THE IMPACT OF INDUSTRY-BASED LEARNING PROGRAMS ON SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS STUDENTS: A CASE STUDY OF INDONESIAN HIGHER EDUCATION

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Keywords

Industry-based learning (IBL), work integrated learning (WIL), work placement, university-industry partnership (UIP), university-industry collaboration (UIC), STEM, STEM education, academic performance, academic achievement, qualitative research, case study.

Abstract

Collaboration between universities and industries has become increasingly important for the development of Science and Technology and for developing a competitive workforce. This is particularly relevant for the Science Technology Engineering and Mathematics (STEM) disciplines. Literature suggests that the key element of university-industry partnership (UIP) is the exchange of knowledge that is mutually beneficial for both parties. One good example of UIP is industry-based learning (IBL) program, through which university students enter industries to experience and learn how their skills and knowledge acquired in the classroom are implemented in the workplace. Despite the large body of research on the implementation of IBL programs in developed countries such as in Australia, research on this subject within an Indonesian context is surprisingly scarce, and little is known about the perspectives of the Indonesian HE stakeholders on this topic. This study, therefore, seeks to clarify the purposes for establishing IBL programs at Indonesian higher education institutions (HEIs) and explore the impacts of the programs on Indonesian STEM undergraduate students, in particular on their academic performance.

A qualitative approach adopting the case study method was utilised in this research to capture the perceptions and real-life experience of relevant stakeholders involved in the IBL program. The data collection method involved interviewing 40 key stakeholders, including university students, academic staff members, and industrial supervisors who previously participated in IBL programs through the UIP scheme. The majority of the research respondents were from an Indonesian university, and others were from industries. Analysis of relevant documents was also used as a second and final form of data collection. The collected data were analysed using a thematic analysis to identify the key findings.

The findings show that *the acquisition of work experience* and *implementation of theories* by the students are the two main purposes for establishing IBL programs at HEIs in Indonesia. Furthermore, the findings suggest that IBL programs play an important role in increasing both the academic performance and employability skills of Indonesian university students. The majority of respondents (78%) shared this perception. The remaining respondents (22%) perceived that IBLs program either had no significant impact on the students' academic performance, or the impact was very difficult to measure. The other main positive impacts of the IBL program as perceived by the majority of the respondents were: that IBL increased the students' soft skill capabilities such as communication, teamwork, motivation, and discipline in achieving goals; increased students' work experience; and established links to professional networks.

The findings also confirm that IBL programs promote STEM development at HEIs in Indonesia; this was the perception of 65% (26 out of 40) of participants in the study. During IBL programs, STEM students act as ambassadors for their respective study programs. When they perform well in their placement programs, it is seen as a good advertisement for their STEM study programs and STEM education itself. In the long term, IBL programs indirectly help to promote STEM education in Indonesia by equipping STEM undergraduate students with the skills and knowledge necessary to compete for jobs and leadership roles in Indonesia and overseas.

The research findings provide useful insights into the role of IBL in STEM disciplines, and offer new understandings of the influence of IBL programs on Indonesian university students, as perceived by the stakeholders. The research contributes to existing knowledge by providing empirical evidence of the impact of industry-based learning programs on undergraduate university students' performances. The outcomes and findings will contribute to the development of Indonesian HEIs by providing evidence-based knowledge that can be used to improve the quality of IBL and UIP programs, and inform the Indonesian HE authorities of approaches that will enhance their IBL programs.

Publications

Rajibussalim, R., Sahama, T., & Pillay, H. (2016). *Enhancing the learning experiences through Industry-Based Learning from Indonesian university perspective*. Paper presented at the 8th International Conference on Educational and Learning Technolgies, Barcelona, Spain.

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List of Abbreviations

ACEN	Australian Collaborative Education Network
ACM	Association for Computing Machinery
AQF	Australian Qualification Framework
ASEAN	Association of Southeast Asian Nation
BIT	Bachelor of Information Technology
CRC	Cooperative Research Center
DGHE	Directorate General of Higher Education
GPA	Grade Point Average
HE	Higher Education
HEI	Higher Education Institution
IBL	Industry-Based Learning
ICT	Information and Communication Technology
IPB	Institut Pertanian Bogor
IS	Information System
IT	Information Technology
ITB	Institut Tekhnologi Bandung
LiWC	Learning in the Workplace and Community
MP3EI	Master Plan for Acceleration and Expansion of Indonesia Economic Development
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
SME	Small and Medium Enterprises
STEM	Science Technology Engineering and Mathematics
TAFE	Technical and Further Education

UGM	Universitas Gajah Mada
UI	Universitas Indonesia
UIC	University-Industry Collaboration
UIL	University-Industry Linkage
UIP	University-Industry Partnership
UNAIR	Universitas Airlangga
UNDIP	Universitas Diponogoro
UNHAS	Universitas Hasanuddin
UNPAD	Universitas Pajajaran
UWI	University of Western Indonesia
VBA	Visual Basic for Application
VET	Vocational Education and Training
WIL	Work Integrated Learning

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature:

QUT Verified Signature

Date: June 2017

Dedication

To my beloved father Drs Saifuddin Ibrahim and my family members who lost their lives in the Tsunami on 26 December 2004: Alawiyah (mother), Sarwati (wife), Anas Amirul Hakim (son), Fildhah Hulwana (daughter), Julisati, Khalisah, Khamisah (sisters), and other extended family members.

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The PhD journey itself has not been an easy ride for me. It has been full of challenges. But that's what makes this PhD journey very special, and it will last long in my memory. Struggle, injustice, support, togetherness, and happiness are a few words that can be used to describe this long journey. Every beginning must have an end. Finally, I completed this journey to the finish line.

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Chapter 1 Introduction

1.1 Background

An important report from the Boston Consulting Group (BCG) published in 2013 suggests that there is a severe shortage of adequately qualified leaders in Indonesia who can manage the growing number of companies and industries that support the recent impressive country's economic performance. There is a danger that this problem will undermine the current and future economic success of Indonesia (Tong & Waltermann, 2013).

To make matters worse, the shortage of talent is not only in quantity but also in the talent quality. The most affected areas are those requiring technical skills, or Science, Technology, Engineering, and Mathematics (STEM). For example, due to its recent remarkable economic development, Indonesia requires around 50,000 engineers per year to keep the economy at its current position. However, Indonesian universities can only produce 30,000 engineers per year. Thus there is a 40% shortfall, and it is predicted that this will rise to 70% by the year 2025 (Tong & Waltermann, 2013).

Tong and Waltermann (2013) argue that Indonesia has made satisfactory progress in building infrastructure but not so in developing its human resources, particularly in STEM disciplines. One of the main reasons for the shortage of skilled graduate is the inability of Indonesian higher education institutions (HEIs) to produce sufficiently competent graduates to fill strategic positions within the growing service sector. The Indonesian service sector has expanded rapidly from 36% to 41% of GDP between 2010 and 2015. Currently, managerial or administrative jobs constitute 36% of total employment in Indonesia. However, this percentage will increase to 55% by

2020, and Indonesia simply does not produce sufficient skilled graduates to fulfil these strategic roles (Tong & Waltermann, 2013). Although other East-Asian countries and other countries in the world face the same problem (Barakos, Lujan, & Strang, 2012; Breiner, Harkness, Johnson, & Koehler, 2012; Brown, Brown, Reardon, & Merrill, 2011; Fifolt & Searby, 2010), the phenomenon is more significant in Indonesia.

In this regard, Indonesian HEIs can play a more active role in addressing the shortage of proficient STEM graduates by forming strong and mutually beneficial partnerships with industries. Partnership between a university and industry is known as a university-industry partnership (UIP) or university-industry collaboration (UIC) program. UIPs can be implemented in many activities such as research, conference events, or student education or learning. One of the important partnerships between university and industry in the area of education is *industry-based learning* (*IBL*) programs. In these programs, universities send their students to industry partners to learn and gain important skills, knowledge, and work experience. These skills, knowledge and work experience are often referred to as 'professional competence'. As a result of mastering professional competency, university graduates are expected to succeed not only in getting employment after graduation but also in increasing their academic performance upon their return to university study after the completion of an IBL placement. An illustration of an IBL placement under the umbrella of the UIP program is depicted in Figure 1.1.

Industry partners can also benefit from the UIP program by utilising the university's research centre and its human expertise to find solutions to their industrial problems. Through their research centres, Universities can offer solutions and innovative ideas that can be utilised by the business community for their benefit. In this regard, universities have contributed to the growth of industrial and business sectors and their contribution will in turn strengthen Indonesia's economy (Tong & Waltermann, 2013).

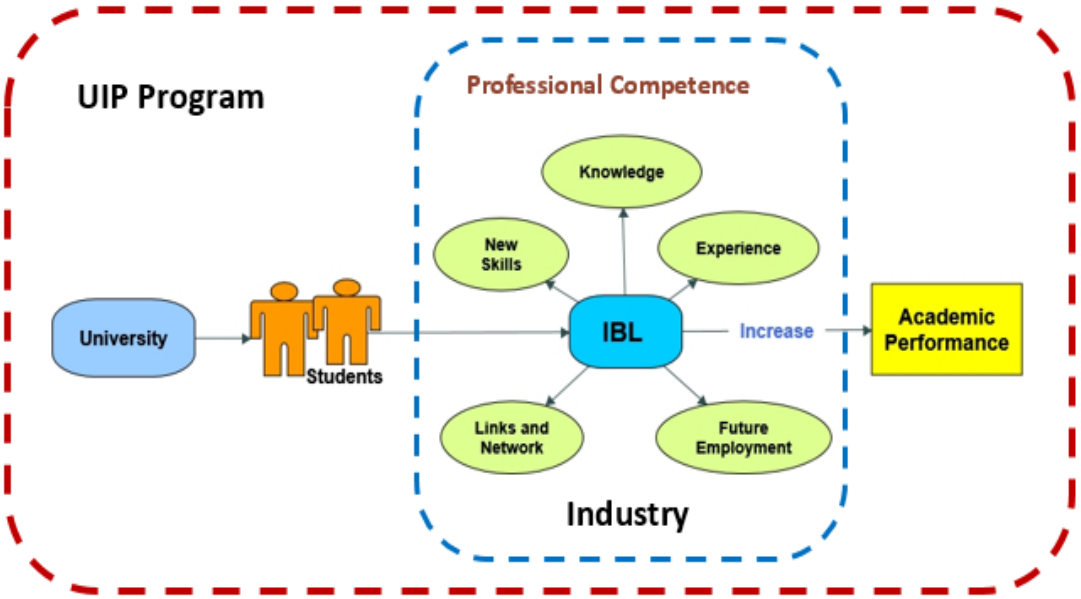

Figure 1.1 An illustration of IBL programs under university-industry partnership (UIP) umbrella.

IBL programs can play an important role in equipping STEM graduates with the necessary skills, knowledge and experience to enter workplaces (Mehta & Sun, 2013; Tong & Waltermann, 2013). However, there is minimal focus on the extent to which IBL programs can enhance students' academic performance after their return to university in the literature. This thesis therefore, aims to investigate the impact of IBL programs on the students' academic performance, particularly on Indonesian STEM undergraduate students.

Before delving into a detailed discussion of student academic performance, it is important to clarify the term 'academic performance' used in this study. The terms 'academic performance' and 'academic achievement' are used interchangeably throughout the literature. The present study differentiates the terms.

Academic achievement is often regarded as *proficiency* and can be quantified and measured in several ways, such as by academic scores and grades (Astin, 2012; Haertel, 2013). Academic achievement is commonly considered a benchmark of academic performance. Academic performance is more than just achieving high scores or Grade point averages (GPAs) in university subjects. The term can be used "to

describe different factors that may influence student success" at the university (Rasberry et al., 2011, p. S12). Hence, academic achievement is considered a subset of academic performance. When academic achievement is combined with other factors such as a set of employability skills and work experience, it becomes academic performance, as illustrated in Figure 1.2.

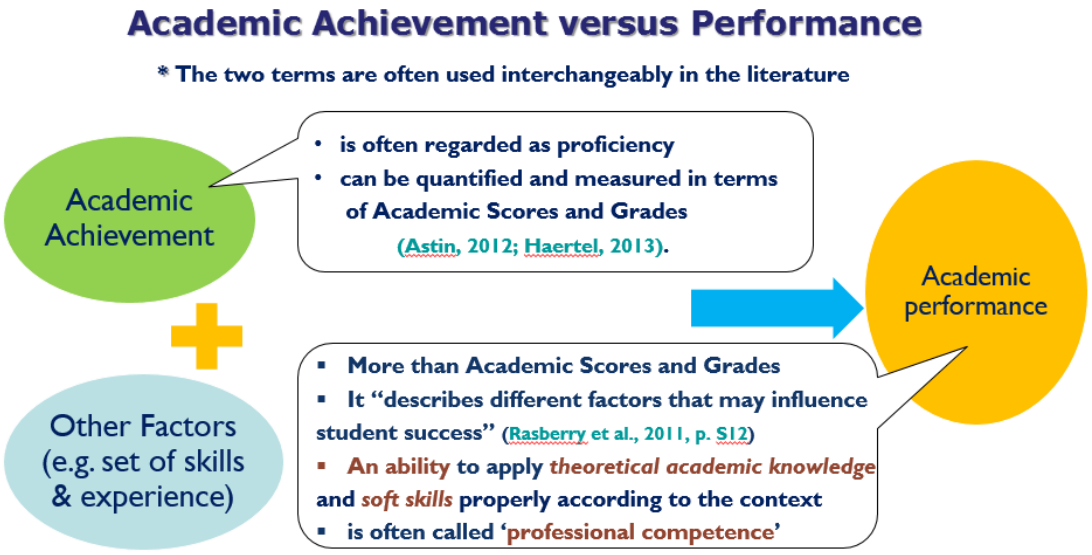

Figure 1.2. The relationship between academic achievement and academic performance

In this study, academic performance is defined as an ability to apply *theoretical academic knowledge* and *soft skills* properly according to the context. This ability is often called 'professional competence'. Graduates with professional competence are often demanded and sought after by employers. The current study focuses on the impact of IBL programs on the academic performance (professional competence) of STEM students as future engineers or scientists rather than on their academic achievement.

1.2 Research Problem

There is a growing body of work that explores industry-based learning within university-industry partnership programs. In the Australian context for example, the research into IBL and UIP programs emphasises how integrating IBL programs into university curricula improves them, and explores what constitutes best practice (Holt,

Mackay, & Smith, 2004; Koppi, Edwards, Sheard, Naghdy, & Brookes, 2010; R. Smith, Mackay, Holt, & Challis, 2008).

Research into IBL and UIP programs in the Indonesian context mostly focuses on how university staff and students can contribute to solving industrial problems and at the same time create and benefit from learning opportunities for students in the industry (Nurdin, 2012; Santosa & Kusumawardani, 2010).

In this context, the studies cited above on IBL and UIP programs, especially in the Indonesian context, do not provide enough information on the impact of IBL programs on the students' academic performance, and how the programs support STEM education in Indonesia. This study seeks to fill this gap.

The main aim of this research is to investigate the impact of IBL programs on Indonesian university students, particularly on their academic performance, with particular reference to the undergraduate students in STEM disciplines.

1.3 Research Objectives

The objectives of this research project are:

1. To investigate the purposes of the Indonesian higher education institutions in establishing IBL programs.
2. To examine the impact of IBL programs on Indonesian undergraduate university students, specifically in regard to their academic performance.
3. To investigate how IBL programs support STEM education in Indonesia.
4. To make recommendations for improvement of IBL programs at higher educational institutions in Indonesia, based on the research findings.

