tidak menjawab mana-mana soalan-soalan yang tidak diingini. Kajiselidik yang dijawab dan dikembalikan kepada pihak kami menandakan persetujuan pihak tuan/puan untuk menyertai kajian ini. Untuk menjamin kerahsiaan penglibatan tuan/puan, langkah-langkah berikut akan diambil: (1) maklumat kajiselidik tidak mempunyai sebarang identifikasi, (2) data akan disimpan di dalam komputer peribadi penyelidik yang dilengkapkan dengan kata laluan, manakala data yang dicetak akan disimpan di dalam kabinet yang berkunci, (3) kajiselidik yang telah berjawab akan disimpan dalam tempoh setahun, manakala maklumat lain yang berkaitan akan disimpan sekurang-kurangnya tiga tahun, (4) hanya penyelidik dan penyelia beliau sahaja yang mempunyai akses kepada maklumat penyelidikan, dan (5) sekiranya kajian akan diterbitkan, maklumat tuan/puan akan tetap dirahsiakan. Tiada sebarang risiko yang akan tuan/puan hadapi pada masa kini dan akan datang atau melibatkan sebarang kos sekiranya tuan/puan menyertai kajian ini.

Penyertaan tuan/puan amatlah dihargai. Sekiranya tuan/puan mempunyai sebarang pertanyaan, sila hubungi saya, Siti Noridah Ali di talian (+603) 6038-6102/(+6017) 3225271 atau emailkan kepada sna1672@iastate.edu. Sebarang soalan berkaitan dengan hak privacy dan dignity responden, sila hubungi Pentadbiran IRB di talian (+1515) 294-4566 atau Pengarah IRB di talian (+1515) 294-3115, email:IRB@iastate.edu, Office of Research Assurances, Iowa State University, Ames, Iowa 50011 USA.

Kerjasama yang tuan/puan berikan didahului dengan ucapan terima kasih.

Siti Noridah Ali
Calon PhD.
Kurikulum dan Teknologi Pengajaran
Iowa State University

APPENDIX G: SUPPORTING LETTER FROM MAJOR PROFESSOR

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Human Sciences
Department of Curriculum and Instruction
N131 Lagomarcino Hall
Ames, Iowa 50011-3190
515 294-9531
FAX 515 294-6206

August 31, 2011

Ana-Paula Correia
Associate Professor
Curriculum & Instruction/ Center for Technology in Learning and Teaching
N165 B Lagomarcino Hall
Iowa State University
Ames, Iowa 50011-3193, USA

Director of Polytechnic Research and Development Center
Department of Polytechnic Education,
Ministry of Higher Education Malaysia

Dear Sir,

I am writing this letter as Director of Siti Noridah Ali's Dissertation. Siti Noridah is a doctoral candidate at Iowa State University majoring in Curriculum and Instructional Technology. As part of her degree requirements, Siti Noridah must complete an extensive research project. Her degree is dependent upon the success of this research project and hence the reason for this letter. Siti Noridah's research has been approved by her Dissertation Committee as well as the Office of Institutional Research Review Board at Iowa State University.

Siti Noridah will be in Malaysia for three months to collect data for her research project on instructional technology. She will be studying Malaysian polytechnic lecturers' teaching experience and practices with ICT utilization to promote higher-order thinking skills in four Malaysian polytechnics. She will collect her data through a comprehensive survey to be administered to polytechnic lecturers and extensive document analysis. This mixed methods approach to the research is unique and will yield valuable contributions to the field.

I hope you are able to offer her assistance in this important research project. I thank you in advance for your support. Should you have questions, I can be reached at the phone number or e-mail listed below.

Sincerely,

Ana Paula Correia

Ana-Paula Correia
Associate Professor
acorreia@iastate.edu
+1 515 294 9376

APPENDIX H: PILOT TESTING EVALUATION FORM

Introduction:
My name is Siti Noridah Ali, a PhD. candidate from Iowa State University, Ames, Iowa, USA. I am currently doing my dissertation entitled "Malaysian Polytechnic Lecturers' Teaching Experience and Practices with Information and Communication Technology (ICT) Utilization to promote Higher-Order Thinking Skills (HOTs)".

Purpose of pilot test:
The aim of this pilot test is to test the reliability of the survey. It is also to ensure that the words and scales used in the survey are clear and easy to understand.

Research background:
I am exploring polytechnic lecturers' experience on how much emphasis they are be able to place on teaching students to use higher-order thinking skills and the use of ICT to promote higher-order thinking skills in their teaching at a technical polytechnic setting in Malaysia

Procedures for pilot test:
Your participation in this pilot test is voluntary and completely confidential.

1) Read the directions before you start to answer the questions. You may skip any questions that you are not comfortable answering. All data received from this pilot test will be kept at least one year after completion of the study.
2) After completion, you will be requested to complete the pilot test form attached. This form will ask you how understandable words or scales were used in the survey.
3) You may also make any suggestions to improve the clarity of the survey.

I really appreciate your time and effort in assisting me with this pilot test.

Thank you.

Best regards,

Siti Noridah Ali
PhD. Candidate
Curriculum and Instructional Technology
Iowa State University
+603-60386102/+6017-3225271
sna1672@iastate.edu

Ana-Paula Correia
Associate Professor/Major Professor for Siti Noridah
Curriculum and Instructional Technology
Iowa State University
+1515-294-9376
acorreia@iastate.edu

PILOT TEST FORM

Please answer the following questions or make any comments upon the completion of your survey.

1. How long did it takes for you to fill out this survey?
   ______________minute(s)

2. Were the questions understandable?

   ☐ Yes ☐ No

   If no, please indicate the question number and what needs to be clarified.

Question number	Clarification

3. Were the scales (rankings) understandable? _____________________________

   ☐ Yes ☐ No

   If not, please suggest what needs to be done to make the scales easier to understand.

   ____
   ____
   ____
   ____

4. Overall, what suggestions do you have to improve the survey?

   ____
   ____
   ____
   ____

Thank you for your assistance with this pilot study.

APPENDIX I: RELIABILITY TABLES (PILOT STUDY)

1. Subsection A: Critical Success Factors

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qA_1	30	+	0.7829	0.6728	0.2993	0.7193	Teaching Experiences
qA_2	30	+	0.4593	0.2629	0.3986	0.7991	Modelling other colleagues
qA_3	30	+	0.4825	0.2898	0.3915	0.7942	Personal Beliefs
qA_4	30	+	0.6904	0.5474	0.3277	0.7452	ICT Changes
qA_5	30	+	0.7504	0.6278	0.3093	0.7288	Class size
qA_6	30	+	0.6290	0.4680	0.3465	0.7609	Requirement institution
qA_7	30	+	0.8084	0.7085	0.2915	0.7117	Training on effective teaching methods
Test scale					0.3378	0.7812	mean(standardized items)

2. Subsection B: Teaching Method

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qB_8	30	+	0.4998	0.4066	0.3015	0.8580	Lecturing
qB_9	30	-	0.2288	0.1169	0.3276	0.8721	Memorize content accurately
qB_10	30	+	0.5189	0.4279	0.2997	0.8569	Covering syllabus content
qB_11	30	-	0.3757	0.2715	0.3134	0.8647	Discussing course content
qB_12	30	+	0.7454	0.6875	0.2779	0.8434	Engaging students in dialogue
qB_13	30	+	0.7880	0.7382	0.2738	0.8407	Oral Presentation skills
qB_14	30	+	0.5351	0.4460	0.2981	0.8560	Reflect experience
qB_15	30	+	0.6212	0.5432	0.2898	0.8510	Find varied correct answers
qB_16	30	+	0.5591	0.4728	0.2958	0.8547	Small group activities
qB_17	30	+	0.6594	0.5870	0.2861	0.8488	Stretching to think beyond reading
qB_18	30	+	0.6064	0.5263	0.2912	0.8519	Assessing learning with objective testing
qB_19	30	+	0.2954	0.1863	0.3212	0.8688	Sequencing questions from concrete to abstract
qB_20	30	+	0.7731	0.7204	0.2752	0.8417	Atmosphere for exploration of ideas
qB_21	30	+	0.7924	0.7435	0.2733	0.8404	Discussing how content relate to career preparation
qB_22	30	+	0.7547	0.6985	0.2770	0.8428	Reflecting on how content has meaning for life
Test scale					0.2934	0.8617	mean(standardized items)

3. Subsection C: Teaching Strategies

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qC_23	30	+	0.8200	0.7470	0.5911	0.8966	Class discussion
qC_24	30	+	0.7846	0.7001	0.6044	0.9016	Brainstorming
qC_25	30	+	0.8316	0.7627	0.5866	0.8949	Problem Solving
qC_26	30	+	0.8596	0.8006	0.5761	0.8908	Case Study Analysis
qC_27	30	+	0.7529	0.6587	0.6163	0.9060	Project-Based Learning
qC_28	30	+	0.7458	0.6495	0.6190	0.9070	Field Trips
qC_29	30	+	0.8632	0.8056	0.5747	0.8902	Guest Speakers
Test scale					0.5955	0.9115	mean(standardized items)

4. Subsection D: Barriers

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qD_31	30	+	0.8233	0.6579	0.3824	0.6501	Time consuming
qD_32	30	+	0.7895	0.6014	0.4169	0.6820	Lack of preparation
qD_33	30	+	0.8737	0.7467	0.3312	0.5977	Traditional lecture
qD_34	30	+	0.5667	0.2788	0.6436	0.8442	Low expectation
Test scale					0.4435	0.7612	mean(standardized items)

5. Subsection ICT: Level of Support and Training and Lecturer's Confidence Level

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qICT_7a	30	+	0.7931	0.6531	0.4183	0.7421	Provides training
qICT_7b	30	+	0.8268	0.7049	0.3974	0.7251	Provides enough time
qICT_7c	30	+	0.8542	0.7483	0.3803	0.7105	Provides sufficient ICT
qICT_7d	30	+	0.4314	0.1784	0.6435	0.8783	Important to use ICT
qICT_7e	30	+	0.8285	0.7076	0.3963	0.7242	Confident to use ICT
Test scale					0.4472	0.8018	mean(standardized items)

6. Subsection ICT: Use of ICT

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qICT_8a	30	+	0.6699	0.5930	0.6555	0.9448	Use ICT to increase teaching productivity
qICT_8b	30	+	0.7811	0.7254	0.6304	0.9388	Use ICT to promote creativity
qICT_8c	30	+	0.7811	0.7254	0.6304	0.9388	Use ICT to facilitate student learning
qICT_8d	30	+	0.8110	0.7618	0.6237	0.9372	Use ICT to facilitate HOTs
qICT_8e	30	+	0.7818	0.7263	0.6303	0.9388	Identify the benefits of ICT to maximize student learning
qICT_8f	30	+	0.7719	0.7143	0.6325	0.9394	Identify the benefits of ICT to facilitate HOTs
qICT_8g	30	+	0.8887	0.8580	0.6061	0.9327	Use ICT specifically designed
qICT_8h	30	+	0.9005	0.8728	0.6035	0.9320	Teach student centered learning activities
qICT_8i	30	+	0.8661	0.8297	0.6112	0.9340	Use ICT for student performance data
qICT_8j	30	+	0.8776	0.8440	0.6086	0.9333	INtegrate ICT-based assessment
Test scale					0.6232	0.9430	mean(standardized items)

7. All Items (Likert Scale)

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qA_1	30	+	0.3192	0.2803	0.2288	0.9331	Teaching Experiences
qA_2	30	+	0.4234	0.3876	0.2265	0.9323	Modelling other colleagues
qA_3	30	+	0.2007	0.1595	0.2313	0.9340	Personal Beliefs
qA_4	30	+	0.5670	0.5372	0.2234	0.9311	ICT Changes
qA_5	30	+	0.4804	0.4467	0.2252	0.9318	Class size
qA_6	30	+	0.5835	0.5545	0.2230	0.9310	Requirement institution
qA_7	30	+	0.5645	0.5346	0.2234	0.9311	Training on effective teaching methods
qB_8	30	+	0.4008	0.3643	0.2270	0.9324	Lecturing
qB_9	30	+	0.2483	0.2078	0.2303	0.9336	Memorize content accurately
qB_10	30	+	0.3630	0.3254	0.2278	0.9327	Covering syllabus content
qB_11	30	+	0.2658	0.2258	0.2299	0.9335	Discussing course content
qB_12	30	+	0.4686	0.4345	0.2255	0.9319	Engaging students in dialogue
qB_13	30	+	0.5635	0.5335	0.2234	0.9311	Oral Presentation skills
qB_14	30	+	0.5715	0.5419	0.2233	0.9311	Reflect experience
qB_15	30	+	0.5482	0.5174	0.2238	0.9313	Find varied correct answers
qB_16	30	+	0.4564	0.4219	0.2258	0.9320	Small group activities
qB_17	30	+	0.3614	0.3236	0.2278	0.9327	Stretching to think beyond reading
qB_18	30	+	0.3972	0.3606	0.2271	0.9325	Assessing learning with objective testing
qB_19	30	+	0.6530	0.6277	0.2215	0.9304	Sequencing questions from concrete to abstract
qB_20	30	+	0.5097	0.4773	0.2246	0.9316	Atmosphere for exploration of ideas
qB_21	30	+	0.5282	0.4966	0.2242	0.9314	Discussing how content relate to career preparation
qB_22	30	+	0.6346	0.6082	0.2219	0.9306	Reflecting on how content has meaning for life
qC_23	30	+	0.6341	0.6077	0.2219	0.9306	Class discussion
qC_24	30	+	0.6154	0.5880	0.2223	0.9307	Brainstorming
qC_25	30	+	0.4481	0.4132	0.2259	0.9321	Problem Solving
qC_26	30	+	0.5456	0.5147	0.2238	0.9313	Case Study Analysis
qC_27	30	+	0.5888	0.5600	0.2229	0.9309	Project-Based Learning
qC_28	30	+	0.4342	0.3988	0.2263	0.9322	Field Trips
qC_29	30	+	0.5365	0.5053	0.2240	0.9314	Guest Speakers
qD_31	30	+	0.3863	0.3493	0.2273	0.9325	Time consuming
qD_32	30	+	0.2761	0.2362	0.2297	0.9334	Lack of preparation
qD_33	30	+	0.5855	0.5565	0.2230	0.9310	Traditional lecture
qD_34	30	+	0.1195	0.0774	0.2331	0.9346	Low expectation
qICT_7a	30	+	0.6065	0.5787	0.2225	0.9308	Provides training
qICT_7b	30	+	0.4848	0.4514	0.2251	0.9318	Provides enough time
qICT_7c	30	+	0.6430	0.6170	0.2217	0.9305	Provides sufficient ICT
qICT_7d	30	+	0.2768	0.2369	0.2297	0.9334	Important to use ICT
qICT_7e	30	+	0.4445	0.4095	0.2260	0.9321	Confident to use ICT
qICT_8a	30	+	0.2168	0.1759	0.2310	0.9339	Use ICT to increase teaching productivity
qICT_8b	30	+	0.3223	0.2835	0.2287	0.9330	Use ICT to promote creativity
qICT_8c	30	+	0.3223	0.2835	0.2287	0.9330	Use ICT to facilitate student learning
qICT_8d	30	+	0.4538	0.4192	0.2258	0.9320	Use ICT to facilitate HOTs
qICT_8e	30	+	0.8775	0.8672	0.2166	0.9285	Identify the benefits of ICT to maximize student learning
qICT_8f	30	+	0.7894	0.7725	0.2185	0.9293	Identify the benefits of ICT to facilitate HOTs
qICT_8g	30	+	0.6379	0.6117	0.2218	0.9305	Use ICT specifically designed
qICT_8h	30	+	0.7690	0.7507	0.2190	0.9295	Teach student centered learning activities
qICT_8i	30	+	0.7840	0.7668	0.2186	0.9293	Use ICT for student performance data
qICT_8j	30	+	0.6642	0.6394	0.2212	0.9303	INtegrate ICT-based assessment
Test scale					0.2250	0.9330	mean(standardized items)

APPENDIX J: RELIABILITY TABLES (MAIN STUDY)

1. Critical Success Factors

```
. alpha qA_1 qA_2 qA_3 qA_4 qA_5 qA_6, casewise detail item label std

Test scale = mean(standardized items)
```

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qA_1	389	+	0.6121	0.4091	0.3159	0.6978	Teaching Experiences
qA_2	389	+	0.6621	0.4749	0.2965	0.6782	Personal Beliefs
qA_3	389	+	0.6291	0.4312	0.3093	0.6913	ICT Changes
qA_4	389	+	0.5844	0.3736	0.3267	0.7081	Class size
qA_5	389	+	0.6981	0.5240	0.2825	0.6632	Requirement institution
qA_6	389	+	0.6964	0.5216	0.2832	0.6639	Training on effective teaching methods
Test scale					0.3024	0.7223	mean(standardized items)

2. Teaching Method

```
Test scale = mean(standardized items)
```

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qB_7	389	+	0.3394	0.2262	0.3255	0.8625	Lecturing
qB_8	389	+	0.3521	0.2397	0.3241	0.8618	Memorize content accurately
qB_9	389	+	0.4174	0.3102	0.3172	0.8579	Covering syllabus content
qB_10	389	+	0.6013	0.5153	0.2977	0.8464	Engaging students in dialogue
qB_11	389	+	0.6648	0.5886	0.2910	0.8421	Oral Presentation skills
qB_12	389	+	0.6937	0.6224	0.2879	0.8402	Reflect experience
qB_13	389	+	0.6568	0.5792	0.2918	0.8427	Find varied correct answers
qB_14	389	+	0.6334	0.5522	0.2943	0.8443	Small group activities
qB_15	389	+	0.7021	0.6323	0.2870	0.8396	Stretching to think beyond reading
qB_16	389	+	0.5408	0.4466	0.3041	0.8503	Assessing learning with objective testing
qB_17	389	+	0.6348	0.5538	0.2941	0.8442	Sequencing questions from concrete to abstract
qB_18	389	+	0.7000	0.6299	0.2872	0.8397	Atmosphere for exploration of ideas
qB_19	389	+	0.6849	0.6121	0.2888	0.8408	Discussing how content relate to career preparation
qB_20	389	+	0.6480	0.5691	0.2927	0.8433	Reflecting on how content has meaning for life
Test scale					0.2988	0.8565	mean(standardized items)

3. Teaching Strategies

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qC_21	389	+	0.6190	0.4740	0.4886	0.8515	Class discussion
qC_22	389	+	0.7362	0.6237	0.4488	0.8301	Brainstorming
qC_23	389	+	0.7072	0.5857	0.4587	0.8356	Problem Solving
qC_24	389	+	0.7607	0.6562	0.4405	0.8253	Case Study Analysis
qC_25	389	+	0.7884	0.6935	0.4310	0.8197	Project-Based Learning
qC_26	389	+	0.7818	0.6846	0.4333	0.8210	Field Trips
qC_27	389	+	0.7024	0.5796	0.4602	0.8365	Guest Speakers
Test scale					0.4516	0.8522	mean(standardized items)

4. Barriers

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qD_29	389	+	0.7905	0.5184	0.4589	0.6291	Time consuming
qD_30	389	+	0.8311	0.5952	0.3620	0.5316	Lack of preparation
qD_31	389	+	0.7634	0.4702	0.5235	0.6872	Traditional lecture
Test scale					0.4481	0.7090	mean(standardized items)