1.4 Research Questions

Based on the research problems and research objectives, the following research questions are formulated:

1. Why do Indonesian universities establish industry-based learning programs?
2. What are the impacts of industry-based learning on Indonesian university students, particularly on their academic performance?
3. How does industry-based learning support STEM education in Indonesia?

1.5 Research Significance and Contributions

The research offers significant contributions to existing knowledge on IBL programs and their implementation, particularly in the Indonesian context. The contributions of this research project as follows:

1. The research findings provide useful insights and new understandings of the impact of IBL programs on Indonesian university students, as perceived by Indonesian stakeholders.
2. The research contributes to existing knowledge by providing empirical evidence of the impact of industry-based learning programs on undergraduate university students' performance.
3. The outcomes and findings will benefit Indonesian HEIs by providing evidence-based knowledge that can be used to improve the quality of IBL and UIP programs, and inform the Indonesian HE authorities of the best approaches to enhancing their IBL programs.
4. The research outcomes have so far resulted in two research publications published in reputable conference proceedings.

1.6 Structure of the Thesis

This thesis is organised into six chapters:

Chapter 1 presents the background and overview of the topic under investigation. It highlights the research problems of the thesis, presents the research objectives and the research questions, and finally the outline of the thesis.

Chapter 2 reviews the current literature related to industry-based learning (IBL) and university-industry partnership (UIP) programs. The terms 'UIP' and 'IBL' are defined, and the changing role of higher education (HE) reviewed in a brief overview of the Indonesian HE system. The benefits of UIPs in relation to Industry-Based Leaning programs are discussed, including the impact of IBL on academic performance and enhancement of students' soft skills and experience. The discussion concludes by looking at how IBL programs may promote STEM education in Indonesia.

Chapter 3 explains the research methodology and choice of research design, and details of the procedure used in this study. These include the choice of the research site, the participants for the study, the data collection techniques, and the validation methods implemented to ensure the rigour of the study.

Chapter 4 discusses the results and findings of the research, based on a systematic analysis of codes and themes.

Chapter 5 contextualises the findings in terms of the research questions and how they are supported by and add to the relevant literature.

Chapter 6 concludes the discussion and postulates possible future work from this research project.

Chapter 2 Literature Review

2.1 Overview

This chapter reviews the literature related to the industry-based learning (IBL) program. The first section defines university-industry partnerships (UIP) and IBL (Section 2.2); the next section gives an overview of the higher education (HE) system in Indonesia and educational experts' perception of its role as a new paradigm (Section 2.3). The chapter continues with a discussion of the benefits of IBL under the umbrella of UIP (Section 2.4). The next section discusses the implementation of the IBL program in the educational industry (Section 2.5), followed by a review of the impact of IBL on undergraduate university students (Section 2.6). Section 2.7 reviews the relationship between the IBL program and the Science, Technology, Engineering, and Mathematics (STEM) education development in Indonesia; this is followed by a chapter summary.

2.2 Defining the UIP and IBL Program

Before proceeding to the literature review, it is necessary to clarify how the terms 'industry-based learning' (IBL) and 'university-industry partnership' (UIP) are used in this thesis. The term UIP is found in several variants within the literature. Researchers refer to it as 'university-industry linkages' (UIL) (Plewa et al., 2013), as 'university-industry collaboration' (UIC) (Gertner, Roberts, & Charles, 2011; Laursen, Reichstein, & Salter, 2011; Lind, Styhre, & Aaboen, 2013), and as 'university-industry partnership' (UIP) (Abdullah, 2013; Choy & Delahaye, 2009; Kenworthy, DiPadova-Stocks, & Hogner, 2010; Moeliodihardjo, Soemardi, Brodjonegoro, & Hatakenaka, 2012). The present study investigates the implementation of IBL through the UIP program within the Indonesian context. In Indonesian context, the 'UIP' is the most commonly used term to describe the

collaboration between university and industry. For this reason, the present study also adopts this term to describe the collaboration between university and industry.

Several terms are used in the literature to describe the work placement program. For example, 'work-integrated learning' (WIL) is used in the majority of Australian studies, as found in Milne and Caldicott (2016); Rampersad (2015); M. D. Simpson and Swist (2016); P. Simpson, Thyer, Van Nugteren, Mitchell, and Werner (2016); C. D. Smith (2016); and Winchester-Seeto, Rowe, and Mackaway (2016). Other popular terms that refer to work placement are 'industry-based learning' (IBL) (used by Blicblau , Nelson, & Dini, 2016; Cross, 1996; Ram, 2008), and 'co-operative learning' is(used by Breen & Hing, 2012; D. Drewery, Nevison, & Pretti, 2016; Dave Drewery, Pretti, & Barclay, 2016; Una & Ursula, 1995). The terms 'co-operative learning' and 'WIL' are commonly used in the *Asia Pacific Journal of Cooperative Education* (APJCE).

Other terms for work placement found in the literature are 'work-based learning' (WBL) (as in Evans, Guile, & Harris, 2010; Walton & Steinert, 2010), 'work placement' (in Brooks, 2012; Gomez, Lush, & Clements, 2004; Jones, Green, & Higson, 2015), and 'internship' (used by Barbarash, 2016; McNamara, 2008; Wandahl, Olsen, & Ussing, 2011).

The literature that reports the implementation of IBL within the Indonesian context also uses various terms to refer to the work placement program. For example, Abdullah (2013) refers to the IBL program as the 'industry-training partnership,' while Santosa and Kusumawardani (2010) refer to the program as the 'industrial attachment program.' Other Indonesian researchers such as Anantadjaya (2011) refers to 'IBL program as 'university's internship' or 'internship.'

The present study investigates the implementation of the IBL program at an Indonesian university, where the terms 'industry training' or 'industry learning' are commonly used. The present study uses the term of 'industry-based learning' (IBL) throughout the thesis to describe the work-placement activities and programs. Other terms such as 'work-integrated learning' (WIL) or 'work placement' are also used occasionally when it is appropriate.

Besides the variations in the way researchers refer to the work placement program in the literature, there are multiple definitions of the concepts of IBL or WIL (Davies & Shirley, 2007). Any attempt to use one definition or emphasise one aspect and scope of the IBL may invite disagreement. Despite these different discourses around work placement programs, there is communal understanding that the root meaning of IBL concerns the relationships between *working* and *learning (Evans et al., 2010)*.

The IBL or WIL program itself is not new; it has been implemented for quite some time, for example in Australia within Technical and Further Education (TAFE) courses (Webb & Hayes, 2008). TAFE courses adhere to the Vocational Education and Training (VET) approach that emphasises practical experience above theoretical learning in the classroom; the latter is considered the province of universities. However universities, as discussed in Section 2.3.1, are now under pressure to include more practical experience and generic employability skills in their curriculum, to enable graduates to compete in an increasingly competitive global employment market (Bates, Thompson, & Bates, 2013; Freudenberg, Brimble, & Cameron, 2011; Gribble, 2014). Therefore, inclusion of the industry-based learning program in the universities' curricula, followed by strategic implementation of the work placement program in collaboration with industrial partners (UIP), is considered crucial and important to the universities. This strategy may address the global issue of skills shortages and increase graduate employability (McLennan & Keating, 2008; C. Smith, 2012).

This section discusses several industry-based learning definitions that have been proposed in the literature. This thesis adopts the definition of the industry-based learning as "an umbrella term for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum" (Patrick et al., 2008, p. iv). This is a general definition of IBL, which explains the integration of theory and practice within the specifically designed curriculum. Most of the work placements will fall into this category since the essence of the IBL program is to integrate or to implement the theories and concepts learned in the classroom into the

work environment at the workplace. In this regard, students implement theories and knowledge while at the same time learning something new from this implementation.

A more detailed definition of industry is proposed by M. Smith et al. (2009) as "Work-related learning involves students learning about themselves and the world-of-work in order to empower them to enter and succeed in the world-of-work and their wider lives" (p. 24). In this definition, the author emphasises that industry-based learning is actually 'the process of *learning*' that is carried-out within the real work environment. Hence, students can learn about themselves and about their work.

The more interesting view is stated by Abeysekera (2006), that perceives work-integrated learning (WIL) as "an attempt to bridge and establish the relationship between tacit and explicit knowledge" (p. 8). The author elaborates that tacit knowledge "comprises experimentation and action learning in an academic setting and" WIL allows the student to gain "experience and community of practice in an industry setting" (p. 8). Meanwhile, explicit knowledge "comprises conceptualisation in an academic setting, and reflection in an industry setting (p. 8).

Amongst the three definitions mentioned above, the current study adopts the definition of the IBL or WIL based on the definition proposed by Patrick et al. (2008, p. iv): "an umbrella term for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum." This definition represents and accommodates multiple other terms and approaches related to the implementation of IBL or WIL at Indonesian universities; all perceive the IBL learning experience as integrating theory and practice at the workplace within the guidance of the specifically designed curriculum.

2.3 The Higher Education System Overview

2.3.1 Role of Higher Education: A New Paradigm

The university-industry partnership (UIP) has increasingly become an important feature of modern universities (Breen & Hing, 2012; Lind et al., 2013;

Malfroy, 2011). Universities are now encouraged to enhance their collaboration with outsiders such as industries and manufacturers (Lind et al., 2013). This approach is to position the institutions as *agents of change* for innovation and creativity while maintaining their status as contributors to the social well-being of society (Malfroy, 2011). Higher education institutions (HEIs) can no longer rely on their traditional role as providers for the expansion of students' knowledge within the campus. Modern HEIs are now expected to provide industry-based knowledge and employability skills to their graduates. To achieve this goal, many tertiary education institutions now establish mutually beneficial partnerships with relevant industry partners.

By introducing students to industrial practice, HEIs encourage them to be independent, self-motivated, and develop new learning experiences that extend beyond classroom learning. Students' learning ability and retention may be accelerated by putting the concepts and theories they have learned into practice in the workplace. Their learning is no longer limited to theoretical knowledge acquired in the classrooms and laboratories but is conditioned by practical knowledge and experience. They have an opportunity to collaborate with leading industrial experts and use cutting-edge technology tools and equipment in their work placement.

Research has shown that IBL placement and informal learning offer an effective and efficient learning method that can improve the performance of either the individuals (placement students) or the companies (Sarvi & Pillay, 2015). Studies in situated learning suggest that humans effectively learn most of the tasks and the skills for their jobs not through classroom lectures, but through work experience (Sarvi & Pillay, 2015).

Current higher education institutions are expected to recognise the need to equip their graduates with the practical skills and working knowledge they require to compete for job opportunities (Holt et al., 2004), because the issues surrounding work-readiness and employability of university graduates are important (Franz, 2008; 2011; Orrell, 2004; Webb & Hayes, 2008). There is a growing concern amongst HE stakeholders about universities' learning outcomes and the inadequate generic skills

possessed by university graduates. Universities are now under pressure to equip their graduates with the necessary generic skills and practical knowledge to the level required by the industry (McLennan & Keating, 2008) in order to compete for job opportunities (Bates et al., 2013; Franz, 2008).

The HE stakeholders' concern is understandable, since the gap between graduate attributes and the skills required by the industry has increased (Freudenberg et al., 2011; Tong & Waltermann, 2013). At present, a tertiary qualification does not guarantee graduates a competitive advantage in seeking employment, since other factors such as work experience and practical skills play an important role in selecting new recruits for workplaces (Daniel & Daniel, 2015). Therefore, it is critically important for universities to initiate a plan to address these issues (Brimble & Freudenberg, 2010; Gribble, 2014).

Within the last decade, educational practitioners and researchers have proposed that IBL programs need to address two main issues:

1. The lack of industry-standard skills amongst university graduates;

2. How to increase the work-readiness of the prospective graduates (Abeysekera, 2006; Gribble, 2014; McLennan & Keating, 2008; M. Smith et al., 2009; Universities Australia, Australian Chamber of Commerce and Industry, Business Council of Australia, & Australian Collaborative Education Network, 2015).

Since the implementation of the WIL program, Australian universities have been considered successful to some degree in preparing their graduates for the workforce (Delahaye & Choy, 2007). Currently, more Australian tertiary education institutions are engaging in IBL programs (C. Smith, 2012; Trede, 2012). This engagement is important for the development of the Australian tertiary education sector (Collis, 2010). Universities Australia and the Australian Chamber of Commerce and Industry has proposed a *National WIL Strategy* in eight key areas, advocating the importance of nationally structured WIL programs in order to address both a national skills shortage and the university graduates' employability. The eight areas proposed

in the National WIL strategy are presented below (Universities Australia et al., 2015, p. 3). A more detailed document on the National WIL strategy can be found in Appendix C.

1. Provide national leadership to expand work integrated learning (WIL).
2. Clarify government policy and regulatory settings to enable and support growth in WIL.
3. Build support — among students, universities, employers across all sectors and governments — to increase participation in WIL.
4. Ensure investment in WIL is well targeted and enables sustainable, high quality experiences, stakeholder participation and growth.
5. Develop university resources, processes and systems to grow WIL and engage business and community partners.
6. Build capacity for more employers to participate in WIL.
7. Address equity and access issues to enable students to participate in WIL.
8. Increase WIL opportunities for international students and for domestic students to study offshore.

All of the strategies proposed in the National WIL Strategy will require a strong partnership between universities, industry, and the community. “Australia’s future depends on strong partnerships” (Universities Australia et al., 2015, p. 1). The linkages between the university and industry are considered important for success in meeting the challenges and opportunities facing the universities in the current global competitive market (Choy & Delahaye, 2009; Kenworthy et al., 2010; Salter, Bruneel, & D'Este Cukierman, 2009).

To understand the university-industry partnership (UIP) program and the benefits that may be gained by the stakeholders involved in this partnership, UIP and its benefits are discussed in Section 2.4.

2.3.2 Indonesian Higher Education System: A Brief Overview

The higher education sector in Indonesia is considered an important and integral part of the economic growth and national competitiveness of a country (Moeliodihardjo et al., 2012). It is commonly expected that the establishment of HEIs in a region will promote regional economic development and boost national competitiveness (Indarti & Wahid, 2013). In relation to this, the Indonesian government has targeted strengthening the national innovation system to accelerate economic development, especially through the development of science and technology. The development of the national innovation program is indicated by the establishment of centres of research excellence, which facilitate the improvement of research productivity, and increase the participation of the private sector.

Indonesia compares with other countries in developing the higher education (HE) sector to the highest standards recognised by international stakeholders; the HE system in Indonesia has been subjected to continuous reform to improve quality. The most noticeable reform was in August 2000, when the Supreme Consultative Assembly (MPR) passed the fourth amendment of the constitution related to educational reform. By this regulation, the Indonesian government allocated 20% of the national budget to the education sector. As a result, funding for the HE sector in Indonesia managed by the Directorate General of Higher Education (DGHE) increased significantly from Rp 12.9 trillion to Rp 32.2 trillion in 2012 (Moeliodihardjo et al., 2012).

Despite this significant increase in funding allocated for the education sector and DGHE, the proportion allocated for the research sector by DGHE remained low, at around IDR 436 Billion or only 1.34% of the total DGHE budget. This low figure highlights the key issue of the low priority given by the government to research and development (R&D) in the HE sector in Indonesia (Moeliodihardjo et al., 2012). Indonesian HE scientific outcomes such as journals, patents, and researchers are given relatively low priority compared to other countries in nearby regions (Figure 2.1).