5. ICT: Level of Support and Training

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qICT_7a	389	+	0.8013	0.5638	0.6993	0.8230	Provides training
qICT_7b	389	+	0.8822	0.7205	0.4935	0.6608	Provides enough time
qICT_7c	389	+	0.8616	0.6783	0.5460	0.7063	Provides sufficient ICT
Test scale					0.5796	0.8053	mean(standardized items)

6. ICT: Lecturer's Confidence Level

Test scale = mean(standardized items)

Average interitem correlation:	0.5645
Number of items in the scale:	2
Scale reliability coefficient:	0.7216

7. Use of ICT to promote HOTS

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qICT_8a	389	+	0.8409	0.7996	0.6533	0.9443	Use ICT to increase teaching productivity
qICT_8b	389	+	0.8413	0.8000	0.6532	0.9443	Use ICT to promote creativity
qICT_8c	389	+	0.8494	0.8100	0.6513	0.9439	Use ICT to facilitate student learning
qICT_8d	389	+	0.8407	0.7993	0.6534	0.9443	Use ICT to facilitate HOTs
qICT_8e	389	+	0.8723	0.8384	0.6461	0.9426	Identify the benefits of ICT to maximize student learning
qICT_8f	389	+	0.8709	0.8366	0.6464	0.9427	Identify the benefits of ICT to facilitate HOTs
qICT_8g	389	+	0.8079	0.7593	0.6609	0.9461	Use ICT specifically designed
qICT_8h	389	+	0.8124	0.7647	0.6599	0.9458	Teach student centered learning activities
qICT_8i	389	+	0.7743	0.7187	0.6687	0.9478	Use ICT for student performance data
qICT_8j	389	+	0.7970	0.7460	0.6634	0.9466	INtegrate ICT-based assessment
Test scale					0.6557	0.9501	mean(standardized items)

8. All Items (Likert Scales)

Test scale = mean(standardized items)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem corr.	alpha	Label
qA_1	389	+	0.3198	0.2777	0.2211	0.9259	Teaching Experiences
qA_2	389	+	0.4922	0.4563	0.2171	0.9242	Personal Beliefs
qA_3	389	+	0.4661	0.4291	0.2177	0.9245	ICT Changes
qA_4	389	+	0.2675	0.2242	0.2223	0.9263	Class size
qA_5	389	+	0.4934	0.4575	0.2171	0.9242	Requirement institution
qA_6	389	+	0.4987	0.4631	0.2169	0.9242	Training on effective teaching methods
qB_7	389	+	0.3169	0.2747	0.2211	0.9259	Lecturing
qB_8	389	+	0.3185	0.2764	0.2211	0.9259	Memorize content accurately
qB_9	389	+	0.3560	0.3150	0.2202	0.9255	Covering syllabus content
qB_10	389	+	0.4879	0.4518	0.2172	0.9243	Engaging students in dialogue
qB_11	389	+	0.5483	0.5150	0.2158	0.9237	Oral Presentation skills
qB_12	389	+	0.5375	0.5037	0.2161	0.9238	Reflect experience
qB_13	389	+	0.4997	0.4641	0.2169	0.9242	Find varied correct answers
qB_14	389	+	0.5022	0.4667	0.2169	0.9242	Small group activities
qB_15	389	+	0.5792	0.5475	0.2151	0.9234	Stretching to think beyond reading
qB_16	389	+	0.4289	0.3904	0.2186	0.9248	Assessing learning with objective testing
qB_17	389	+	0.5171	0.4823	0.2165	0.9240	Sequencing questions from concrete to abstract
qB_18	389	+	0.5706	0.5384	0.2153	0.9235	Atmosphere for exploration of ideas
qB_19	389	+	0.5736	0.5416	0.2152	0.9235	Discussing how content relate to career preparation
qB_20	389	+	0.5384	0.5046	0.2160	0.9238	Reflecting on how content has meaning for life
qC_21	389	+	0.4825	0.4461	0.2173	0.9243	Class discussion
qC_22	389	+	0.6170	0.5873	0.2142	0.9231	Brainstorming
qC_23	389	+	0.5446	0.5111	0.2159	0.9237	Problem Solving
qC_24	389	+	0.6150	0.5853	0.2143	0.9231	Case Study Analysis
qC_25	389	+	0.5946	0.5637	0.2147	0.9233	Project-Based Learning
qC_26	389	+	0.5422	0.5086	0.2159	0.9238	Field Trips
qC_27	389	+	0.5472	0.5139	0.2158	0.9237	Guest Speakers
qD_29	389	+	0.3191	0.2770	0.2211	0.9259	Time consuming
qD_30	389	+	0.3144	0.2722	0.2212	0.9259	Lack of preparation
qD_31	389	+	0.3066	0.2642	0.2214	0.9260	Traditional lecture
qICT_7a	389	+	0.2886	0.2457	0.2218	0.9261	Provides training
qICT_7b	389	+	0.2070	0.1626	0.2237	0.9269	Provides enough time
qICT_7c	389	+	0.1308	0.0854	0.2254	0.9276	Provides sufficient ICT
qICT_7d	389	+	0.4873	0.4512	0.2172	0.9243	Important to use ICT
qICT_7e	389	+	0.4669	0.4298	0.2177	0.9245	Confident to use ICT
qICT_8a	389	+	0.6047	0.5743	0.2145	0.9232	Use ICT to increase teaching productivity
qICT_8b	389	+	0.6270	0.5979	0.2140	0.9230	Use ICT to promote creativity
qICT_8c	389	+	0.6194	0.5899	0.2142	0.9230	Use ICT to facilitate student learning
qICT_8d	389	+	0.5996	0.5690	0.2146	0.9232	Use ICT to facilitate HOTs
qICT_8e	389	+	0.6260	0.5969	0.2140	0.9230	Identify the benefits of ICT to maximize student learning
qICT_8f	389	+	0.6229	0.5936	0.2141	0.9230	Identify the benefits of ICT to facilitate HOTs
qICT_8g	389	+	0.5891	0.5579	0.2149	0.9233	Use ICT specifically designed
qICT_8h	389	+	0.5855	0.5541	0.2150	0.9234	Teach student centered learning activities
qICT_8i	389	+	0.5593	0.5266	0.2156	0.9236	Use ICT for student performance data
qICT_8j	389	+	0.5893	0.5581	0.2149	0.9233	INtegrate ICT-based assessment
Test scale					0.2173	0.9259	mean(standardized items)

APPENDIX K: STATISTICAL RESULTS (TABLES)

1. Teaching Methods

Table K1: *Comparison of Teaching Methods with Gender*

Item	Male (*n*= 135)		Female (*n*=254)		*t* value	*df*	*p* value
	Mean	***SD***	***Mean***	***SD***			
Lecturing [TC]	**4.3**	**0.63**	**4.2**	**0.69**	**1.97**	**387**	***0.04****
Memorize content accurately [TC]	3.8	0.87	3.7	0.86	0.73	387	0.46
Cover the syllabus content [TC]	4.1	0.74	4.0	0.70	-0.02	387	0.98
Student engagement in dialogue [LC]	4.3	0.62	4.4	0.61	-0.39	387	0.69
Oral presentation skills [LC]	**4.3**	**0.63**	**4.5**	**0.55**	**-2.43**	**387**	***0.02****
Experiences Reflection [LC]	**4.2**	**0.63**	**4.4**	**0.57**	**-2.06**	**387**	***0.04****
Find varied correct answer [LC]	4.2	0.68	4.3	0.61	-1.43	387	0.15
Small group activities [LC]	**4.2**	**0.73**	**4.4**	**0.60**	**-2.57**	**387**	***0.01****
Think beyond reading [LC]	**4.3**	**0.63**	**4.5**	**0.57**	**-2.35**	**387**	***0.02****
Objective testing [TC]	3.9	0.74	3.9	0.82	-0.72	387	0.47
Concrete to abstract questions [LC]	**3.4**	**0.67**	**4.1**	**0.68**	**-2.31**	**387**	***0.02****
Explorations of ideas [LC]	4.2	0.66	4.4	0.67	-1.42	387	0.16
Career Preparation [LC]	4.2	0.74	4.3	0.66	-0.64	387	0.52
Reflect meaning for life [LC]	**4.1**	**0.69**	**4.3**	**0.64**	**-2.39**	**387**	***0.02****

Notes: *= *p* <.05 (two-tailed tests)

[a] = Robust test in STATA indicates items where variances are not equal.

[TC]= Teacher-Centered Teaching Method

[LC]= Learner-Centered Teaching Method

Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K2: *Comparison of Teaching Methods with Years in Academic Service*

Item	**The Least Experienced** (*n= 276)*		**Experienced** (*n=113*)		***t* value**	***df***	***p* value**
	Mean	***SD***	***Mean***	***SD***			
Lecturing [TC]	4.1	0.65	4.3	0.75	-1.13[a]	183.6	0.25
Memorize content accurately [TC]	**3.8**	**0.83**	**3.6**	**0.92**	**2.27**	**387**	***0.02****
Cover the syllabus content [TC]	**4.1**	**0.72**	**4.0**	**0.69**	**2.08**	**387**	***0.03****
Student engagement in dialogue [LC]	4.5	0.58	4.3	0.68	1.75	387	0.08
Oral presentation skills [LC]	4.4	0.57	4.2	0.61	-0.58	387	0.56
Experiences Reflection [LC]	4.3	0.59	4.1	0.58	0.41	387	0.68
Find varied correct answer [LC]	4.3	0.61	4.0	0.69	-0.31	387	0.76
Small group activities [LC]	4.3	0.60	4.0	0.77	0.71	387	0.48
Think beyond reading [LC]	4.5	0.57	4.2	0.67	-0.17[a]	181.2	0.86
Objective testing [TC]	**4.0**	**0.74**	**3.8**	**0.88**	**2.21[a]**	**181.1**	***0.02****
Concrete to abstract questions [LC]	4.0	0.68	4.0	0.69	-1.05	387	0.29
Explorations of ideas [LC]	4.3	0.66	4.2	0.68	-0.99	387	0.31
Career Preparation [LC]	4.3	0.65	4.2	0.75	0.99	387	0.32
Reflect meaning for life [LC]	4.3	0.66	4.2	0.66	0.61	387	0.54

Notes: *= $p < .05$ (two-tailed tests)

[a] = Robust test in STATA indicates items where variances are not equal.

[TC]= Teacher-Centered Teaching Method

[LC]= Learner-Centered Teaching Method

Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K3: *Comparison of Teaching Methods with Age*

Item	**Below 25 (*n*=22)**		**25-35 (*n*=234)**		**36-45 (*n*=104)**		**Over 45 (*n*=29)**		***F* value**	***p* value**
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Lecturing [TC]	**4.0**	**0.72**	**4.2**	**0.65**	**4.3**	**0.68**	**3.9**	**0.77**	**3.48**	***0.01****
Memorize content accurately [TC]	**3.6**	**1.04**	**3.8**	**0.78**	**3.6**	**0.87**	**3.2**	**1.08**	**4.49**[a]	***0.01****
Cover the syllabus content [TC]	**4.2**	**0.61**	**4.1**	**0.73**	**4.0**	**0.69**	**3.7**	**0.68**	**3.39**	***0.01****
Student engagement in dialogue [LC]	4.6	0.59	4.4	0.57	4.4	0.65	4.2	0.74	1.72	0.16
Oral presentation skills [LC]	4.5	0.59	4.4	0.54	4.4	0.65	4.3	0.63	0.33	0.80
Experiences Reflection [LC]	4.3	0.55	4.3	0.58	4.3	0.61	4.2	0.66	0.19	0.91
Find varied correct answer [LC]	4.3	0.48	4.3	0.62	4.3	0.65	4.1	0.82	0.87	0.45
Small group activities [LC]	4.4	0.50	4.3	0.59	4.3	0.78	4.2	0.82	0.45[a]	0.71
Think beyond reading [LC]	4.5	0.51	4.4	0.58	4.5	0.65	4.1	0.63	0.33	0.80
Objective testing [TC]	**4.2**	**0.61**	**4.9**	**0.75**	**3.8**	**0.90**	**4.1**	**0.70**	**3.42**[a]	***0.01****
Concrete to abstract questions [LC]	4.2	0.75	3.9	0.67	4.0	0.67	4.1	0.72	1.26	0.85
Explorations of ideas [LC]	4.4	0.67	4.2	0.66	4.4	0.66	4.1	0.66	2.35	0.07
Career Preparation [LC]	4.4	0.79	4.3	0.64	4.2	0.71	4.1	0.84	0.49	0.69
Reflect meaning for life [LC]	4.4	0.73	4.3	0.65	4.2	0.65	4.2	0.77	0.49	0.68

Notes: *= p <.05 (two-tailed tests)

[a] = Robust test in STATA indicates items where variances are not equal.

[TC]= Teacher-Centered Teaching Method

[LC]= Learner-Centered Teaching Method

Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K4: *Comparison of Teaching Methods with Academic Degree*

Items	**Diploma (*n*=19)**		**Bachelor (*n*=211)**		**Master (*n*=159)**		***F* value**	***p* value**
	M	***SD***	***M***	***SD***	***M***	***SD***		
Lecturing [TC]	4.3	0.73	4.2	0.62	4.0	0.74	0.20	0.81
Memorize content accurately [TC]	3.7	0.81	3.7	0.82	3.7	0.92	0.08	0.93
Cover the syllabus content [TC]	4.3	0.73	4.1	0.71	4.0	0.72	0.97	0.37
Student engagement in dialogue [LC]	**3.9**	**0.88**	**4.5**	**0.60**	**4.4**	**0.56**	**7.43**[a]	***<0.00****
Oral presentation skills [LC]	4.3	0.67	4.5	0.54	4.5	0.62	0.62	0.53
Experiences Reflection [LC]	4.2	0.63	4.3	0.60	4.4	0.58	0.48	0.61
Find varied correct answer [LC]	4.3	0.58	4.4	0.63	4.4	0.65	0.25	0.77
Small group activities [LC]	4.2	0.76	4.4	0.63	4.5	0.68	0.94	0.39
Think beyond reading [LC]	4.3	0.58	4.5	0.56	4.6	0.64	0.87	0.42
Objective testing [TC]	3.8	0.97	3.7	0.73	3.7	0.84	0.35	0.71
Concrete to abstract questions [LC]	3.9	0.88	4.0	0.68	4.1	0.66	0.26	0.76
Explorations of ideas [LC]	4.1	0.74	4.3	0.65	4.3	0.68	0.95	0.38
Career Preparation [LC]	4.3	0.58	4.3	0.67	4.3	0.71	0.87	0.42
Reflect meaning for life [LC]	4.3	0.82	4.4	0.67	4.4	0.63	0.07	0.93

Notes: *= p <.05 (two-tailed tests)
[a] = Robust test in STATA indicates items where variances are not equal.
[TC]= Teacher-Centered Teaching Method
[LC]= Learner-Centered Teaching Method
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K5: *Comparison of Teaching Methods with Institution*

Items	**Polytechnic A (*n*=189)**		**Polytechnic B (*n*=132)**		**Polytechnic C (*n*=68)**		***F* value**	***p* value**
	M	***SD***	***M***	***SD***	***M***	***SD***		
Lecturing [TC]	4.2	0.62	4.2	0.73	4.2	0.73	0.14	0.87
Memorize content accurately [TC]	3.7	0.87	3.7	0.86	3.7	0.86	0.01	0.99
Cover the syllabus content [TC]	4.0	0.69	4.1	0.72	4.2	0.72	2.84	0.06
Student engagement in dialogue [LC]	**4.3**	**0.63**	**4.5**	**0.61**	**4.5**	**0.56**	**3.68**	***0.02****
Oral presentation skills [LC]	**4.3**	**0.59**	**4.6**	**0.55**	**4.5**	**0.53**	**6.59**	***<0.00****
Experiences Reflection [LC]	4.3	0.63	4.4	0.59	4.3	0.47	2.01[a]	0.13
Find varied correct answer [LC]	4.2	0.63	4.4	0.67	4.3	0.59	0.50	0.61
Small group activities [LC]	4.3	0.66	4.4	0.72	4.3	0.50	1.73[a]	0.18
Think beyond reading [LC]	**4.3**	**0.63**	**4.6**	**0.55**	**4.5**	**0.53**	**7.28**	***<0.00****
Objective testing [TC]	4.0	0.82	4.0	0.76	3.9	0.76	0.44	0.64
Concrete to abstract questions [LC]	3.9	0.67	4.1	0.69	4.0	0.69	1.18	0.31
Explorations of ideas [LC]	**4.2**	**0.69**	**4.4**	**0.63**	**4.4**	**0.61**	**5.73**	***<0.00****
Career Preparation [LC]	**4.2**	**0.72**	**4.4**	**0.64**	**4.4**	**0.64**	**4.03**	***0.02****
Reflect meaning for life [LC]	4.2	0.66	4.3	0.71	4.2	0.57	1.54	0.21

Notes: *= p <.05 (two-tailed tests)

[a] = Robust test in STATA indicates items where variances are not equal.

[TC]= Teacher-Centered Teaching Method

[LC]= Learner-Centered Teaching Method

Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

2. Teaching Strategies

Table K6: *Comparison of Teaching Strategies with Gender*

Item	Male (*n*= 135)		Female (*n*=254)		*t* value	*df*	*p* value
	Mean	***SD***	***Mean***	***SD***			
Discussing questions	4.2	0.69	4.4	0.65	-1.73	387	0.08
Brainstorming	4.3	0.60	4.4	0.63	-1.54	387	0.13
Problem solving	4.3	0.67	4.4	0.58	-1.23	387	0.22
Case study analysis	4.0	0.65	4.2	0.69	-1.66	387	0.09
Project-Based Learning	4.1	0.69	4.2	0.69	-0.91	387	0.37
Field Trips	4.1	0.81	4.1	0.78	-0.89	387	0.37
Guest Speakers	3.9	0.83	4.0	0.79	-1.37	387	0.17

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K7: *Comparison of Teaching Strategies with Years of Academic Service*

Item	The Least Experienced (*n*= 276)		Experienced (*n*=113)		*t* value	*df*	*p* value
	Mean	***SD***	***Mean***	***SD***			
Discussing questions	4.4	0.67	4.4	0.66	-0.91	387	0.36
Brainstorming	4.5	0.63	4.4	0.61	-1.31	387	0.19
Problem solving [a]	4.4	0.55	4.3	0.75	1.33	163.9	0.18
Case study analysis	4.1	0.68	4.0	0.68	1.81	387	0.07
Project-Based Learning	4.2	0.69	4.1	0.71	1.15	387	0.24
Field Trips	4.1	0.79	4.1	0.79	0.86	387	0.39
Guest Speakers	4.0	0.77	3.8	0.85	1.41	387	0.15

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K8: *Comparison of Teaching Strategies with Age*