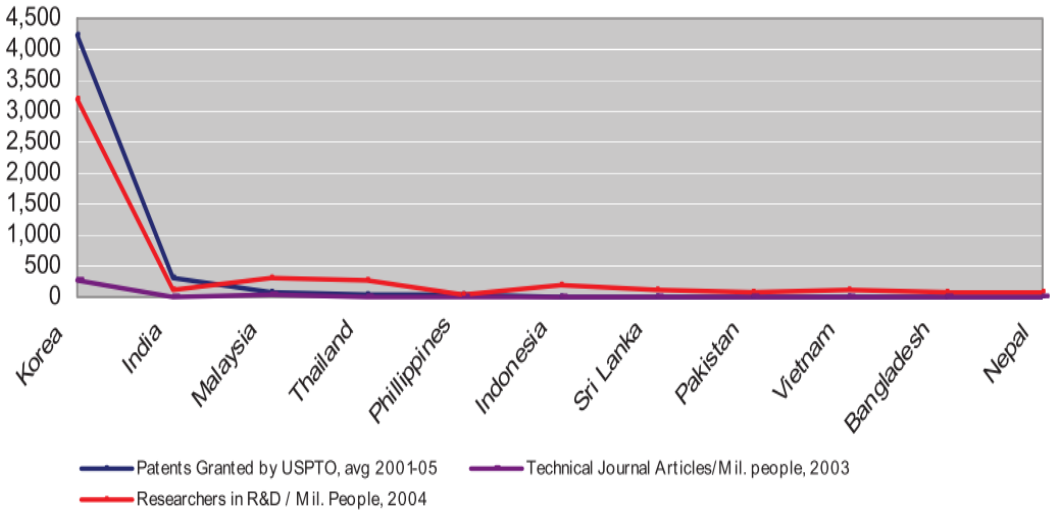

Figure 2.1. Scientific outcomes from different Asian countries (Moeliodihardjo et al., 2012, p. 310).

Even though Indonesia has shown initiative and effort in strengthening the R&D capacity of HE and other public R&D institutions by enacting many regulations and public policies to facilitate or create a conducive environment for the development of a better HE system, these efforts seem to be inadequate (Lakitan, 2013).

Greater effort and resources are required to develop an improved HE system in Indonesia, which has 3,958 HE institutions[1] (state and privately owned higher education institutions). This revitalisation requires the serious attention of decision makers at the national level and is not a trivial task to undertake. Fortunately, the policy makers in Indonesia have begun to realise this issue and that they need to act fast to rectify the problem.

It is widely accepted today that improvement of HE is critical for the economic development and competitiveness of a nation (S. Armstrong & Chapman, 2011; Marginson, 2011; Welch, 2011). A strong emphasis on improved linkages between universities, industry and government is a global trend not only in OECD countries but also in many emergent developing countries such as Indonesia (Moeliodihardjo et

[1] The National Bureau of Statistic of Indonesia 2013/2014. Available at https://www.bps.go.id/

al., 2012). By implementing this strategy, the Indonesian higher education institutions (HEIs) will significantly contribute to the development of talented and work-ready graduates, and eventually be able to reduce the shortage of skilful graduates, who are required to accelerate Indonesian economic growth.

2.4 University-Industry Partnership (UIP) as an Umbrella for IBL

In this competitive era, universities are facing many challenges. The more eminent challenges including the increase in cost of higher education and the need to improve status and reputation of universities to be a world leader in higher educational sector. Many universities in Indonesia and other South East Asian nations are faced with similar issues. The university-industry partnership is considered as a solution to increase fund to the universities (Meyer-Krahmer & Schmoch, 1998; Thune, 2010). Through this partnership program, the universities can offer prestigious research grants and scholarships sponsored by industry to the most talented students. The collaboration with the industry will also increase the quality and broaden the courses offered by universities (Breen & Hing, 2012).

Although the primary orientations of higher education institutions and industrial companies are different, there is a key element that is mutually important for both institutions. This element is the *exchange of knowledge* (Meyer-Krahmer & Schmoch, 1998) or *transfer of knowledge*, as described by Gertner et al. (2011). Both organisations can work together to achieve this shared goal. The exchange of knowledge in the form of collaboration can be facilitated by, for example, the university research centre. Studies report that university-industry partnerships can be in many sectors, but the dominant sector is in the research sector (Lind et al., 2013; Malfroy, 2011). A university research centre can act as a *facilitator of collaborations* or *mediator* among the stakeholders to ensure a mutually beneficial partnership (Lind et al., 2013). Other types of university-industry relations include licensing, academic cooperation, enterpreneurship, collaborative research, contract research, and consulting (Table 2.1).

Table 2.1 The areas of partnership between university and industry (Perkmann, King, & Pavelin, 2011, p. 540)

Areas of Partnership	Explanation
Licensing	Contractual assignment of university-generated intellectual property (such as patents) to external organizations
Academic entrepreneurship	Development and commercial exploitation of technologies pursued by academic inventors through a company they (partly) own.
Collaborative research	Research jointly pursued by university and industrial partners – commonly with public funding
Contract research	Application-oriented research and development activities carried out by university – commissioned and funded by industry
Consulting	Application-oriented research and development activities or advice provided individually by academics – commissioned and funded by industry

Another key element that may bring a strong partnership between universities and industry is that both sectors are facing a similar fundamental challenge, the issues of skill shortages and employability (Breen & Hing, 2012). On the one hand, universities want all of their graduates to gain acceptance in the job market, and on the other hand, industries require university graduates to possess the necessary skills and knowledge to advance the company to the next level. Both sectors need to cooperate and establish a platform that enables them to solve their communal problems in the best possible way.

Implementation of IBL programs requires mutual agreement between universities and their industrial partners. The agreement could be in the form of a Memorandum of Understanding (MoU) between the parties, to initiate a UIP program to accommodate a collaborative program such as an industry-based learning (IBL) program. Such a partnership is depicted in Figure 2.2.

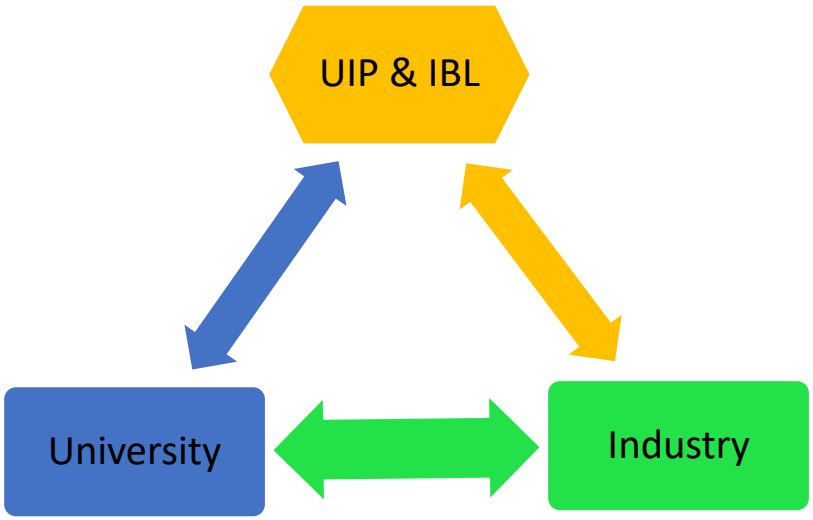

Figure 2.2. A triangular relationship between university and industry

A UIP program serves as a foundation as well as an umbrella for an industry-based learning (IBL) program. This underlines the importance of UIP for the continuity of IBL programs. Without collaboration or a partnership agreement between the industrial partners or relevant institutions, for example in the form of a Memorandum of Understanding (MoU), it is difficult for a university to implement mutually-beneficial partnerships such as an IBL program (Kenworthy et al., 2010). The following sections discuss the benefits and challenges of UIP for both universities and industries.

2.4.1 Benefits for Universities of UIP

Increasing Scientific Productivity

Scientific productivity is usually measured by the output of scientific products, which include publications in the form of scientific literature, scientific texts, prototypes and patents (Meyer-Krahmer & Schmoch, 1998). However, not all these products are easily available or readily accessible (Lakitan, Hidayat, & Herlinda, 2012). Therefore, measuring the scientific production generated by each tertiary education in Indonesia every year is not an easy task. Hence in many studies, scientific productivity is usually measured by calculating the number of publications in peer-reviewed journals (Lakitan et al., 2012).

In the Indonesian context, Lakitan et al. (2012) suggest that university-industry collaboration has a *positive* and *significant* impact on scientific productivity. The impact is observed from the increase in scientific publication from many Indonesian universities, especially from eight of the largest universities in Indonesia since 2008, as depicted in Figure 2.3.

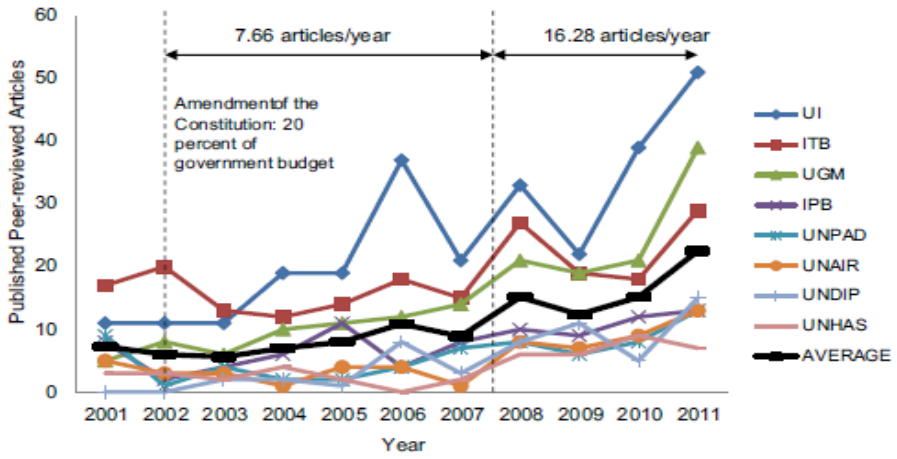

Figure 2.3. The increase in scientific publication by the top eight Indonesian universities between 2001 to 2011 (Lakitan et al., 2012, p. 233)

The increase in productivity based on scientific publication however was not immediate. It took approximately six years after Indonesia made the fourth amendment to its constitution, allocating at least 20% of its national budget (APBN)[2] to the educational sector, for an increase in the number of publications by Indonesian universities. The increase in funding for the education sector and minor changes in the higher education policy have encouraged academics to publish their research findings in peer-reviewed journals and conferences. As shown in Figure 2.4, the number of peer-reviewed journals and conferences of Indonesian academics and researchers increased significantly (350%) between 2002 and 2012.

[2] Indonesian National Budget

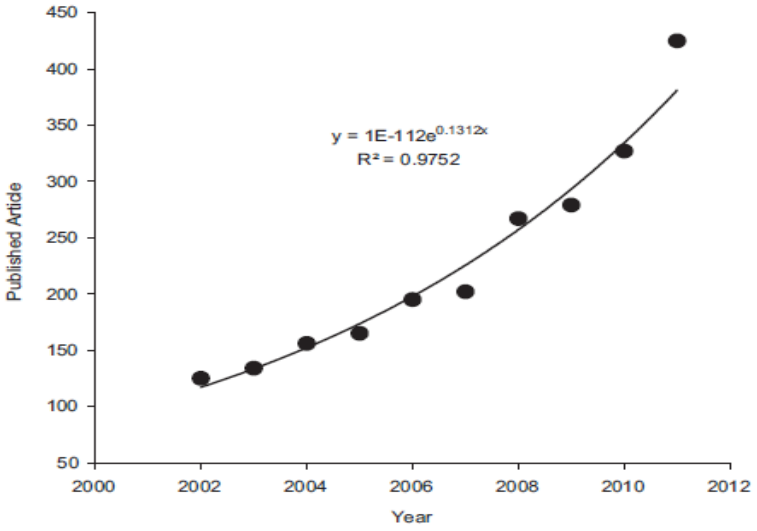

Figure 2.4. Scientific publication by Indonesian researchers (Lakitan et al., 2012, p. 234)

Despite the increase in the number of scientific publication published in international peer-reviewed journals by Indonesian researchers, this number is considered low compared to publications of researchers from neighbouring countries such as Singapore, Thailand, and Malaysia (Figure 2.5).

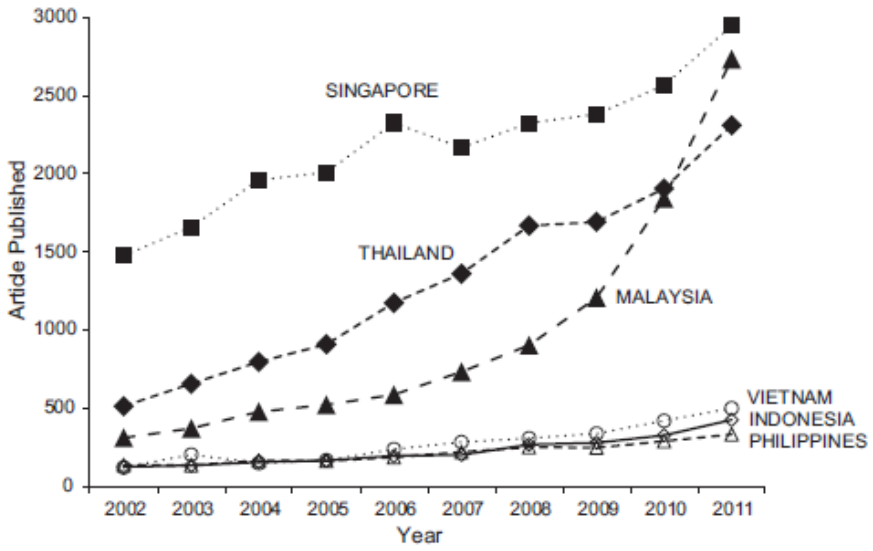

Figure 2.5. Scientific publications from selected ASEAN countries from 2001-2011 (Lakitan et al., 2012, p. 234)

There are many factors affecting the scientific productivity of research institutions such as universities. Lakitan (2012) summarises that the most dominant factor influencing scientific productivity is the availability of resources and funding. Other factors such as institutional culture and social factors also affect the scientific productivity of researchers at Indonesian universities.

Increasing University Funding and Reputation

In this digital era, when changes and development in every aspect of life are certain and rapid, universities are faced with the challenge of the rising cost of education. University collaboration with industry will invite more funding from industry (Meyer-Krahmer & Schmoch, 1998; Thune, 2010), for example in the form of research grants and scholarships, which are magnets for attracting qualified research fellows and new students to the university. In addition to the financial benefits, university-industry collaboration broadens the courses offered by universities and enhances the quality of course content in related disciplines (Breen & Hing, 2012). Improvements in the quality and variety of courses offered by the university will, in turn, improve the economic value the university can gain. Furthermore, high-quality graduates and useful research outcomes will foster improved status and reputation for the university.

Opportunity for Future Partnerships

The success of current partnership projects constructs the path for the future success of the collaborating parties. Creating sustainable and effective partnerships is not an easy task (Kenworthy et al., 2010). Greitzer, Pertuze, Calder, and Lucas (2010) point out that previous successful collaboration between industry and university is positively correlated to the successful outcome of subsequent collaborative efforts. In this study, the author examined more than 100 industry-university collaborative projects sponsored by companies and found that nearly 80% of the current projects have a history of previous collaboration between industry and university.

Overall, the primary positive effect for universities has been improvement in the quality of education, in university services, and in revenue from non-government funds (Breen & Hing, 2012).