Item	Below 25 (*n*=22)		25-35 (*n*=234)		36-45 (*n*=104)		Over 45 (*n*=29)		*F* value	*p* value
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Discussing questions.	4.4	0.50	4.3	0.69	4.4	0.64	4.3	0.67	1.68	0.17
Brainstorming	4.4	0.50	4.4	0.64	4.4	0.63	4.2	0.57	0.50	0.68
Problem solving. [a]	4.5	0.51	4.4	0.56	4.3	0.73	4.2	0.68	1.96	0.12
Case study analysis.	4.1	0.61	4.0	0.66	4.1	0.72	4.0	0.74	2.26	0.08
Project-Based Learning.	**4.1**	**0.92**	**4.2**	**0.66**	**4.0**	**0.70**	**4.3**	**0.63**	**3.02**	***0.02****
Field Trips	4.1	0.72	4.2	0.79	4.1	0.78	3.9	0.82	1.21	0.30
Guest Speakers.	3.9	0.68	4.0	0.78	3.9	0.85	3.9	0.73	2.02	0.11

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K9: *Comparison of Teaching Strategies with Academic Degree*

Items	Diploma (*n*=19)		Bachelor (*n*=211)		Master (*n*=159)		*F* value	*p* value
	M	*SD*	*M*	*SD*	*M*	*SD*		
Discussing questions	4.2	0.63	4.3	0.66	4.3	0.62	1.01	0.36
Brainstorming	4.3	0.81	4.4	0.61	4.4	0.62	1.48	0.22
Problem solving	4.5	0.51	4.4	0.62	4.4	0.62	0.28	0.75
Case study analysis	4.1	0.78	4.1	0.65	4.1	0.71	0.82	0.44
Project-Based Learning	4.1	0.94	4.2	0.68	4.1	0.68	0.73	0.48
Field Trips	3.9	1.03	4.1	0.77	4.1	0.78	1.30	0.27
Guest Speakers	4.0	0.94	4.0	0.76	3.9	0.82	1.03	0.35

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K10: *Comparison of Teaching Strategies with Institution*

Items	**Polytechnic A (*n*=189)**		**Polytechnic B (*n*=132)**		**Polytechnic C (*n*=68)**		***F* value**	***p* value**
	M	***SD***	***M***	***SD***	***M***	***SD***		
Discussing questions	4.3	0.66	4.4	0.68	4.4	0.63	2.49	0.08
Brainstorming	**4.3**	**0.67**	**4.5**	**0.56**	**4.4**	**0.58**	**6.59**	***<0.00****
Problem solving	4.4	0.62	4.4	0.65	4.4	0.56	0.25	0.78
Case study analysis	4.1	0.72	4.1	0.66	4.1	0.63	0.16	0.85
Project-Based Learning	4.2	0.74	4.2	0.68	4.2	0.58	0.14	0.87
Field Trips	4.1	0.84	4.1	0.77	4.2	0.67	0.45	0.64
Guest Speakers	4.0	0.84	4.0	0.79	4.0	0.68	0.24	0.78

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

3. Critical Success Factors

Table K11: *Comparison of Critical Success Factors with Gender*

Item	**Male** (*n= 135)*		**Female** (*n*=254)		***t* value**	***df***	***p* value**
	Mean	***SD***	***Mean***	***SD***			
Teaching experience	4.4	0.69	4.6	0.71	-1.05	387	0.29
Personal beliefs	4.3	0.72	4.4	0.62	-1.54	387	0.12
Current ICT changes	4.2	0.67	4.5	0.63	0.82	387	0.41
Class size	4.3	0.63	4.4	0.60	-2.03	387	0.14
Institutional requirement	4.2	0.69	4.3	0.63	-0.88	387	0.38
Effective teaching method training	4.4	0.65	4.5	0.64	-1.59	387	0.11

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K12: *Comparison of Critical Success Factors with Years in Academic Service*

Item	**The Least Experienced** *(n= 276)*		**Experienced** (*n=113*)		***t* value**	***df***	***p* value**
	Mean	***SD***	***Mean***	***SD***			
Teaching experience [a]	**4.3**	**0.76**	**4.6**	**0.52**	**-3.06**	**301.6**	***<0.00****
Personal beliefs	4.3	0.68	4.4	0.61	-1.22	387	0.22
Current ICT changes	4.3	0.63	4.5	0.68	-1.96	387	0.06
Class size	4.2	0.59	4.3	0.67	0.46	387	0.64
Institutional requirement	4.2	0.64	4.2	0.63	-0.73	387	0.46
Effective teaching method training.	4.4	0.64	4.4	0.67	0.03	387	0.96

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K13: *Comparison of Critical Success Factors with Age*

Item	**Below 25 (*n*=22)**		**25-35 (*n*=234)**		**36-45 (*n*=104)**		**Over 45 (*n*=29)**		***F* value**	***p* value**
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Teaching experience. [a]	4.3	0.65	4.4	0.78	4.5	0.52	4.6	0.57	1.64	0.17
Personal beliefs.	4.3	0.65	4.4	0.65	4.3	0.69	4.5	0.57	0.56	0.64
Current ICT changes.	4.2	0.53	4.4	0.62	4.4	0.73	4.5	0.63	0.85	0.47
Class size [a]	4.4	0.48	4.4	0.61	4.3	0.66	4.5	0.40	5.42	0.09
Institutional requirement.	4.3	0.47	4.3	0.68	4.3	0.64	4.3	0.55	0.15	0.93
Effective teaching method training.	4.7	0.58	4.4	0.66	4.4	0.64	4.7	0.57	1.40	0.24

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K14: *Comparison of Critical Success Factors with Academic Degree*

Items	Diploma (*n*=19)		Bachelor (*n*=211)		Master (*n*=159)		*F* value	*p* value
	M	***SD***	***M***	***SD***	***M***	***SD***		
Teaching experience. [a]	4.7	0.45	4.4	0.76	4.4	0.63	2.26	0.10
Personal beliefs	4.5	0.61	4.4	0.62	4.3	0.71	2.73	0.06
Current ICT changes.	4.5	0.61	4.4	0.59	4.4	0.71	0.66	0.51
Class size	4.5	0.61	4.4	0.63	4.4	0.58	0.05	0.96
Institutional requirement.	4.4	0.75	4.2	0.67	4.3	0.59	1.48	0.22
Effective teaching method training.	4.5	0.61	4.4	0.68	4.4	0.59	0.36	0.69

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K15: *Comparison of Critical Success Factors with Institution*

Items	Polytechnic A (*n*=189)		Polytechnic B (*n*=132)		Polytechnic C (*n*=68)		*F* value	*p* value
	M	***SD***	***M***	***SD***	***M***	***SD***		
Teaching experience	4.4	0.74	4.4	0.67	4.4	0.66	0.65	0.52
Personal beliefs	4.3	0.70	4.4	0.66	4.4	0.54	0.04	0.96
Current ICT changes	4.4	0.63	4.4	0.69	4.4	0.59	0.28	0.76
Class size	4.4	0.61	4.4	0.65	4.4	0.55	0.02	0.98
Institutional requirement	4.3	0.64	4.3	0.63	4.2	0.70	2.08	0.13
Effective teaching method training [a]	4.4	0.58	4.4	0.62	4.4	0.83	0.65	0.52

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= p <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

4. Barriers

Table K16: *Comparison of Barriers with Gender*

Item	Male (*n*= 135)		Female (*n*=254)		*t* value	*df*	*p* value
	Mean	***SD***	***Mean***	***SD***			
Time consuming	4.2	0.65	4.2	0.74	0.01	387	0.99
Lack of preparation	4.2	0.70	4.2	0.74	0.08	387	0.94
Traditional lecture and testing approach.	3.9	0.79	3.9	0.84	-0.17	387	0.87

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K17: *Comparison of Barriers with Years in Academic Service*

Item	The Least Experienced (*n*= 276)		Experienced (*n*=113)		*t* value	*df*	*p* value
	Mean	***SD***	***Mean***	***SD***			
Time consuming.	4.2	0.71	4.3	0.70	-0.96	387	0.33
Lack of preparation.	4.3	0.71	4.1	0.75	1.49	387	0.13
Traditional lecture and testing approach. [a]	**3.9**	**0.79**	**3.6**	**0.85**	**3.22**	**194.9**	***<0.00****

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K18: *Comparison of Barriers with Age*

Item	Below 25 (*n*=22)		25-35 (*n*=234)		36-45 (*n*=104)		Over 45 (*n*=29)		*F* value	*p* value
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Time consuming.	4.2	0.69	4.2	0.71	4.2	0.75	4.1	0.54	0.15	0.93
Lack of preparation.	4.3	0.78	4.3	0.71	4.2	0.72	4.1	0.83	0.77	0.51
Traditional lecture and testing approach.	**4.0**	**0.93**	**3.9**	**0.78**	**3.7**	**0.79**	**3.6**	**0.98**	**3.44**	***0.01****

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K19: *Comparison of Barriers with Academic Degree*

Items	Diploma (*n*=19)		Bachelor (*n*=211)		Master (*n*=159)		*F* value	*p* value
	M	***SD***	***M***	***SD***	***M***	***SD***		
Time consuming.	4.4	0.68	4.2	0.71	4.3	0.70	1.48	0.22
Lack of preparation.	4.4	0.59	4.2	0.75	4.2	0.71	0.38	0.68
Traditional lecture and testing approach.	3.7	1.00	3.9	0.77	3.9	0.85	0.68	0.51

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

Table K20: *Comparison of Barriers with Institution*

Items	Polytechnic A (*n*=189)		Polytechnic B (*n*=132)		Polytechnic C (*n*=68)		*F* value	*p* value
	M	***SD***	***M***	***SD***	***M***	***SD***		
Time consuming	4.2	0.67	4.3	0.76	4.2	0.69	0.69	0.50
Lack of preparation. [a]	4.2	0.68	4.2	0.86	4.3	0.57	0.38	0.68
Traditional lecture and testing approach. [a]	4.0	0.74	4.0	0.94	4.0	0.74	2.41	0.09

Notes: [a] = Robust test in STATA indicates items where variances are not equal.
*= *p* <.05 (two-tailed tests)
Scale for items: 1=*Not Important*, 2=*Minimally Important*, 3=*Moderately Important*, 4=*Important*, 5=*Very Important*

OPEN-ENDED QUESTION RESPONSES

1. Mechanical Engineering

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P2-024	Packaging Design	The students are required to work in 'designer team' and they have to seek information through internet to get some ideas of new packaging design/product. They need to analyze information gathered whether they comply with the packaging concept and principles.	-	Students need to be able to defend their new packaging design/product by giving strong justification why their new packaging product is marketable.	• Use of internet to find information. • PowerPoint for presentations
2P2-040	Pneumatic & Hydraulic	Students have to find information regarding the foundation of pneumatic through internet and various sources.	With the information collected, students need to produce the example of pneumatic foundation used in the local industry current system.	Students should be able to justify the use of pneumatic foundation and also to improve the current system.	• Use of internet to find information. • PowerPoint for presentations • Short video recording • MS Word for reporting
3P2-129	Project	Students have to analyze the previous project related to the mechanical engineering and they have to find the advantages and disadvantages of that project. They need to explore in terms of pattern, experiment, and marketing values before they develop a new project.	Marketing principles need to be included in their project final report in order to produce a product that has a commercial value.	Students need to apply the concept of PLAN-DO-CHECK-ACTION in completing their final project design.	• Use of internet to find information. • PowerPoint for presentations • Short video recording • MS Word for reporting
4P1-150	AUTOCAD Drawing	-	Students are given a product and they have to	Student need to explain and justify the	• CAD-CAE • Autodesk Inventor

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
			draw in the CAD design form (solid model) with precise measurement. The end product will be in the engineering drawing form.	method/technique they used in producing the engineering drawing.	
5P1-152	Industrial Robotics	Students are required to come up with their own robotic design based on criterion given to them. They need to seek and analyze the latest design and technology using internet and YouTube.	Based on the information collected, they have to synthesize it, write and present reports their project using 3D drawing AUTOCAD or Inventors.	They should be able to justify and defend their design concepts.	• Use of internet to find information. • Robotic Programming Software • PowerPoint for presenting • MS Word for reporting
6P1-155	Electronic	Students need to identify and analyze several programmable logic controller (PLC) exist in the current market. They need to identify the attributes such as input-output devices, PLC functional area, life span, and software used to program the particular PLC.	They have to write a summary paper that will include consideration of the system requirement that used the PLC system.	They have to be able to defend their point of view why they are using that particular PLC for their new developed system.	• Use of internet to find information. • PowerPoint for presentations • MS Word for reporting • Use Facebook group to distribute assignments and reading materials.
7P1-157	Strength of Material	Students are required to get current method in testing the strength and characteristics of the material. They need to analyze the information they gathered is valid based on the material principles and methods.	They have to summarize the methods and principles in testing the strength of the materials.	Students will be given a case study and they need to justify the methods and principles that are appropriate to use.	• Use of internet to find information. • PowerPoint for presentations • MS Word for reporting

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
8P1-170	Engineering Mechanic	Students are required to write their time, distance, initial velocity, and final velocity during their journey to attend the class. Then, they have to analyze those data using graphs in order to predict acceleration of their vehicles.	Using the graphs, students should be able to synthesize the relationship between time, distance, velocity, and acceleration.	Student should be able to prove it using calculation methods.	• PowerPoint for presentations

2. *Commerce*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P2-002	Insurance Principles	Students have to find information on road accident rates in Malaysia. Then they have to analyze the accident rates in a certain range of periods.	They have to identify, analyze, and synthesize the risks that exist in the particular areas.	-	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

3. *Civil Engineering*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P1-069	Environmental Sciences	• Students will be given a case study (use the building block in the polytechnic). • Students have to study the impact and the effectiveness of sun-	• Students are required to take photos, draw, and write the findings of the form of shadows. • In the group of three or four, students have	Students also need to choose the best sun-shading device upon the discussion.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • Digital Camera

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		shading devices in that building block at three different times (morning afternoon and evening) through analyzing the form of shadows (if any).	to discuss the advantage and disadvantages of the sun-shading devices in terms of functional, practicality, and aesthetic values.		• Google Sketchup to develop 3D animation. • MS Project • Geographical Information System (GIS)
2P1-074	Building Services	Students are required to identify services in existing building and explain the system used in the building. They also have to relate it with the actual services theory they have studied in class.	Students have to produce a report about the services in the particular building.	They need to describe clearly the system services used and how it relates with what they have learned theoretically in class.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • Video clip related to topics. • CAD and MovieMaker
3P2-055	Forestry and Forest Product	Students need to use Internet to gather information regarding the forest product such as pulp and paper technology. They need to analyze it.	They have to create a short video clip using Video Maker software and publish it via YouTube in duration of 5 to 10 minutes. The video is to summarize information what they have searched via Internet.	-	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video • Video Maker software
4P2-056	Building Services Drawing	Students are required to draw one house floor plan and analyze it. Then, students will equip it with the piping, electrical & water systems.	Students will be asked to design it using CADD drawing software.	Students can explain the system that they have designed and justify it.	• Use of Internet to find information. • PowerPoint for presentations • CADD drawing software
5P2-114	Pollution	Students need to find information regarding air	Students have to summarize the	Student should be able to justify their opinion in the	• Use of Internet to find information.

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		pollution. They have to analyze the cause and effect of the air pollution.	information gathered to produce a summary paper.	summary paper.	• PowerPoint for presentations • MS Word for reporting
6P3-035	Engineering Science	Students are required to find and gather the example of physics application in everyday life using Internet. They need to analyze its validity based on the physics principles they have learned in class.	Students have to prepare a precise and concise report regarding one principle that they have chose. For example: Archimedes principle. They need to elaborate what the Archimedes principle is and explain how Archimedes applicable in everyday life and etc.	Students need to produce at least one example of application model to be presented in the class. Strong justification on the model produced is needed.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

4. *Tourism and Hospitality*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P3-009	Project – Food & Beverage Product	Students use a nutrition calculator program to analyze and advise ‘clients’ to promote healthier living.	-	Students are able to key-in and use data analysis to draw conclusions and recommendations for their clients.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
2P3-001	Excellent Hospitality & Customer Service	Students need to analyze information from online articles and identify values required in the customer service area. They have to analyze using the method of end-of chapter problem.	They will write a summary of each topic that they have learned in class. Discussion activities among them are required.	They need to be able to justify their thoughts and suggestions on how to solve certain problems or situation using end-of chapter problem method. Evaluation through	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • Video clip related to

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
				reflective journal.	topics.
3P3-027	Recreational Marine	In my class, students are required to find articles regarding recreational marine and video on the topic of basic technique of recreational marine such as swimming, kayaking, scuba diving, fishing and snorkeling. Analyzing the information retrieved and identifying the differences and similarity among them.	Students have to write a paper for two articles related to recreational marine.	Students are able to evaluate the right techniques for recreational marine activities locally and internationally.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video

5. *Information Technology*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P1-001	Network Fundamentals	Students are required to seek information about communication technology such as infra red technology, Bluetooth, WLAN. They have to compare between these technologies in terms of several aspects (advantages vs, disadvantages)	Students will summarize and conclude the findings from information collected. They also need to suggest what the next technology will look like.	Students should be able to justify their findings and thoughts on the topic given.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube
2P1-010	Database System	Students are needed to use Oracle Database system to produce ERD program based on the existing database scheme that they have	-	-	• Use of Internet to find information. • Oracle Database System

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		learned in class. They have to research several sample of database scheme.			
3P1-122	Web Programming	Students are required to review the industrial standard for Web Apps and design from IEEE Journal. Then, they have to examine several designs in web apps.	Students have to design one web apps pertaining to the topic of web programming.	-	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video • Blogging
4P1-131	Computer Networking System	Students have to search information via Internet about technology in computer networking. Also, they need to connect the fundamental of networking they have learned in class with the information gathered.	Students have to put together all information collected and networking concepts in one review paper.	Students should be able to defend their view in the paper.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video • Blogging
5P1-132	Fundamental of Information Technology	Students are required to analyze “Green Computing” concept.	Students need to produce a paper about “Green Computing” and relate it with computing ethics.	They have to justify the advantages of “Green Computing”	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video
6P1-139	Network Security	Students are required to find the encryption and decryption software. They should be able to complete the task of encryption and decryption.	-	-	• Blogging • Encryption and decryption software
7P1-143	Programming Fundamentals	Students will be given one problem and they have to analyze that problem. Then they are required to produce	Students will develop a system using Java programming language that will include all the	Students will evaluate the programming methods that are appropriate for developing the system.	• Use of Internet to find information. • PowerPoint for presentations

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		one algorithm and pseudo code before developing one computer programming.	concepts of programming.		• MS Word for reporting • Java Programming Language • Blogging
8P2-065	Computer Application	Students are required to identify and analyze the basic component of a computer. They need to do comparisons among operating systems.	Students should be able to synthesize the fundamentals of operating systems and application software.	-	• Use of Internet to find information. • PowerPoint for presentations • MS Excel to produce charts and calculation