2.4.2 Benefits for Industry Through the UIP Program

University-industry partnership programs in general offer further benefits to the industrial world, including enhancing companies' professionalism, public image and reputation, which thereby increases their competitiveness and prestige (Breen & Hing, 2012). The other benefits include: access to the universities' expertise that may offer new ideas or concepts to: improve the companies' products or services; help in reducing production costs; increase sales and profits; and achieve joint commercialisation of products (Indarti & Wahid, 2013). Thus, university-industry partnership can be a sustainable process to bring various benefits, either short or the long term, to the both parties. In collaborating, the universities that represent the educational sector and the companies or firms that represent the industrial sector may complement each other in mutual benefit partnerships.

The following section elaborates some of the aforementioned benefits of collaboration for the industrial sector.

Gaining Access to Experts from University

Many studies of UIP have focused on the research *outcomes* as a result of the collaboration. The positive outcomes have been defined as raising company profits, improving the product, or enhancing and optimising the use of technology for the company's development.

Pertuze, Calder, Greitzer, and Lucas (2013) proposed a different viewpoint on the benefits of UIP programs. They consider that UIP is not about the outcome but the *impact*. The impact of UIP on university and industry are more important that the outcome itself. The outcome may bring short term rewards but the impact for the benefit of the industry usually lasts longer. The academic knowledge and insights can be used for the benefit of the company; for example, the knowledge acquired from

collaboration can be utilised to manage and run the company better. Other benefits of university-industry partnership that the company can capitalise on are: the possibility to create innovative products; optimisation of production time; upgrading of new hardware and software; and/or increasing managerial efficiency.

In order to preserve the benefits of impact, the company may seek advice from the university experts on how to gain sustainable profits. This perception is supported by Welsh, Glenna, Lacy, and Biscotti (2008) and Indarti and Wahid (2013). The latter examined university-industry collaboration from the perspective of industry stakeholders. In their study, research participants from industry were asked about their motivation in joining UIP programs, and what the benefits were for them. Indarti and Wahid found that "access to new ideas, know-how, or technologies through university interaction" was the participants' motivation for joining UIP programs (2013, p. 164). The full list of UIP benefits as perceived by industry participants in Indarti and Wahid's study is given in Table 2.2.

Increasing the Competitiveness and Reputation of a Company

There is abundant evidence that university and industry collaboration would boost industry competitiveness and reputation (Ankrah, Burgess, Grimshaw, & Shaw, 2013; Cohen, Nelson, & Walsh, 2002). Breen (2012, p. 67), argues that industry through cooperative partnership may obtain the following potential benefits:

- Industry legitimacy through enhanced professionalism;
- Professional status for the industry and its participants;
- Improved public perception of the industry;
- Maintaining an advantageous position through controlling abstracts knowledge of work-related problems;
- Improving industry competitiveness through enhanced professional standards.

Table 2.2 The list of benefits perceived by respondents from industry (Indarti & Wahid, 2013, p. 165).

Benefits	Mean Rating*
Access to new ideas, know-how, or technologies through university interaction	4.2
Improve a product or process	3.9
Provided customers/suppliers with improved technical information	3.8
Influenced the R&D agenda of this or another firm unit	3.7
Developed a new product/process	3.7
Licensed technology or software developed by university	3.6
Received direct technical assistance from university	3.5
Adopted university technology or research output for manufacturing or production	3.5
Reduced costs	3.3
Increased sales/profits	3.3
Used university facilities or equipment	3.2
Developed joint research proposals or projects with other sponsors	3.2
Commercialised a product/process obtained from university	3.1
Increased interaction with other firms partnering with university	3.1
Decreased the lead-time needed for the introduction of new product/process	2.5
Hired university student or graduate	2.5
Established a new company/joint venture based on university technology/product	2.5

*Measured using a five-point Likert scale (1: strongly disagree; 5: strongly agree)

In the context of developing countries such as Indonesia, the most common issues faced by the companies, especially small to medium enterprises (SME) are managerial and technical problems (Nurdin, 2012). Although the needs and requirements of the industrial sector change over time (Othman, 2011), in many cases, a UIP program at least can assist in providing alternative solutions for the host company's problems. Santosa and Kusumawardani (2010) summarise the benefits for industries (companies and firm) from the implementation of IBL programs under UIP schemes for small to medium enterprises (SME) in Indonesia as follows:

- Improvement in competitiveness;
- Solving ICT problems;
- Understanding comprehensive, strategic business planning;
- Improved understanding of audits;

- Ability to engage in good planning for ICT related programs; and
- Opening the pathway for further collaboration with HEIs.

UIP programs can also increase the competitiveness of industrial partners, such as when the manufacturing and construction industry continuously strives to improve its products (Kagioglou et al., 1998). Through university and industry partnership programs, universities can play an important role in solving industry problems and designing new and innovative products.

2.4.3 Partnership Success Criteria

A reliable and long lasting partnership is built based on three influential factors:

1. Partnership environment such as type, size, and location of partnership (Laursen et al., 2011), reputation, formality, and cultural issues of partnership (Malik, 2013).
2. The process of training; for example, flexibility, administration, and return on investment; and
3. The people involved in partnership play an important role in building a long lasting partnership success. All participating parties should maintain good communication and mutual trust (Abdullah, 2013).

Every partnership is unique in terms of its scale and complexity. However, one important aspect of long lasting collaboration is a willingness to be flexible and resilient towards changes that may occur in the partnership (Abdullah, 2013; Park & Leydesdorff, 2010). In addition, all parties involved in the partnership should have *a high level of mutual trust* amongst them; this is the main driver for partnership longevity (Abdullah, 2013). Abdullah (2013) argues that collaboration is not mainly about gaining high profits, although he indicates that financial sustainability is a characteristic of a successful partnership. He emphasises that "win-win" solutions are the primary goal of a partnership. Satisfactory and successful partnerships between

higher education institutions and the industry are usually defined by good quality cooperation and communication between the two parties.

2.4.4 Challenges in the Implementation of UIP in Indonesia.

The application of university-industry partnerships is well established and matured in more developed countries. UIP programs in OECD countries are usually characterised by a strong linkage with the government in terms of funding. In Australia for instance, the Australian government has encouraged the growth in the linkages between university research and the industry by providing funds through government-funded schemes. These schemes have a strong influence on the universities' research policies and direction towards embracing and boosting the development of UIP programs in Australia. The government's support of these schemes enables the establishment of Cooperative Research Centres (CRCs) which help to foster university-industry linkages and to prepare work-ready graduates from Australian universities (Malfroy, 2011).

This is not the case, however, for developing countries such as Indonesia. The universities are often struggling to establish meaningful strategic partnerships with industries due to limited funds and resources. Despite the increase in government's allocation of funding for education to accelerate university-industry collaboration and strengthen the Indonesian universities' research and development (R&D) capacity (Lakitan, 2013), the collaborative success of these partnerships has not been thoroughly evaluated (Indarti & Wahid, 2013). The implementation of university-industry partnerships in Indonesia often faces many challenges (Lakitan, 2013; Moeliodihardjo et al., 2012). Some these challenges are outlined below.

Low Mutual Understanding

Many universities in Indonesia have developed their own research strategies without including a strategic plan for university-industry collaboration within their blueprint. There is a viewpoint in the academic world that the industrial sector is money-oriented and less interested in academic research and development. From the

industries' viewpoint, universities are bureaucratic and slow in practical aspects such as developing a product (Moeliodihardjo et al., 2012).

This lack of mutual understanding, however, is not specific to Indonesia. It has been reported by Bruneel, D'este, and Salter (2010) that a lack of understanding between university and industry about expectations and working practices were experienced by 34% of both small to medium enterprises (SMEs) and large firms in the UK and Europe.

The difference in fundamental perceptions between universities and industry creates a barrier for establishing a long lasting university-industry partnership. The two parties need to initiate a discussion to bring about unified views and perceptions in order to establish a strong and mutually beneficial UIP program.

Institutional Framework

Many academics view the uncertain future of a policy of autonomy for Indonesian universities as a barrier to them developing a better partnership with industry. According to the regulation, only the government of Indonesia has a status as a legal entity, while public universities are considered the government's implementation units. This policy makes it more difficult for universities to negotiate with industry as independent organisations and equal partners. Specific problems of legal contracts and research ownership will surface and will need to be handled wisely by the university (Moeliodihardjo et al., 2012).

Regional Development

An imbalance in economic growth in Indonesian cities has been another concern for Indonesian policymakers. The capital city of Jakarta and other big cities in Java have advanced economic development compared to other regional cities in Indonesia. As a result, the universities in Java are more developed, well resourced, and account for 50% of Indonesian universities which have strong research capability (Table 2.3).

Table 2.3. Distribution of higher education in Indonesia per region (Moeliodihardjo et al., 2012, p. 309).

	Public		Private	
Economic corridor	Polytechnics	Higher Education Institution	Polytechnics	Higher Education Institution
Sumatra	7	16	17	762
Java	9	23	68	1102
Kalimantan	2	4	7	84
Sulawesi	4	8	6	336
Bali	5	6	11	15
Maluku	3	5	5	130
Total	30	62	114	2565

In summary, to establish good collaboration between university and industry, strong motivation and participation of relevant stakeholders are required to bring the masterplan into effect. This is not an easy task as each sector or institution has their own priority agenda. If a partnership faces significant challenges and obstacles, collaboration will not follow the original plan (Salter et al., 2009). The outcomes of UIP programs do not commonly occur immediately and may take a long time to be profitable (Lind et al., 2013). For this reason, the resilience and fortitude of all participating stakeholders are needed in order to make the partnership program a success story.

2.5 Implementation of IBL programs

The previous section reviewed how University-Industry Programs (UIP) serve as an umbrella to any collaborations between university and industry. The implementation of IBL programs is discussed in this section.

2.5.1 The Purpose of IBL Programs

The current literature suggests that there are many reasons for universities or TAFEs to introduce industry-based learning (IBL) programs to their students. Some universities initiate IBL programs for the purpose of giving real work experience to their students (Brooks, 2012; Tran & Soejatminah, 2016). Other institutions aim for their students to put the theories and concepts they learn from classrooms into practice

(Orrell, 2011; Wandahl et al., 2011). Other purposes are: to increase the students' employability rate (L. Armstrong, Waite, & Rosenthal, 2015; Daniel & Daniel, 2015; Gomez et al., 2004; Moore, Ferns, & Peach, 2015); to provide different learning experiences for the students (Duignan, 2002; Nagarajan & McAllister, 2015; Santosa & Kusumawardani, 2010); and to enable students to establish links and network with professionals (Blicblau, Nelson, & Dini, 2014; Blicblau et al., 2016; Silva et al., 2016).

Among the aforementioned reasons, the most common reason underlying the establishment of the IBL program was to *increase the employability* of the graduates. The universities are now under pressure to equip their students with generic employability skills and work experience that will enhance their chances to compete for jobs in today's increasingly competitive job markets (Bates et al., 2013; Freudenberg et al., 2011; Gribble, 2014; Trede, 2012).

The concern to increase the employability of universities graduates is triggered by a number of reasons, including the increasing gap between the number of *skilled graduates* that can be produced by HE institutions and the demand for *work-ready graduates* in the job market (Patrick et al., 2008; Tong & Waltermann, 2013). Another reason for concern is that limited vacancies are available in the current job market for the abundant number of traditional HE graduates worldwide (Tong & Waltermann, 2013). This puts pressure on the universities and other HE institutions to provide solutions to the problems. Many HEIs face tough competition in increasing their status as leading educational institutions that can produce good quality graduates who can compete nationally and globally for leading roles in industry or the community (Marginson, 2006).

The second most common reason for establishing IBL programs at HE institutions is to equip students with *work experience*. The National Strategy on work integrated learning in University Education published by the Australian Collaborative

Education Network (ACEN),[3] a not-for-profit organisation with experience in managing WIL programs (IBL), states that IBL "facilitates the transition between preparing for and operating in the high skills work environment. It empowers students to understand, adapt to and apply skills in the workplace" (Universities Australia et al., 2015, p. 2). This statement indicates that one of the purposes of work placement is to prepare the student in the period of transition from a knowledgeable (in terms of theory) person without work experience to a skilful worker with experience of the workplace. To gain work experience, students must learn a number of skills, from the organisation of the workplace to a more detailed skill set and knowledge gain relevant to their study discipline (Tran & Soejatminah, 2016). The work experience students gain from work placement will enhance their competitiveness in the employment market, as many employers require prospective employees to possess appropriate work experience in addition to academic qualifications (Brooks, 2012).

The third reason for establishing an IBL program at HE institutions is *to establish a link with professional networks* (Blicblau et al., 2014; Blicblau et al., 2016; Silva et al., 2016). Most HE institutions feel obliged to provide the best possible option for their graduates to embark on their relevant jobs after the completion of their studies, and IBL programs help to cater to this issue.

The links and networks established during IBL placement bring a number of benefits for students. For example, the students have chances to interact with important persons or experts within and beyond the company. These persons may be the leaders and the decision makers in the industry. This network of important persons might open a new pathway for the students to be involved in other projects and is important for job applications and career opportunities in the future (Tran & Soejatminah, 2016).

As the final destination of the majority of the tertiary students is to embark on their dream job after completion of their studies, universities want to ensure a successful pathway for their students. Therefore, the students are encouraged to expand their horizon and create links with their professional network during their work

[3] http://acen.edu.au/

placements. In summary, IBL programs provide personal and professional development to students that will enhance their employability after graduation (Martin, Rees, Edwards, & Paku, 2012).

2.5.2 The Implementation of IBL: Australian Context

In response to the demand for more skilful and professional graduates to fulfil the increasingly competitive job market, universities need to prepare and equip their graduate with necessary skills and practical working knowledge. In Australia, the universities are mandated to include work integrated learning (WIL) programs into their curricula (Bilsland & Nagy, 2015). In line with this policy, the Australian Chamber of Commerce and Industry[4] and Business Council of Australia for the Department of Education have long formulated nine generic employability skills that are required to be mastered by Australian university graduates, as summarised below (Holt et al., 2004, p. 2):

1. *Communication skills*. Excellent communication skills are highly regarded in the workplace.
2. *Teamwork skills*. Ability to work in a team is highly sought after because it increases productivity.
3. *Problem-solving skills* promote high productivity.
4. *Initiative and enterprise skills*. Innovation is an expectation for employees.
5. *Planning and organising skills*. Graduates who possess these skills can promote timely delivery of products.
6. *Self-management skills*. Every employee is expected to be well organised and manage their time effectively.
7. *Adaptation skills*. A prospective employee should be able to adapt and learn new skills and knowledge quickly.

[4] https://www.acci.asn.au

8. *Technology skills*. University graduates are expected to utilise new technology to achieve goals.
9. *Good personal attributes*. A prospective employee should possess good interpersonal skills, trustworthiness, and leadership skills.

Most of these employability skills are the main focus of the skills that are targeted in the workplace. To equip students with these important employability skills, many Australian universities have embedded them into their curricula through industry-based learning (IBL) programs. For example, Deakin University, through its Bachelor of Information Technology (BIT) (Honours) program embraces this policy, and prepares its students to possess these generic employability skills (Holt et al., 2004). Deakin's BIT program is unique, as it incorporates substantial periods of industry placement (IBL) and a major industry-based honours thesis in the program. Through the IBL program, Deakin's BIT program aims for all students within the program to develop the following skills:

1. Technical skills in systems, analysis, design and software development.
2. Problem solving skills.
3. Written communication skills.
4. Strategic and leadership skills.