6. *General Studies*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P1-073	Islamic Education	Students are required to search information about moral ethics values. They have to analyze and link it with the current issues in Malaysia	They are required to produce a paper related to that particular issue.	Students are required to indicate their thoughts on the current issues and propose a possible solution.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
2P1-010	Communicative English	Students are required to find online advertisements for any product/service. They have to compare and contrast the features of the chosen products/services and select the best options available based on the given criteria.	They have to come up with the PowerPoint presentation for their comparison.	They have to present their selection and need to be able to defend their choices.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
3P1-088	Communicative English	As one of the practices in this course, students are required to seek online articles/newspapers/magazines and react/response to the article based on their own observation/opinion using all the input given by the lecturer in writing a 'reaction' paper	They are required to summarize the article based on the lecture on 'how to make summary' of an article.	In evaluating the material, students are asked to produce their own personal observation or opinion regarding the article.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
4P1-131	Communicative English	Students are required to find online articles about current issues. They have to analyze the information in the articles they read and identify the key points of the articles as related to the topic in the course.	They have to write a reaction paper based on the article and give their own opinion /ideas on the issues.	They need to be able to justify their opinion /ideas whether they agreed or disagreed on the topic and it can be reflected from their point of views.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
5P1-097	Islamic Education	Students are required to find online articles about the types of marriage. They have to analyze the information in the articles they read is valid based on the marriage principles in Islam.	They have to write a summary paper of the articles by comparing it with the Islamic principle of marriage.	Students are asked to justify their own personal opinion regarding the articles, the reason why they chose that articles.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • YouTube video
6P1-188	Communicative English	Students are required to find poems and analyze the vocabulary used. They will recite the poem in the class and a representative from respective classes will upload the poem on course Facebook	There is an assessment called 'Reaction Paper'. Students need to write a response based on the videos uploaded by the lecturer or other students in the form of comments on	Students watch video on current issues. They watch and share their opinions on FB. In class, students will have the discussion on that particular issue. It helps students to speak and	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		wall. Students will discuss the new vocabulary and interactively help one another.	course Facebook wall. They need to share their opinions on that issues brought up for discussion.	generate ideas among them.	• YouTube • Facebook
7P3-016	Communicative English	For the topic on environmental issues, students will be divided into small groups and each group has to find information on different issues on the world wide web.	Each group will collect information from the other group via cooperative learning in order to synthesize the information.	Each group has to present their findings and suggests ways to overcome those issues. Each group will write a complete report of the whole information gathered on environmental issues.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
8P2-104	Communicative English	Students are assigned to search topic and literature review from the Internet for their project survey. They also need to use IT tools to present in PowerPoint and to provide valid source cited from the Internet.	They need to choose a topic such as abortion and conduct a survey on students' opinion regarding the topic and present their findings in class.	They should be able to support the importance of their survey through literature review and able to ask valid questions to obtain data from polytechnic students.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

7. *Electrical Engineering*

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
1P3-056	Fundamental Programming	Students are exposed to myriad of programming coding. They have to analyze each and every code (functionality). They are asked to fill in the IPO table,	In the end of semester, students will do a project in group. In the project they will synthesize the programming they have learned with the simple	They should be able to defend their ideas during the project presentation.	• Use of Internet to find information. • PowerPoint for presentations

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		develop the pseudo code and also the flowcharts for the problem givens.	hardware/circuiting (Embedded programming)		• MS Word for reporting. • Programming languages.
2P2-052	Programmable Logic Controller	Students are required to develop a program and simulation for one machine or system.	They have to write a report and observation based on the system developed.	They are required to redesign simulation system based on the devices given to them.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • PLC software
3P2-053	Communication Engineering	-	Students need to write summary on the difference of the available communication technologies.	They must be able to evaluate which communication technologies are the best on their research of all areas	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
4P2-084	Industrial Safety	Students are given an assignment to find information about Occupational Safety and Health (OSHA) act. Then, they have to review the act based on the information gathered.	-	Students are required to justify their opinions on how the particular industry/company practices the concept of safety based on their industrial practical experiences.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
5P2-091	Occupational Safety and Health (OSHA)	Students are required to find articles about OSHA. They have to analyze and state their views and comments with reasonable arguments based	Students have to write summary of the articles.	They should be able to state their views, comments and relate with OSHA act and principles.	• Use of Internet to find information. • PowerPoint for presentations

Ref #	Course	Analysis	Synthesis	Evaluation	ICT Utilization
		on the OSHA principles they have learned in class.			• MS Word for reporting
6P2-095	Project	In class project, students are asked to seek and review literature about the circuits that they want to use in their project. They have to identify the advantages and disadvantages of each circuits used.	-	-	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting • PCB Wizard for circuit drawing
7P2-045	Audio Video System	In this class, students are required to find information about the current audio video system. They have to determine the current changes and technologies used.	-	Students should be able to justify the use of audio visual system that is parallel with the current technologies.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting
8P1-078	C++ Programming	In this class, students are asked to find one medium-size computer programming via Internet. Based on the program, students need to discuss several aspects in terms of SDLC cycle.	Students are required to develop a new computer programming that will include consideration of the programming concept and cycle that they have learned in class.	Students have to rate their ideas which can contribute to the enhancement of the computer programming they have developed.	• Use of Internet to find information. • PowerPoint for presentations • MS Word for reporting

ANALYSIS OF EXISTING DOCUMENTS (LESSON PLANS):

1) Engineering Mathematics (Basic Level)

Analysis (A)	Synthesis (S)	Evaluation (E)	Teaching & Learning Strategy	ICT Utilization
• Simply algebraic fractions. • Analyze the expression related to indices. • Analyze and express the index number to logarithm form. • Simply the logarithm expressions. • Identify transversals corresponding angles, alternate angles and interior angles. • Identify the hypotenuse of right-angle triangles. • Compare and contrast the given shapes (the concepts of similarity). • Analyze and sketch a linear graph when given the gradient and point of interception. • Analyze and sketch graphs of quadratic functions. • Analyze and sketch graphs of cubic	• Solve algebra fractions using addition, subtraction multiplication, and division methods. **(E)** • Perform conversion of formulas. • Solve quadratic equations using factorization, quadratic formulas and completing squares. **(E)** • Solve simultaneous linear equation with two variables using elimination and substitution methods. **(E)** • Change the base of logarithms. • Solve the equations that contain indices and logarithm expressions. **(E)** • Solve trigonometric equations using trigonometric identities. **(E)** • Solve problems involving properties of angles associated with transversal. **(E)** • Solve problems on the angles of cyclic quadrilaterals. **(E)** • Solve problem using the	• Use quadrant to determine the value of trigonometric functions (positive and negative angles) • Determine the area of a triangle using the formula of…. • Calculate the arc length of a circle • Determine the area of a sector and segment. • Determine the perimeter and area for rectangle, parallelogram, triangle, and trapezium. • Determine the surface of area and volume for sphere, hemisphere, cylinder, cube, cuboid, prism, pyramid and circular cone. • Measure the lengths of unknown sides of two similar shapes. • Measure the area and volume for any similar shapes.	• Lecturing **(P1, P2, P3)** • Question and Answer Practical **(P1, P2, P3)** • Problem solving in group **(P1, P3)** • Computer assisted learning **(P1)** • Class Presentation **(P1, P3)**	• Computer Assisted Learning **(P1)** • LCD Projector **(P1, P2, P3)** • PowerPoint **(P1, P2, P3)** • CIDOS (Course Management System **(P1, P2)**

Analysis (A)	Synthesis (S)	Evaluation (E)	Teaching & Learning Strategy	ICT Utilization
functions. • Analyze and sketch graphs of reciprocal functions.	Pythagoras Theorem. **(E)** • Convert angle from degree to radian and vice-versa. • Construct table of values for given linear functions. • Solve the simultaneous linear equation using linear graph. **(E)** • Construct tables of values for given quadratic functions. • Solve problems involving linear and quadratic equations using graph. **(E)** • Solve problems involving two quadratic equations using graph. **(E)**			

* Note: P1- Institution 1, P2- Institution 2, P3- Institution 3
A-Analysis, S-Synthesis, E-Evaluation

2) Engineering Mathematics (Intermediate Level)

Analysis (A)	Synthesis (S)	Evaluation (E)	Teaching &Learning Strategy	ICT Utilization
• Identify lower and upper class limit. • Analyze the first term and common differences of Arithmetic Progressions. • Analyze the1st term and common difference of a Geometric Progression. • Distinguish matrix notations (types of matrices).	• Construct frequency table • Build histogram and frequency polygon. • Construct cumulative frequency table. • Solve the problems related to Arithmetic Progressions. **(E)** • Solve problems related to Geometric Progression. **(E)** • Solve the equality of matrices. **(E)** • Solve simultaneous linear equations up to 3 variables. **(E)** • Construct solutions of linear equations using Gaussian elimination method and LU decomposition with Crout method. • Construct solution of non-linear equations using the fixed point iteration method and the Newton-Raphson method,	• Explain fundamental statistical concepts. • Interpret several forms of data presentation such as line graph, bar chart, and pie chart. • Determine class size and class interval. • Determine upper and lower class boundary. • Determine mark class. • Determine mean, median, and mode for grouped and ungrouped data using formula. • Determine modal class from frequency table for grouped data. • Determine mode from histogram for grouped data. • Estimate median, quartiles, interquartile range, deciles, and percentiles from Ogive. • Determine planar surface area of irregular shapes using Trapezoidal rules. • Determine planar surface area of irregular shapes using Simpson's rules.	• Lecturing **(P1, P2, P3)** • Tutorial **(P1, P2, P3)** • Question and Answer Practical **(P1, P2, P3)** • Problem solving in group **(P1)** • Class Presentation **(P1)**	• LCD Projector **(P1, P2, P3)** • PowerPoint **(P1, P2, P3)**

Analysis (A)	Synthesis (S)	Evaluation (E)	Teaching &Learning Strategy	ICT Utilization
		• Determine value of n^{th} and sum of the first n^{th} term of an Arithmetic Progression. • Determine the value of n^{th} term, sum of the first n^{th} term, sum to infinity, and geometric mean of Geometric Progressions. • Determine multiplication of a matrix by a scalar and conformable matrix. • Determine the transpose of a matrix.		