Universities in Australia are poised to incorporate these employability skills into their program. Some tertiary courses enable students to learn not only from teachers in the classroom but also from experts in the industry through IBL programs. By incorporating these employability skills into their curricula, universities indicate to their industry partners that they are intent on reducing the skills gap among current graduates (Holt et al., 2004; R. Smith et al., 2008). However, since the employability skills required by industries change over time (Othman, 2011), it is critical that IBL curricula are tailored to meet industry's expectations and standards (Collis, 2010).

There are several research studies on the implementation of IBL curricula in Australian HEIs. A number of researchers, Koppi et al. (2010), Malfroy (2011), and C. Smith (2012) focus their research on the improvement of HE curricula to accommodate the implementation of IBL program at Australian HEIs. Smith et al.

(2008) expanded the research in searching for *the best practice* of IBL program in Information Systems (IS) and Information Technology (IT) at RMIT University and Swinburne University of Technology.

Whannell, Humphries, Whannell, and Usher (2015) go further by looking at the integration of some sets of units from both VET and university into curricula. The integration was motivated by the need to produce more work-ready graduates by developing both theory and practice. This is intended to reduce the gap between *theoretical knowledge* and *ability to apply* this *knowledge* into the practices required in the workplace. This gap is known to be a major problem in preparing work-ready university graduates. In these new Information System and Information Technology degrees, three sets of units are to be completed by students. Two units are already required for degree level, and one unit is specifically developed for this new degree, which is a combination of the National Training Package of Australian Qualification Network (AQF) level 4-5 competencies and AQF level 7 learning outcomes.

In this newly developed degree, the main challenge faced by teachers was how to utilise the Moodle[5] environment to serve the units offered. From the students' perspective however, the challenge is to access relevant WIL opportunities in which, normally, students may not be able to attain placement in the field relevant to their program of study, and are expected to do volunteering jobs to obtain some work experience.

In summary, the majority of research on the IBL program in the Australian context is focused on *how to develop a professional curriculum incorporating the best practice of the IBL program* for higher education institutions. Consequently, the studies of IBL in the Australian context mostly concentrate on participants' opinions

[5] "Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments." Available at https://moodle.org/about/

of the IBL curricula, with less discussion on the impact of the IBL program on the students' academic performance upon their return to university.

2.5.3 The Implementation of IBL: Indonesian Context

As a centre of excellence for research and development, the higher education sector is widely considered an integral part of the economic growth and development of nations (Beerkens, 2010; Gertner et al., 2011; Laursen et al., 2011; Payumo, Arasu, Fauzi, Siregar, & Noviana, 2013). The Organisation for Economic Co-operation and Development (OECD) countries prioritise the development of higher education with a strong research foundation and better linkages with industry. The governments of these OECD countries are now developing strategies to encourage higher education institutions to participate more in the nation's economic development (Moeliodihardjo et al., 2012).

As a country with emerging economic power, Indonesia has similar needs to OECD countries. The government of Indonesia has created a Master Plan for Acceleration and Expansion of Indonesia Economic Development (MP3EI)[6] that will guide Indonesian economic development from 2011-2025. This MP3EI blueprint drives the implementation of high and sustainable economic growth that focusses on two key factors, acceleration and expansion. Acceleration in the economy means that Indonesia will boost its existing development programs, especially in the areas of primary economic sectors, infrastructure, sustainable energy supply, human resources and development of science and technology. The expansion of economic development is not only for some specific regions but will benefit all Indonesians across the nation.

In this economic development master plan, the higher education institutions are expected to play a crucial role along with industry partners and government (Moeliodihardjo et al., 2012). Therefore, strong University-Industry and Government

[6] MP3EI, Masterplan Acceleration and Expansion of Indonesia Economic Development 2011-2025

collaboration and partnerships such as IBL programs will greatly contribute to the success of this strategy.

Many Indonesian universities have included IBL programs to their curricula in an attempt to enhance education excellence (Anantadjaya, 2011). These programs are known by the terms *Kerja Praktek (KP)* or *Kuliah Kerja Praktek (KKP)* in Indonesia. However, there are few studies in reputable peer-reviewed publications that report the implementation of IBL at Indonesian universities.

From the available literature, the studies on the implementation of IBL in Indonesia focus on the economic impact of IBL on industry partners rather than the impact of such programs on the academic performance of university students. For example, the study by Santosa and Kusumawardani (2010) focuses on the contributions of IBL students to solving the Information and Communication Technology (ICT) problems of Small and Medium Enterprises (SME). Another study reported by Nurdin (2012) reveals that the implementation of IBL programs through UIP was intended to solve industry problems by utilising university facilities such as research laboratories and university human resources (experts) such as university staff and students. In other words, skilling up HE graduates and facilitating their employment prospects was not the main aim of these publications.

Although IBL programs have been included in university curricula and have long been implemented as study units at many Indonesian universities, there is still a lack of information and certainty about the effectiveness of the implementation of these programs. Anantadjaya (2011) analyses the effectiveness of the implementation of IBL programs at Indonesian universities. This study, however, limits its scope to examining the implementation of IBL programs in universities with standardised international curricula. Hence, it does not attempt an understanding of the bigger picture of the implementation of IBL programs in Indonesia.

In the absence of a large body of literature that explains the purpose of IBL programs in the Indonesian context, the aforementioned studies represent the purpose of the establishment of the UIP and IBL program at Indonesian universities. In

summary, mainstream IBL research in Indonesia focuses more on how to solve industrial problems and less on the learning experience of IBL students.

2.5.4 Challenges in the Implementation of IBL for Students

Adapting to a New Learning Environment

Work placement in an industrial setting provides a different learning experience from that available in an academic setting. The aspects of an industrial setting that differ from those of a university classroom setting include the learning and working facilities, such as the teaching and meeting rooms and laboratories, the characters of the people working there, the goals and orientation, and the targets to be achieved.

The outcomes of industrial learning are different from those of university classroom learning. Some studies have found that students in some areas learnt more in their work placements than in their university classrooms. For example, Lee (2008) compared the outcomes of industry-based experiential learning (IBL) with those of traditional classroom learning, using the *student's perception index* of both experiences. Lee (2008) found that there are nine areas in which students learned more from their IBL than from classroom learning: practical knowledge related to the major field, understanding of how organisations function, ability to view career expectations, networking with professionals, ability to take initiative, ability to adapt to the changes, leadership skills, self-confidence, and management of finance. The same study also reported that some skills were better learned from classroom teaching: oral presentation skills, writing skills, ability to work with others for specific tasks, ability to design and conduct experiments, and civic responsibility awareness (Lee, 2008).

Student Readiness

One challenge faced by the majority of tertiary students is that they spend a considerable amount of time studying in the campus environment and less time in preparing themselves with the skills needed for entering the workplace. This issue may relate to the demand at many higher education institutions for students to maintain a

good grade point average (GPA) (Rayner & Papakonstantinou, 2015). As a result, students may not be well prepared for their IBL placement. The knowledge and skills learnt during their degrees may not suit their current IBL placement. Additionally, the subjects taught at the university may be too specific and not applicable to the workplace environment. Students need to engage more in the activities that promote self-confidence or provide them with the necessary skills for seeking a job (Rayner & Papakonstantinou, 2015).

Duration of the IBL Program

A few studies report that a longer duration, such as a semester long IBL, is required to maximise the benefits of the IBL experience. Rayner & Papakonstantinou (2015) found that the majority of the students they interviewed preferred a longer work placement period and downgraded a shorter placement. However, some others argue that two months duration is an ideal duration for a work placement (Santosa & Kusumawardani, 2010).

Other important components that need to be considered in designing the IBL program include:

- Timing of IBL placement as close to graduation as possible;
- Relevance of IBL program to the students' interests and study programs;
- Involvement of IBL students in publication and promotion. Students who involved in a research project during their work placement encourage to publish their work;
- Integration of the IBL program into the university curriculum as a credit unit and not just as an elective one;
- Provision by HEIs and other related parties of full or partial funding for the students during their IBL placements.

2.6 IBL Impacts on University Undergraduate Students

2.6.1 Impact on Academic Performance

Within the last two years, there has been more research related to industry-based learning (IBL) or work integrated learning (WIL) programs. However, only limited studies have focused on the impact of IBL on students' academic performance.

As discussed in Section 2.5.2, the majority of IBL research in the Australian context concentrates on the improvement of the curriculum to incorporate the best practice for IBL programs within HE institutions in Australia. In Indonesia, IBL research focuses on the economic impact of industrial partners participating in the IBL program rather than on the learning experience of IBL students (Section 2.5.3).

Among the studies that discuss IBL implementation in higher education in both Australia and Indonesia, only a limited number focus on the impact of IBL placement on students' academic performance or achievement. The majority of these papers report a rise in the academic achievement of students after the completion of their IBL program (Brooks, 2012; Gomez et al., 2004; Jones et al., 2015; Mandilaras, 2004; Tanaka & Carlson, 2012). Wandahl et al. (2011) and Sahama, Andersson, et al. (2014) report found that the very positive relationship between IBL placement and students' academic performance was due to their development of knowledge and strong technical skills during their IBL placements. These skills and knowledge were useful upon their return to university studies (Blicblau et al., 2014).

However, there was an argument that the increase in academic performance is not merely due to the student's involvement in IBL program. Some studies postulate that an increase in academic performance may result from various pre-existing conditions, such as students' academic capability (Jones et al., 2015) or students' prior experience of the subject (Thompson, Bates, & Bates, 2016). Some researchers argue that there is no clear evidence that IBL experience will translate into an increase in academic performance (Duignan, 2002).

It is important to note that most of the literature discussing the impact of IBL on academic achievement uses a quantitative research approach. That is, the students'

achievement (or performance) was quantitatively measured using the statistical method. For example, an increase in academic performance is commonly assessed by comparing the test scores or GPAs of two groups of students: the group who were involved in the IBL placements and the group who did not undertake the IBL placements. Most such studies suggest that the group of students who completed an IBL placement achieved a better final grade on a specific subject or on their final GPA than the students who elected not to do the IBL placement (Blicblau et al., 2016; Gomez et al., 2004; Wandahl et al., 2011).

In contrast to the mainstream research on the impact of the IBL placements on students' academic performance, the present study adopts a qualitative research approach, using case studies to investigate the issue and seek answers to the research questions. Case studies are the method of choice to understand the various stakeholder perspectives. In this case, the researcher examines the perspectives and the IBL experiences of Indonesian university students, academic staff and supervisors, and industry supervisors in a specific context and place.

The qualitative research approach using the case study method is considered appropriate to find the answers to 'how' and 'why' types of research questions (Yin, 2014). The research questions of this study ask "Why do Indonesian universities establish industry-based learning programs?" and "How does industry-based learning support STEM education in Indonesia?"

There are studies which use a qualitative approach to the impact of IBL placement on university students. For example, Wingrove and Turner (2015) interviewed 22 RMIT university students to investigate the impact of work integrated learning (IBL placements) on the students' critical reflection and reflexive thinking. Using a case study approach, they employed thematic analyses to explore the students' perceptions and their authentic learning experiences in certain subjects. The students reflected on the key learning experiences of the subject and how those experiences enhanced their learning capability. The key findings of this study suggest that reflective practice makes students more work ready, and that students' learning from

this practice will engage more fully in a WIL subject. By reflecting on their own learning experiences, students can identify their own strengths and weaknesses (Rajibussalim, 2010); hence they may develop their employability skills or initiate an intervention to rectify their weaknesses.

Other research that employs a qualitative approach to investigate the impact of IBL on university students is reported by Tran and Soejatminah (2016), who explore the perceptions of international students at Australian universities related to their experience in work-integrated learning. The findings suggest that IBL experience not only adds value to the international students' learning experience academically, but also increases their employability by enhancing their symbolic and social capital.

Other qualitative studies suggest that the universities need to adjust their current IBL curriculum in order to create an effective WIL environment and to give the best work placement experience to the students (Holt et al., 2004; R. Smith et al., 2008). Holt et al. (2004) suggest that universities should recognise and pay more attention to "the values of practical working knowledge" developed during students' work placements. Holt et al. (2004, p. 5). argue that students with IBL experience are significantly more mature in their behaviour and more confident in the classroom; they find that internship students have "a great deal of depth in all sorts of things," including presenting themselves well in class, engaging deeply in the discussion of certain topics, understanding workplace ethics, and in general, exhibiting a positive attitude towards their learning.

This argument is endorsed by Rayner and Papakonstatinou (2015) who report that over 90% of students in their study were happy with their IBL placements. They found that students expressed "positive or neutral" opinions about their work placement. Students acknowledged that they were able to apply the knowledge they acquired in the classroom to most of the tasks given at IBL placements. The lack of live interaction between university staff and students in the IBL program need not affect students' performance, since students can engage with their industry supervisor in the absence of an academic supervisor at work placement (Cross, 1996).

The majority of IBL placement students are able to gain valuable learning experience during work placement (Silva et al., 2016), which in turn will be useful upon their return into university life and after their graduation. The relationship between IBL placement and academic performance is depicted in Figure 2.6. This figure portrays that the majority of the students can gain new skills, knowledge, and learning experience throughout their IBL placement, and that their acquisition can increase academic performance. Therefore, some students wish that the duration of their IBL placements could be extended to maximise benefits (Rayner & Papakonstantinou, 2015; Santosa & Kusumawardani, 2010). Other students and academics suggest that the IBL program should be integrated into the university's curriculum as a compulsory credit unit and not as just an elective unit.

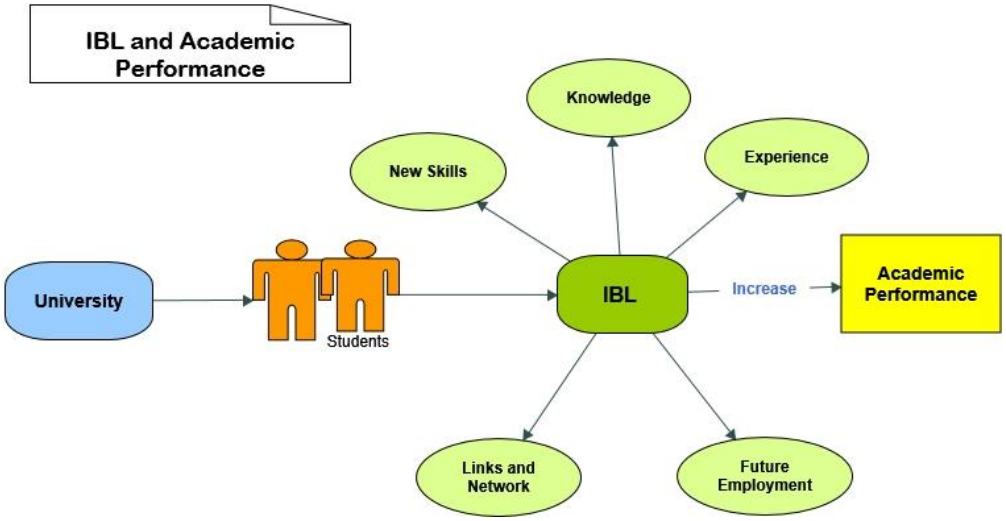

Figure 2.6 Acquisition of new skills, knowledge and experience during the IBL program may increase academic performance

2.6.2 Learning New Skills

In their affiliation with industry partners, students receive lessons in the form of technical skills that were not available in the university classroom. The technical

skills gained from learning in the field usually satisfy the job markets' demands. Santosa and Kusumawardani (2010) have summarised employability skills that can be learned by students during their IBL program as follows:

- *Working as a team player*. IBL enhances students' ability to work as a team player rather than an individual.
- *Solving real world problems*. Students gain valuable lessons, experience real world problems and learn to solve these problems.
- *Learning how a business is run*. Students acquire understanding of how an industry or organisation is professionally managed and run.
- *Working to achieve goals within a time frame*. Students learn how to work on scheduled tasks and how to complete the tasks within a deadline — time management.

Besides these skills, students may learn communication skills (Koppi et al., 2010), negotiation skills, management and leadership skills (Lee, 2008), industry regulations and rules, industry best practice and deliverability as well as time and stress management.

2.6.3 Transfer of Knowledge and Experience

Researchers argue that IBL plays an important role in transferring skills and knowledge to students (Lee, 2008; Nurdin, 2012). This knowledge includes the ability to take initiative, to socialise with other professionals, to increase the network of professional contacts and to manage financial activities (Lee, 2008). A survey at German universities has shown that partnerships between universities and industrial firms has resulted in the exchange of knowledge in both directions (Meyer-Krahmer & Schmoch, 1998).

The centre of attention for stakeholders is on students who are involved in IBL programs, and on the elements that help students to achieve the best possible outcomes in their IBL program. As illustrated in Figure 2.7, a *student* as an entity participating in an IBL program intersects with other entities, *University*, and *Employer*, and their IBL experience results from multiple interactions with the university and employer

entities (Patrick et al., 2008). This daily interaction and association initiates the transfer of skills, knowledge, and experience from the relevant person in the workplace to the students, enriching their IBL experience.

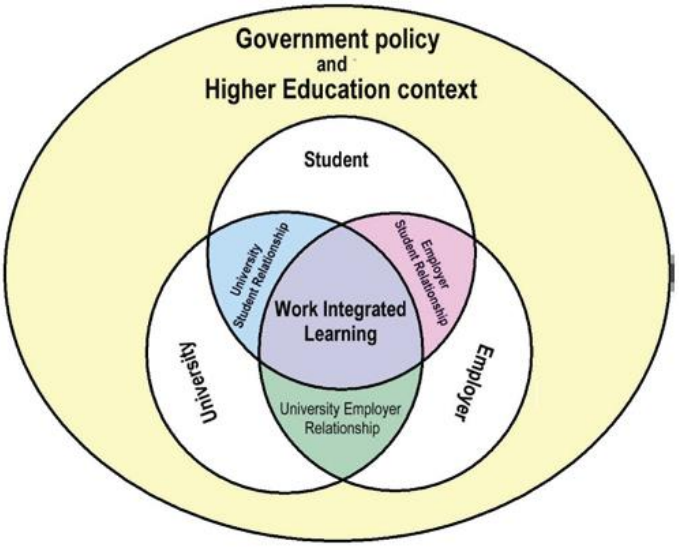

Figure 2.7. Stakeholder participation in the study (Patrick et al., 2008, p. 11)

2.6.4 Impact on Future Employment

In their IBL placements, students may bring good technical skills and work experience from non-educational institutions where they have worked previously. During their industry attachment program, students learn and understand the way companies run. They also understand the expectations industrial sectors have of their employees. This IBL opportunity provides authentic experience for students and will increase their understanding of work ethics, standards, and expectations in the real world (R. Smith et al., 2008). This experience gives them a competitive edge that helps them compete for jobs and excel in their future work (Lee, 2008). Rayner and Papakonstatinou (2015) also find that IBL experience is useful in preparing students for future employment. Students who were interviewed for their research strongly endorsed that WIL placement had prepared them well for competing in the job market.

Although the majority of studies report that IBL placement has a positive correlation with future employment, a small number of researchers argue that IBL placement is not adequate to prepare work ready students (Herrington, 2006). Some argue that the main role of universities is not to produce graduates who are ready for employment at any institution (Boulton & Lucas, 2011).

From employer's perspective, the IBL placement is considered useful and offered some values for students in terms of workplace experience and enhancement of work-related skills (Patrick et al., 2008). However, the value of IBL from an employer's perspective may vary depending on the nature of the industry (government, non-government or not-for-profit) and its size (Rayner & Papakonstantinou, 2015).

IBL experience is useful in preparing students for their future work. Participation in an industrial project gives internship students an idea of what skills and knowledge are required in the workplace (Koppi et al., 2010; Lee, 2008). IBL activities provide an opportunity for students to link the theory they learnt at university to practices in the workplace, and the ability to assess and prepare for the skills and knowledge necessary for future employment.

2.6.5 Measuring the Success of IBL Programs

Measuring students' performance in IBL programs requires various forms of assessment. Variations in IBL assessment standards may have serious implications for grades or credits awarded to the students (Ram, 2008). Assessment of IBL placements are typically both formative and summative. In contrast to conventional classroom learning, formative assessment is used more than summative assessment (Martin et al., 2012). Formative assessment encourages students to reflect on their learning experience and to identify their respective strengths and weaknesses (Rajibussalim, 2010).

Lee (2008) measured how much students learned from their IBL by comparing the skills learned with the ones learned in the traditional classroom. The study reported nine areas where students learned more from their industry-based experiential learning

than from classroom learning: practical knowledge related to the students' major subject, understanding of how organisations function, ability to view career expectations, making a network with professionals, ability to take initiative, ability to adapt to change, leadership skills, self-confidence, and finance management. The same study also reported that some skills are better learned from classroom teaching. These skills include oral presentation skills, writing skills, ability to work with others in specific tasks, ability to design and conduct experiments, and civic responsibility awareness.

2.7 Promoting STEM Education Through IBL Programs

In the global context, there have been many calls for reform to the traditional lecture-based STEM courses taught at the universities due to their ineffectiveness as a process of learning for these fields of knowledge (Breiner et al., 2012; Henderson & Dancy, 2011; Prinsley & Baranyai, 2015a). Researchers argue that some fields such as Science and Engineering are better learnt not merely in the classroom but through the implementation of knowledge outside the classroom, such as in the relevant industries (Sarvi & Pillay, 2015).

A survey in Australia found that employers of STEM graduates value highly vocational skills such as the ability to apply and develop contextual knowledge along with critical thinking and problem-solving skills (Rayner & Papakonstantinou, 2015). Surprisingly, self-confidence and numerically related skills are valued least in the survey (Rayner & Papakonstantinou, 2015). The importance of the vocational skills to graduates' prospective employers suggests that there is a need to reform undergraduate STEM curricula in Australia, which currently focus on knowledge acquisition (Rayner & Papakonstantinou, 2015). Thus Australian STEM undergraduate students will have better opportunities to apply their knowledge "in real life, industry-based contexts" such as through participation in IBL or WIL programs (Rayner & Papakonstantinou, 2015, p. 100).

It is widely accepted that IBL programs are able to bridge the gap from study to work by equipping graduates with job-ready skills, while also bringing the

university closer to industry in a mutually beneficial collaboration (Prinsley & Baranyai, 2015a). STEM curriculum reform coupled with closer collaboration between university and industry will bring fruitful benefits to society as a whole (Rayner & Papakonstantinou, 2015). This is because technology requires specialised learning and teaching processes that are sometimes better learnt at the workplaces (Sahama & Bandara, 2014; Sahama, Kushniruk, & Borycki, 2014). STEM curriculum reform is expected to rectify the issue of the shortages of STEM graduates faced by business and industry, and correct the mismatch of graduates' skills with employers' requirements (Prinsley & Baranyai, 2015b; West, 2012).

2.7.1 The lack of STEM Talents in Indonesia

Indonesia, as a matter of priority, needs to invest in building its strong research capacity. University research centres are the key elements to support this policy (Tong & Waltermann, 2013), as they serve as a hub for the development of high-quality research. High-quality research, particularly in STEM disciplines, enables Indonesian universities to provide innovative ideas for the business community and can contribute to rapid business development and expansion. Indonesian universities are in a position to initiate collaboration with industry in the sectors that enable the development of human resources and at the same time boost economic growth (Salim & Al-Arief, 2011).

As mentioned in the introductory chapter, Indonesia is currently experiencing a shortage of reliable STEM graduates ready for the increasingly competitive job market. Although Indonesia has progressed well in building research infrastructure, the development of human resources lags behind. The shortage of a highly skilled workforce is hampered by the low quality of STEM graduates produced by higher education institutions in Indonesia. Only a few Indonesian graduates are accepted in multinational companies established in Indonesia due to the lack of relevant experience and skills for the jobs available (Tong & Waltermann, 2013).

The shortage of skilful and talented university graduates in Indonesia is predicted to continue for the next decade (Figure 2.8). The lack of talent will affect all

levels of management from the entry level to the senior management level, with the middle management the most affected. Consequently, Indonesia will not be able to balance demand and supply of skilled personnel in the workplace.

Figure 2.8 Projection of the shortage of talent in all levels of management in Indonesia by 2020 (Tong & Waltermann, 2013, p. 5)

Indonesian firms in both manufacturing and service areas are looking for employees who are capable of contributing to innovation and higher productivity. Industries seek Indonesian university graduates who possess good communication, management, and problem-solving skills. However, in the current situation, not many Indonesian university graduates have mastered these essential skills. Therefore, industries face a serious problem when recruiting university graduates, due to the lack of applicants that possess the required skills (Salim & Al-Arief, 2011).

Within the past decade, Indonesia has enjoyed healthy economic growth. This is evident in the growth of middle and lower income technology-based companies. These companies have been able to utilise technology to promote industrialisation,

develop more technology infrastructure, and improve the manufacturing industry. Despite this improvement, human resources to handle this growth in technology are limited. To overcome this problem, the higher education institutions in Indonesia need to take a more active role in providing focused skills for the graduates, to equip them for employment by industrial sectors (Tong & Waltermann, 2013). Universities have an important role to play in elevating Indonesia into a more productive and innovative nation that will be ready for the global challenges of creating sustainable economic growth.

Another important role of higher education institutions is building their strength in research capability, especially in STEM disciplines. The biggest challenge to improving STEM education at universities is the lack of good research-based strategies for engagement with industry (Henderson & Dancy, 2011). Universities need more research centres that have a link with relevant industries and firms. A strong research centre enables universities to produce ideas to be used by the business community and contribute to the growth of industrial and business sectors (Tong & Waltermann, 2013). This contribution, in turn, will strengthen Indonesia's economy.

Recent research highlights that industry affiliation or work placement plays an important role in preparing skilled graduates who are ready for job placements in the competitive global market (Mehta & Sun, 2013; Tong & Waltermann, 2013). To this end, Salim and Al-Arief (2011) propose two main priorities that need to be adressed by Indonesian HEIs in order to limit the issue of STEM talent shortage: (1) to address the skills gaps by maintaining and improving the quality of HE graduates; (2) to increase the number of research centres at universities relevant to the economic growth.

Besides improving partnerships with industry, universities will also need to develop partnerships with government, another stakeholder that can support university in terms of funds. The Indonesian government can also play an important role in increasing qualified STEM graduates by providing support for better management of public HE institutions. Specifically, the government can provide greater autonomy to

higher education institutions in Indonesia to make them more accountable and able to produce work-ready graduates.

2.8 Chapter Summary

The purpose of this chapter is to review the literature related to the implementation of IBL programs at HEI in Australia and particularly in Indonesia. The chapter reviews the literature related to the topic of industry-based learning programs in line with the research question being investigated. It begins by defining the terms UIP and IBL, then discusses the role of HEIs, particularly the HE system in Indonesia. The review continues with an account of UIP as an umbrella for successful university IBL programs.

In relation to the first research question, the chapter continues by reviewing the body of literature on the purpose of university IBL programs, and their implementation in Australian and Indonesian contexts. The literature highlights three main purposes for the establishment of IBL programs at universities in Australia and Indonesia: to increase the employability of universities' graduates; to equip students with work experience; and to allow students to establish links and professional networks with professionals in order to enhance employment opportunities after graduation.

The second research question asks about the impact of IBL programs on university students, particularly on their academic performance. The review of the literature reveals a growing body of work exploring the implementation of IBL programs at universities in Australia and around the globe. Unfortunately, there are few research studies on this topic within the Indonesian context.

In the Australian context, the majority of studies of IBL programs emphasise *developing HEI curricula* that pay more attention to IBL programs and finding ways to improve *best practice* in the implementation of IBL program within Australian universities. Studies on the implementation of IBL programs in Indonesia, however, mostly focus on the university's contribution (by university staff and students) to solving problems faced by industry while students are learning from this process.

In regard to the impacts of IBL on undergraduate university students, the majority of studies acknowledge that there is a positive correlation between work placement and improved academic performance. Improvements in academic performance are usually measured by quantitative methods, comparing a group of students with IBL experience and a group of students without IBL experience. The results indicate that the groups of students with IBL experience achieved better final grades on specific subjects. The other positive impacts of IBL include acquiring new skills and knowledge, valuable learning experience, and established links and networks with professionals.

The third research question examines the relationship between IBL programs and STEM education in Indonesia. The review of the literature establishes that there is a need for reform of undergraduate STEM curriculum in Indonesia. This will provide better opportunities for undergraduate students to learn and apply their knowledge within the real workplace, such as through strategic participation in IBL programs. In the Indonesian context, a strategic application of IBL programs within the university's STEM disciplines is critical to reducing the STEM skills shortage among Indonesian university graduates. This strategy is expected to reduce the graduates' skills gaps and to satisfy the industry's demand for work-ready graduates from Indonesian universities.

The review of literature suggested that the studies on IBL implementation in Indonesian context do not necessarily explain the impacts of IBL programs on Indonesian university students, particularly on their academic performance. Additionally, there lack of studies on how IBL programs can promote the STEM education in Indonesia. This PhD project aims to fill this research gap.

Chapter 3 Research Methodology and Design

3.1 Overview

This chapter describes the research methodology of the present study, followed by an explanation of the research design, including the research site and participants, data collection techniques and instruments, strategy for data analysis, and the techniques for validation to ensure the rigour of the methodology.

3.2 Research Methodology

> Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation … The selection of a research approach is also based on the nature of the research problem or issue being addressed, the researcher's personal experiences, and the audience for the study. (Creswell, 2014b, p. 3).

Creswell (2014b) identifies three factors in the choice of a research approach for a study, namely: the nature of the research problem, the experiences of the researchers, and the intended audience. If the research problem calls for the identification of factors that affect an outcome, or an understanding of the best predictor of outcomes, then a quantitative approach is the best method for such problems. In other cases, if the research involves understanding a new concept or phenomenon that is not well discussed or understood, then a qualitative approach is more appropriate.

3.2.1 The Choice of Research Methodology

This study adopts a qualitative method to investigate the research problem and to answer the research questions. A case study is utilised to examine the impacts of an

industry-based learning (IBL) program on STEM undergraduate students, particularly on their academic performance, at an Indonesian higher education institution.

Case Study Method

Case study research has been used in many fields of study, including psychology, sociology, political science, anthropology, social work, business, education, nursing, and community planning (Yin, 2014).

> Case study research is a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case themes. The unit of analysis in the case study might be multiple cases (a multisite study) or a single case (a within-site study). (Creswell, 2013, p. 97)

The case study is widely used as a research method to understand complex social phenomena. The use of this method allows researchers to concentrate on aspects of the case in its real-life context, the surrounding environment (Yin, 2003). Yin (2014) adds that the rationale for the use of a case study method is when researchers ask "how" or "why" types of questions in their studies. In the case of "what" questions, Yin (2003) suggests that an explanatory or a prevalence approach is suitable. Explanatory research may adopt various research approaches, such as case study, survey, or archival analysis, while for prevalence research, the researchers favour survey or archival analysis. In all cases, the type of research question is one of the important factors in designing a research methodology.