* Note: P1- Institution 1, P2- Institution 2, P3- Institution 3
A-Analysis, S-Synthesis, E-Evaluation

3) Engineering Mathematics (Advanced Level)

Analysis (A)	Synthesis (S)	Evaluation (E)	Teaching &Learning Strategy	ICT Utilization
• Analyzing and sketching graphs of hyperbolic. • Analyzing and sketching inverse hyperbolic function graphs. • Differentiating inverse trigonometric and hyperbolic functions. • Differentiating inverse hyperbolic and implicit functions. • Identifying and analyzing the differential equations.	• Solving inverse trigonometric function equation. • Integrating inverse trigonometric and hyperbolic functions. • Integrating functions using the partial fractions and by-part-integral. • Solving 1st order differential equations by using integration by substitution and integration by part. **(E)** • Solving the 2nd stage of differentiation equation for…. **(E)**	• Explaining and solving first order partial differentiation problems. **(S)** • Explaining and solving 2nd order partial differentiation problems. **(S)** • Explaining and interpret overall differentiation for rate of changes and rate of small increments. • Explaining and interpret formation of differential equations.	• Lecturing **(P1, P2, P3)** • Question and Answer Practical **(P1, P2, P3)** • Tutorial **(P1, P2, P3)**	• LCD Projector **(P1, P2, P3)** • PowerPoint **(P1, P2, P3)**

* Note: P1- Institution 1, P2- Institution 2, P3- Institution 3
A-Analysis, S-Synthesis, E-Evaluation

APPENDIX M: STATISTICAL DATA ANALYSIS

Research Question 1

- Independent Variable: ICT Utilization (Item 8a-8j)

```
. summarize   qICT_8All_Hots, detail

                        qICT_8All_Hots
-------------------------------------------------------------
      Percentiles      Smallest
 1%          2.6              1
 5%            3              2
10%          3.4            2.2       Obs                 389
25%          3.9            2.6       Sum of Wgt.         389

50%            4                      Mean           4.106755
                        Largest       Std. Dev.      .5789482
75%          4.5              5
90%            5              5       Variance        .335181
95%            5              5       Skewness      -.6052802
99%            5              5       Kurtosis       5.012679
```

Independent Variable: ICT Utilization (Divided into 2 groups – Low [1], and High [2])

```
. tab  qICT_8All_NewRange

qICT_8All_N |
    ewRange |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        106       27.25       27.25
          2 |        283       72.75      100.00
------------+-----------------------------------
      Total |        389      100.00
```

- Dependent Variable: Level of Support and Training (Item 7a-7c)

```
. summarize   qICT_7_Support, detail

                       qICT_7_Support
-------------------------------------------------------------
      Percentiles      Smallest
 1%            1              1
 5%            2              1
10%            2              1       Obs                 389
25%     2.666667              1       Sum of Wgt.         389

50%     3.333333                      Mean           3.215062
                        Largest       Std. Dev.      .8367675
75%            4              5
90%            4              5       Variance       .7001798
95%     4.333333              5       Skewness      -.3810888
99%            5              5       Kurtosis       2.812692
```

T-test (Low and High groups of ICT Utilization with Level of Support and Training)

```
. robvar   qICT_7_Support, by( qICT_8All_NewRange)

qICT_8All_N |     Summary of qICT_7_Support
    ewRange |        Mean   Std. Dev.       Freq.
------------+------------------------------------
          1 |   2.9213107   .77599362         106
          2 |   3.3250883   .83341061         283
------------+------------------------------------
      Total |   3.2150615   .83676747         389

W0  =  1.7449757   df(1, 387)     Pr > F = 0.18729015

W50 =  2.3730973   df(1, 387)     Pr > F = 0.12425915

W10 =  2.4492894   df(1, 387)     Pr > F = 0.11839539
```

<u>Sample variance</u>: Equal variance (Pr = 0.187), Pr > 0.05

```
. ttest   qICT_7_Support, by ( qICT_8All_NewRange) level (95)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |     106    2.921311    .0753712    .7759936    2.771864    3.070758
       2 |     283    3.325088    .0495411    .8334106    3.227571    3.422606
---------+--------------------------------------------------------------------
combined |     389    3.215062    .0424258    .8367675    3.131648    3.298475
---------+--------------------------------------------------------------------
    diff |           -.4037777    .0931761               -.5869723    -.220583
------------------------------------------------------------------------------
    diff = mean(1) - mean(2)                                      t =  -4.3335
Ho: diff = 0                                     degrees of freedom =      387

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

- Dependent Variable: Lecturers' Confidence Level (Item 7d-7e)

```
. summarize    qICT_7_Confidence, detail

                      qICT_7_Confidence
-------------------------------------------------------------
      Percentiles      Smallest
 1%          2.5              1
 5%            3              1
10%          3.5            2.5       Obs                 389
25%            4            2.5       Sum of Wgt.         389

50%            4                      Mean            4.27892
                        Largest       Std. Dev.      .6238126
75%            5              5
90%            5              5       Variance       .3891421
95%            5              5       Skewness      -1.032844
99%            5              5       Kurtosis       5.884807
```

T-test (Low and High groups of ICT Utilization with Lecturers' Confidence Level)

```
. robvar   qICT_7_Confidence, by( qICT_8All_NewRange)

qICT_8All_N |   Summary of qICT_7_Confidence
    ewRange |        Mean   Std. Dev.       Freq.
------------+------------------------------------
          1 |   3.9198113   .73723031         106
          2 |   4.4134276   .51615386         283
------------+------------------------------------
      Total |   4.2789203   .62381258         389

W0  =  6.0698890   df(1, 387)     Pr > F = 0.01418467

W50 =  4.1850417   df(1, 387)     Pr > F = 0.04145776

W10 =  4.3768573   df(1, 387)     Pr > F = 0.03708122
```

<u>Sample variance</u>: Unequal variance (Pr = 0.014) less than Pr < 0.05

```
. ttest    qICT_7_Confidence, by ( qICT_8All_NewRange) unequal level (95)

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |     106    3.919811    .0716061    .7372303     3.77783    4.061793
       2 |     283    4.413428    .0306822    .5161539    4.353032    4.473823
---------+--------------------------------------------------------------------
combined |     389     4.27892    .0316286    .6238126    4.216736    4.341105
---------+--------------------------------------------------------------------
    diff |           -.4936162    .0779027               -.6475854   -.3396471
------------------------------------------------------------------------------
    diff = mean(1) - mean(2)                                      t =  -6.3363
Ho: diff = 0                     Satterthwaite's degrees of freedom =  145.272

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Research Question 5

(a) Teaching Method and Age (*ANOVA*)
(1= Below 25 years, 2=25-35 years, 3=36-45 years, 4=Over 45 years)

- Item 7: Lecturing

```
. oneway qB_7 qDemo_02_New, bonferroni scheffe tabulate
```

qDemo_02_New	Summary of Lecturing Mean	Std. Dev.	Freq.
1	4.0454545	.72224997	22
2	4.2307692	.64700851	234
3	4.3173077	.68640647	104
4	3.8965517	.77204865	29
Total	4.218509	.67813179	389

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	4.7152269	3	1.5717423	3.48	0.0160
Within groups	173.711508	385	.451198723		
Total	178.426735	388	.45986272		

Bartlett's test for equal variances: chi2(3) = 2.1392 Prob>chi2 = 0.544

Sample variance: Equal variance (Pr = 0.544), Pr > 0.05

Comparison of Lecturing by qDemo_02_New (Scheffe)

Row Mean-Col Mean	1	2	3
2	.185315 0.675		
3	.271853 0.397	.086538 0.754	
4	-.148903 0.893	-.334218 0.096	-.420756 0.032

- Item 8: Asking student to memorize content accurately

```
. oneway qB_8 qDemo_02_New, bonferroni scheffe tabulate
```

qDemo_02_New	Summary of Memorize content accurately Mean	Std. Dev.	Freq.
1	3.6818182	1.0413528	22
2	3.8034188	.78875483	234
3	3.6538462	.86764082	104
4	3.2068966	1.0816426	29
Total	3.7120823	.86118058	389

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	9.72613891	3	3.2420463	4.49	0.0041
Within groups	278.027074	385	.722148245		
Total	287.753213	388	.741631993		

Bartlett's test for equal variances: chi2(3) = 8.3176 Prob>chi2 = 0.040

<u>Sample variance</u>: Unequal variance (Pr = 0.040) less than Pr < 0.05

Comparison of Memorize content accurately by qDemo_02_New (Scheffe)

Row Mean-Col Mean	1	2	3
2	.121601 0.938		
3	-.027972 0.999	-.149573 0.527	
4	-.474922 0.273	-.596522 0.006	-.44695 0.101

b) Teaching Method and Academic Degree (*ANOVA*)
(1= Diploma, 2=Bachelor, 3=Master)

- Item 10: Student engagement in dialogue

```
. oneway qB_10 qDemo_03_New, bonferroni scheffe tabulate

            |    Summary of Engaging students in
qDemo_03_Ne |              dialogue
          w |        Mean   Std. Dev.       Freq.
------------+------------------------------------
          1 |   3.8947368   .87526103          19
          2 |    4.450237   .60248489         211
          3 |   4.4239772    .5658462         159
------------+------------------------------------
      Total |   4.4123711   .61346703         389

                        Analysis of Variance
    Source              SS         df      MS            F     Prob > F
------------------------------------------------------------------------
Between groups      5.41491357      2   2.70745679      7.43     0.0007
 Within groups      140.605705    386   .364263484
------------------------------------------------------------------------
    Total           146.020619    388    .3763418

Bartlett's test for equal variances:  chi2(2) =   7.6536  Prob>chi2 = 0.022
```

Sample variance: Unequal variance (Pr = 0.022) less than Pr < 0.05

```
         Comparison of Engaging students in dialogue by qDemo_03_New
                                (Scheffe)
Row Mean-|
Col Mean |          1          2
---------+----------------------
       2 |      .5555
         |      0.001
         |
       3 |     .52924    -.02626
         |      0.002      0.918
```