A case study has been selected for this research for the following reasons. First, we wanted to understand the perspectives of various stakeholders (university students, university staff, and people from organisations involved in the IBL program). For this purpose, interviewing the stakeholders in their local environment is considered the

best approach. This allows an in-depth investigation of participants' responses to the research questions, to explore the complexities of a phenomenon being studied. For example, the investigator can follow up a particularly interesting topic with another question. The use of interviews enables the investigator to develop understanding and to clarify particular issues directly with stakeholders. Second, the case study method offers flexibility in the mode of reporting. The researcher has scope to interpret the case while ensuring that authenticity and reliability are maintained.

In summary, the case study method in this study is, appropriately, an explanatory approach to investigating a specific topic in a particular context and place. This is in line with the aim of the study — to explore the impact of an IBL program on students' academic performance in a higher education institution in Indonesia.

3.3 Research Design

To address the research questions, the researcher needs to prepare and employ sampling procedures. This involves defining the location or site for the research, choosing the sampling technique, and inviting the participants to provide the data for the study. Although there is a significant difference in the sampling methods used in qualitative and quantitative research, for example the size of the sample and the approach used, ,the general sampling procedures can be applied to both qualitative and quantitative research (Clark & Creswell, 2011).

3.3.1 The Research Site

The research study investigates the impact of an IBL program on Indonesian university students, particularly on their academic performance. Several criteria were applied to choosing the research location or HEI in Indonesia for participation in the project:

1. The higher education institution has to offer a variety of STEM disciplines such as Natural and Life Science, Engineering, Information Technology and Mathematics.

2. The higher education institution has to offer an IBL program within its STEM disciplines.
3. The higher education institution has to be a sizeable institution, as indicated by the number of its students (more than 30,000 students).
4. The HEI has to be among the top ranking universities in Indonesia and classified as an A-rank University by the Indonesian National Accreditation Board of Higher Education ('Badan Akreditasi Nasional-Perguruan Tinggi' [BAN-PT]).
5. There has to be easy access to the research site for repeated data collection such as interviews and document retrieval and analysis.

Based on these selection criteria, a thorough online search of the leading Indonesian HEIs that offer IBL programs within their STEM discipline was conducted, and a list of leading Indonesian HEIs compared. Among the listed universities, one university in the western part of Indonesia satisfied all the criteria and was chosen as the research site. For ethical considerations in this thesis, this university is referred to as the 'University of Western Indonesia" (UWI). This pseudonym is used to preserve the university's privacy and conceal its identity. The abbreviation 'UWI' will be used throughout the remainder of the thesis and chapters in order to satisfy Queensland University of Technology's ethics requirements.

The University of Western Indonesian (UWI) is the largest and the oldest state university in the region with more than 30,000 students in all program studies and disciplines. It has 10 faculties and 55 study programs offering undergraduate (Diplomas and Bachelors) and post-graduate programs (including Masters and Doctoral degrees). The UWI offers STEM-based undergraduate and postgraduate studies within the Faculties of Science, Engineering, Medicine, Agriculture, Oceanography and Fisheries. The university is located in one of the capital cities of the western part of Indonesia. Therefore, it offers flexibility of access and time for conducting data collections. The focus of the research study is on the IBL experiences

and perspectives of the UWI students and staff within the STEM disciplines. In addition to this, interviews with employees and IBL supervisors in industry were conducted to seek their perspectives related to their experience of IBL.

The majority of the STEM undergraduate programs at UWI are under the Faculties of Science and Faculty of Engineering. For example, the Faculty of Science offers undergraduate and post-graduate studies in Mathematics, Physics, Electronics Engineering, Chemistry, Pharmacy, Biology, and Information Technology. The Faculty of Engineering offers undergraduate and post-graduate degrees in Civil Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering, Industrial Engineering, and Geophysical Engineering. This is consistent with the purpose of the present study — to examine the impact of an IBL program on students' academic performance in STEM disciplines. The study focuses on the perspectives and experiences of the study participants who were involved in an IBL program as part of the University and Industry Collaboration (UIC) program.

3.3.2 Participants in the Study

The definition of participants in this study follows Patrick et al. (2008) definition of a stakeholder in IBL as any individual or organisation that has sometimes been involved in and experienced IBL programs at designated institutions, and a participant as an individual who participates in interview, surveys or focus group discussions (Patrick et al., 2008). Based on this definition, this study identifies three key groups of stakeholder participants in the study:

1. University students who have participated in an IBL program. This is the first and the most important group of participants in this study. Students were invited to participate voluntarily in interviews.
2. University academic staff members who have supervised undergraduate students in an IBL program. This is the second group of research participants involved in this study. The data was collected from this group through interviews.

3. Staff or employees of industries (or organisations) that have been involved in IBL programs and have supervised students in IBL programs. The data was collected from individuals within this group through interviews.

Selection Criteria

This study adopted 'criterion sampling' where criteria of importance were set for the samples, and research participants had to satisfy this set of criteria to be selected (Patton, 1990). The sample size is an important issue in qualitative research. In qualitative research, a small sample size is recommended, and the data from participants should be gathered in comprehensive detail. Most qualitative studies use between 20 and 50 participants for the research. This is to ensure that a variation in perceptions and experiences uncovered before reaching saturation point (Creswell, 2013).

Individuals that fitted the criteria were selected and invited to be respondents in the research study. Three key selection criteria were used to select the participants. These are:

1. Current university or HE students within STEM disciplines who have completed an IBL program.
2. Sessional, contracted, or full-time academic staff in chosen universities or employees of industrial partners that participated in an IBL program.
3. Academic staff members and industry employees must have been previously involved in supervising students in their IBL programs.

This study explores the perceptions and experiences of Indonesian undergraduate university students, academics, and industry employees regarding students' work placements and academic performance.

Participant Details

The university participants were recruited through email invitations sent to the relevant departments of the selected institution. This invitation introduced the researchers, described the purpose of the research, and asked the university staff and students to participate in the research study. The invitation also contained the contact detail of the researchers in charge of the research. The participating departments then forwarded the invitation email to their staff and students through their mailing lists. It was mentioned in the invitation letter that around 20 to 30 students and around 15 staff were required for the interviews.

Academic staff members and students who were interested in participating in the study were given the choice of replying directly to the researcher or to the head of the participating departments in UWI through the email addresses provided. Replies from the participants came over a period of one month. Most replies were sent to the heads of departments through their administrative officers, who also arranged face-to-face interviews.

The study also required participation from industry employees. Based on the selection criteria mentioned in the previous section, an eligible industry employee had to be someone with previous involvement in an IBL program, such as a former supervisor of an IBL student. The recruitment process involved sending an invitation letter to prospective industrial employees. For this purpose, prior knowledge of which institutions had been involved in the IBL programs with the UWI previously was required. Fortunately, this information was provided by the head of participating study programs and departments within UWI. The head of departments and some academic staff members extended their help by contacting four employees of industry partners, who accepted our invitation for interviews.

For the interview, the majority of participants were students, constituting 55% (22 respondents) of the 40 respondents. The remaining 45% were either academic staff, at 35% (14 respondents), and industry partner employees, at 10% (4

respondents). Information about the participating departments or industries and study programs and participants' roles is summarised in Table 3.1.

Table 3.1 Participants' departments/disciplines and study programs

Department/Study Program	Role	Number of Respondents	Percentage (%)
hemistry	Student and Staff	12	30
Electronic Engineering	Student	5	12.5
Geophysical Engineering	Student and Staff	3	7.5
Information Management	Student	5	12.5
Information Technology	Staff	3	7.5
Physics	Staff	3	7.5
Mathematics	Student and Staff	3	7.5
Civil Engineering	Student	1	2.5
Chemical Engineering	Staff	1	2.5
Science and Engineering	Industry Employee	4	10
Total		40	100

Regarding participants' educational background, the majority of the respondents were undergraduate students (55%), followed by 27.5% of respondents who hold a doctoral degree, and 17.5 % participants with Masters degrees. From gender perspective, more male respondents (82%) answered our invitation to participate in the interview, compared to female respondents (18%) (Table 3.2).

Table 3.2 Participants' educational background and gender

Educational Background	**Participant**	**Male**	**Female**	**Percentage (%)**
Doctor	11	10	1	27.5
Master	7	6	1	17.5
Undergraduate	22	17	5	55
Total	40	33	7	100
Percentage (%)		82	18	

3.3.3 Data Collection Techniques

The purpose of data collection is to gather information and research evidence systematically to address the questions being asked in the study (Clark & Creswell, 2011). Loseke (2013) states that there are two different categories of data that correspond to the types of questions researchers can ask; how people think/feel and how people act; "Empirical evidence for how people think/feel comes from asking them; empirical evidence for how people act comes from watching them" (Loseke, 2013, p. 83).

The present study used two distinct techniques to gather the data, namely interview and document analysis, as discussed in the following section.

Conducting the Interviews

The interview method is to arrange extended conversations between the researcher and participants. The method was originally developed by psychologists and is the only method that allows the researchers to explore how people understand topics that are too complex to be investigated with the relatively simple and straightforward questions that are typically asked in surveys (Loseke, 2013). The interview method allows researchers the flexibility of altering follow-up questions according to participants' responses. Researchers can also negotiate the place and time for the interview with the participants (Creswell, 2014b).

The present study adopts the interview as the main method to gather data, due to its suitability for obtaining information about people's views, opinions, ideas and experiences (Arksey & Knight, 1999). This method, however, has disadvantages in terms of time and amount of data generated. In comparison to surveys that can generate a large quantity of data from many participants, the interview (especially the in-depth interview) requires more time to conduct both the interviews and to analyse the data (Loseke, 2013).

The current study used semi-structured interviews because of the flexibility they allow for combining formal and informal conversation. To maintain the clarity

and quality of the interview, an *interview protocol* was created, to serve as a framework to ensure the interview stays focused on the research topic. An example of the interview protocol used in this study is presented in Appendix A. Before the interview session, the questions were designed according to the research questions. The structure of the research questions allowed the interviewer to follow up the participants' responses with another question if needed. This is one of the main advantages of the interview method, enabling a detailed exploration of the topic under investigation, which is not possible with a survey or questionnaire. Informal conversation that rises during the interview can be used to fill any gaps in data collection and to clarify participant's responses. In order to obtain a deep and broad range of information, planned questions in the interview protocol are necessary to manage the interview process.

The UWI academic staff members and students who agreed to participate in the research study were invited to participate in face-to-face interviews at their convenient time and location. Most of the interviews were conducted in a meeting room or a small lecture room at the UWI campus, courtesy of the head of participating departments.

The interviews were conducted face-to-face and audio recorded, with the exception of the interviews with industry partner employees. Due to the distance and time constraints, the interviews with industrial partner members were conducted through phone conversations and also audio recorded. Audio recording is commonly used to record interview data (Creswell, 2013; Rubin & Rubin, 2011). It creates a more relaxed atmosphere because the interviewer is free from the distraction of note taking and can concentrate on questions.

At the beginning of the interview, the participants were presented with a consent form to be sighted and signed. QUT research protocol requires that participants in research are taking part in interviews of their own free will. The researcher briefly explained the purpose of the interview and that its duration would be between 20 and 60 minutes. After the participants signed the consent form and

indicated that they were ready for the interviews, the interviews could proceed, using the semi-structured interview questions that had been prepared. The interviews were completed within the period of approximately one month from 20 December 2015 to 25 January 2016.

Document Analysis

In addition to interviews, document analysis was used as the second form of data collection. This method was developed by historians and is used to examine documents related to the topics of study being investigated (Loseke, 2013). The documents can be categories in public documents (such as newspapers, minutes of meetings, official reports) or private documents (such as personal journals and diaries, letters, or emails) (Creswell, 2014b).

The strength of document analysis is that it allows researchers to examine the contents of various documents in-depth. However, it cannot show the motivations of the people creating them nor how the contents of the document were interpreted by members of the intended audience (Loseke, 2013). To conduct effective document analysis, it is necessary for the researcher to create a data collection plan.

Prior to collecting the documents, the participating STEM departments within the Faculties of Science and Faculty of Engineering at the University of Western Indonesia were contacted by email to request access to documents relating to IBL implementation in those departments. As a result, access was granted to identify and collect the relevant documents. The documents are listed in Table 3.3.

Prior to data collection through interviews, several meetings were conducted with the heads of participating departments and their academic staff members. The purpose of the meetings was to explain the research aims to the decision makers within the participating departments. The other purposes of the meetings were: to explain the research study and the data collection methods that would be used; and to ask permission of the heads of departments access the documents related to the IBL programs in their departments. These documents could be the regulations and policies

or the rules created by the faculties or the departments within the faculty that govern how the students within the department should apply for and conduct a work placement with industry partners. Another relevant document could be a Memorandum of Understanding (MoU) between the faculties or the departments within the UWI and the industry partners. These documents are very important sources of information for the present study, as they can complement the information gathered from the interviews. The document analysis together with the excerpts of the interviews can be used for triangulation, to validate the results of the study.

For the document analysis, relevant documents related to IBL programs at UWI were gathered. In the meetings prior to data collection, the majority of the heads of schools within UWI agreed to release the relevant UIP and IBL documents for investigation, and to make duplicate copies. Since the documents were gathered from different departments and places, however, the process of document gathering was not immediate and quick. It took approximately one to two weeks to collect and make copies of documents from every participating department. The relevant IBL documents gathered from the various departments within UWI are listed in Table 3.3.

Characteristics of the IBL Program at UWI

Based on analysis of the IBL documents from participating departments at UWI listed in Table 3.3, the following characteristics of IBL program at UWI were identified:

- There were differences in policy regarding the implementation of IBL in various study programs (departments) within the Faculties of Engineering and Science at UWI. For example, the IBL program was compulsory in some faculties and departments but not compulsory in other faculties and departments. Based on the analysis of documents D9 and D10 (Table 3.3), all students of the Electronic Engineering and Geophysical Engineering departments within the Faculty of Engineering were obliged to participate in "practical work" (work placement program) as a compulsory subject offered

in the third or the fourth years of the study. Thus the IBL subject is part of the degree assessment and included in the curriculum.

Table 3.3 IBL related documents collected from participating faculties and departments at UWI

Label	Type of Document (Indonesian)	Type of Document (English)	Source of Document
D1	SOP Pelaksanaan KKP 1 June 2008	The industry-based learning Guidelines: Dated 1 June 2008	The Administration office of UWI
D2	SOP KKP FMIPA 12 November 2013	The Faculty of Science Industry Based Learning Guidelines: Dated 12 November 2013	The Faculty of Science IBL
D3	Panduan KKP FMIPA 2010	The Faculty of Science industry-based learning Guidelines 2010	The Faculty of Science IBL
D4	Panduan KKP Jurusan Kimia 2010	The IBL Guidelines of Chemistry Department	The Chemistry Department
D5	Contoh Surat Pengantar KKP Jurusan Kimia 2016	Example of IBL cover letter of Chemistry Department 2016	The Chemistry Department
D6	Contoh Surat Ijin Pemakaian Laboratorium Jurusan Kimia	Example of IBL letter for Using Industrial Laboratory Facilities	The Chemistry Department
D7	Panduan KKP Jurusan Fisika 2010	The IBL Guidelines of Physics Department	The Physics Department
D8	Contoh Surat Pengantar KKP Jurusan Fisika 2016	An example of IBL letter Physics Department 2016	The Physics Department
D9	Panduan KKP jurusan Teknik Electronika	The Guidelines of IBL Study Program Electronic Engineering	The Electronic Engineering Department
D10	Panduan KKP jurusan Teknik Geofisika 2010	The Guidelines of IBL Study Program Geophysical Engineering Department	The Geophysical Engineering Department
D11	Contoh Surat Pengantar KKP Jurusan Geofisika 2016	Example of IBL letter of Geophysical Engineering Department 2016	The Geophysical Engineering Department

- There was a variation regarding the implementation of IBL programs within some departments in the Faculty of Science. The study programs and the departments within the Faculty of Science were given authority to decide whether to include IBL subjects in their curriculum as a compulsory or elective subject. Some departments or study programs such as Chemistry, Information Management, Statistics, and Biology elected to oblige their

students to take part in an IBL placement (D3 and D4 documents). This policy is part of their curriculum. Other departments such as Physics, Mathematics, and Information Technology opted not to oblige the students to undertake the IBL subject, which was an elective topic (D3 and D7 documents).

- Prerequisite courses are in place for students wishing to undertake IBL placements at UWI. Before applying for a work placement program, UWI students were required to complete these courses structured as study programs at UWI (D1, D2, and D3 documents).
- The students who apply for an IBL placement must have completed 110 'Satuan Kredit Semester' (SKS) or credit units from a total of 144 credit units required for a bachelor degree at UWI (D2 and D3 documents).

The document analysis enriched the results of the interviews in a positive way. The findings from analysis of the IBL documents were later triangulated with the results and findings from the interviews. This method of enhancing the validity and reliability of the data will be explained further in Section 3.3.5. The majority of the findings from document analysis supported the findings from the interviews.

Observation

The method of observation was first developed by anthropologists (Loseke, 2013) and is widely used in qualitative research. In the method, researchers take field notes and record, in an unstructured or semi-structured way, the activities and behaviour of individuals at the research site (Creswell, 2014b). Researchers observe people "in order to gather data about how they behave" (Loseke, 2013, p. 88). This is important as it allows the researcher to empirically explore how individuals under study act, rather than how they say they act (Loseke, 2013).

In this study, observation was not the main method used for data collection. A limited observation was conducted at UWI campus to observe the students'

preparation for undertaking the IBL program. The observation was conducted within the UWI campus but not at the IBL sites.

3.3.4 Data Analysis

The data analysis process involves not merely presenting the data in forms of tables, matrices, and texts in narrative form, but also certain procedures and activities that interconnect to analyse and represent the data. These activities involve organising the data into a database, reading through the database, coding and organising themes, creating a method of data representation, and interpreting the data (Creswell, 2013). As this research adopts a case study method, data analysis involved creating a detailed description of the case and its setting.

Yin (2003) describes three main techniques for analysing case study evidence (resources). The first is *relying on the theoretical propositions.* The original objectives and design of the case study are based on the underlying theoretical proposition. This proposition is translated into a set of research questions, review of the literature, and, if relevant, new hypotheses. This is the preferred technique for the current study because it helps to focus attention on certain important data and ignore unimportant information (Yin, 2003). This study investigates the perceptions and experiences of participants of the IBL program in terms of the central proposition. The two other techniques are *thinking about rival explanations* and *developing a case description.* These two data analysis techniques are less preferred than the first one for the case study research (Yin, 2003).

In the present study, *thematic analysis* is used to extract relevant information from the data gathered in the interviews and related documents. Thematic analysis is "a method for identifying, analysing and reporting pattern (themes) within the data" (Braun & Clarke, 2006, p. 79). Boyatzis (1998) describes thematic analysis as "a process for encoding qualitative information." Thematic analysis could be done manually without using any software, or by using a computer-assisted software such as Nvivo, or by the combination of both methods. This study adopts the later approach,

combining the manual coding and analysis with computer assisted coding using NVivo 11 software.[7]

Before discussing the data analysis procedure in more detail, the key terms related to the thematic analysis as used throughout the thesis are explained in this section. The thematic data analysis used codes, themes, and patterns to encapsulate or categorise the data. Codes are the labels or names used to identify small segments or elements of the text (Creswell, 2012). ”A theme captures something important about the data in relation to the research questions and represents some level of patterned response or meaning within the data set” (Braun & Clarke, 2006, p. 82). Boyatzis (1998) perceives a theme as “a pattern found in the information that at minimum describes and organises the possible observations and maximum interpretational aspects of the phenomenon.” Themes are observed at *manifest* level or *latent* levels. At the manifest level, the information gathered focuses on what the participants explicitly mention and can be directly observed. Themes at the latent level, however, draw upon interpretations of the participants’ explicit statements (Boyatzis, 1998).

Braun & Clarke (2006, p. 87) describe six phases of thematic analysis:

1. Familiarisation with the data;
2. Generating initial codes;
3. Searching for themes;
4. Reviewing the themes;
5. Defining and naming the themes;
6. Producing the report.

The present study follows this procedure to capture the important information within the data in relation to the research questions under investigation, as depicted in Figure 3.1

[7] http://www.qsrinternational.com/nvivo-product/nvivo11-for-windows

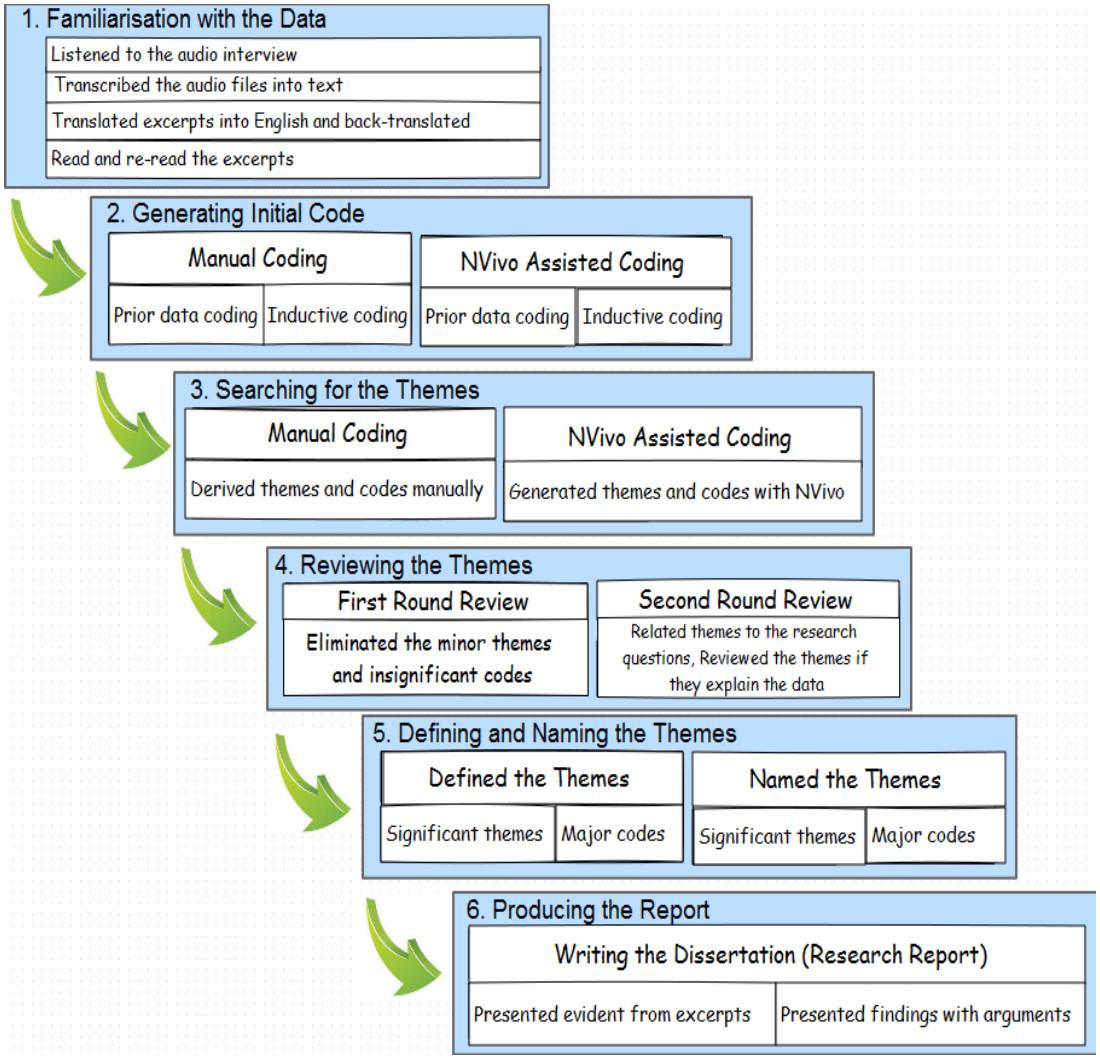

Figure 3.1 The thematic analysis process (adapted from Braun & Clarke, 2006)

Phase 1. Familiarisation with the Data

The data are the central part of qualitative research. Therefore it is very important that researchers familiarise themselves with the data in order to gain insight into it and to know the depth and breadth of its content. The familiarisation process includes repeated reading of the data to search for specific meaning and to identify the patterns (Braun & Clarke, 2006).

The data in this study were gathered through interviews and analysis of related documents. In order to understand the data and to be familiar with the data, the

researcher listened to the audio recording of interviews and read the transcribed interview excerpts thoroughly. Through this process, initial understanding and insights into the data content and the themes and patterns of the data were acquired. These themes and patterns were further contextualised in the next phases of the thematic analysis process.

This research project involves the use of dual languages: English and Indonesian. The entire research process, except for interviews and initial data analysis, was conducted in English. The interviews were conducted in the Indonesian language to eliminate language barriers. By conducting the interviews in Indonesian, participants could freely express themselves when answering the interview questions on the related research topics, and consequently, a wealth of information could be retrieved from participants. The audio interviews were transcribed into excerpts in the original language, and were given to the research participants for the member checking process that is part of the research validation process, to ensure research rigour. The process of ensuring research rigour and reliability is explained in Section 3.3.5. At the member checking process, data was re-read and analysed in its original language.

Following data acquisition, translation of data was undertaken by official translators for further analysis. To maintain the trustworthiness of the research, it is necessary to minimise the translation errors (Sutrisno, Nguyen, & Tangen, 2014). Therefore, the data translation process was conducted in two stages and translated by more than one official translator. The first translator translated the interview scripts from Indonesian to English. After this step was completed, the English translated interview was sent to another translator who translated back into Indonesian without knowing the original Indonesian version. This is known as a back-translation procedure, to minimise translation errors in cross-language or cross-cultural qualitative research data (Liamputtong, 2010; Sutrisno et al., 2014). The results of back-translation interview scripts were compared with the original Indonesian version to identify any errors or inconsistency. After the comparison, both excerpts were

comparable and accurate, with minor inconsistencies of less than 10%. Following this phase, the thematic analysis proceeded to the next phase, using the English excerpts.

Phase 2. Generating Initial Code

"Coding is the process of segmenting and labelling text to form descriptions and broad themes in the data" (Creswell, 2014a, p. 267). In this study, the coding process was conducted by combining the manual and computer assisted software method using NVivo 11 software. The manual coding was conducted by repeated reading of the interview excerpts and underlining important texts with coloured pens. The automatic coding was performed by using NVivo software.

Codes can be derived directly from the literature and theoretical framework prior to the data analysis process. These type of codes are called "prior data" or "prior research driven" codes (Boyatzis, 1998, p. 29). Another type of codes are called inductive codes which can be derived directly from the raw interview excerpts (Boyatzis, 1998).

After the process of translating and back-translating in phase 1, as described, the excerpts were read repeatedly to identify potential codes and themes. Following the process of manual coding (Creswell, 2014a, p. 270), when a code or a theme was identified, the code was hand written on the left side of the excerpts and the themes were written on the right side of the excerpts, as depicted in Figure 3.2. In the manual coding method, the process of generating the themes can be performed directly after the process of generating codes on the same interview excerpt. In this case, phase 2 (generating the initial code) and phase 3 (searching for the themes) were done simultaneously (Creswell, 2014a). As a result, 132 initial inductive codes and 20 initial themes were derived from the excerpts.

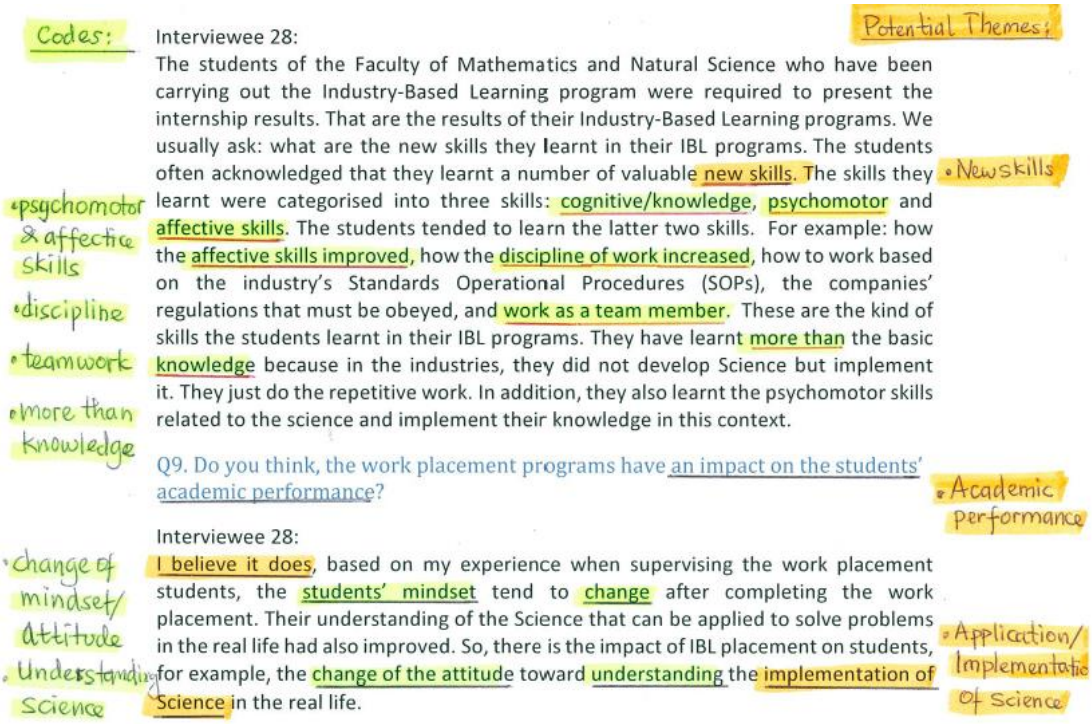

Figure 3.2 An example of manual coding of codes and potential themes

Using NVivo version 11 software, some initial codes were generated directly from the literature and the theoretical framework prior to the data analysis (prior data codes). Codes were subsequently evaluated, elaborated into another code, deleted or changed to be more focused and concise. The process of coding followed an 'iterative and reflective process' (Urquhart, 2013, p. 89), which involves examining the codes and questioning their meaning and relationship.

The codes and themes were often changed or elaborated into a bigger theme (Creswell, 2014a). The initial prior data codes generated with NVivo software are depicted in Figure 3.3. Similar codes were later aggregated together to form major ideas (themes) in the database, forming a core element in the qualitative data analysis (Creswell, 2014a). How the themes were formed from the codes is discussed in the following section.

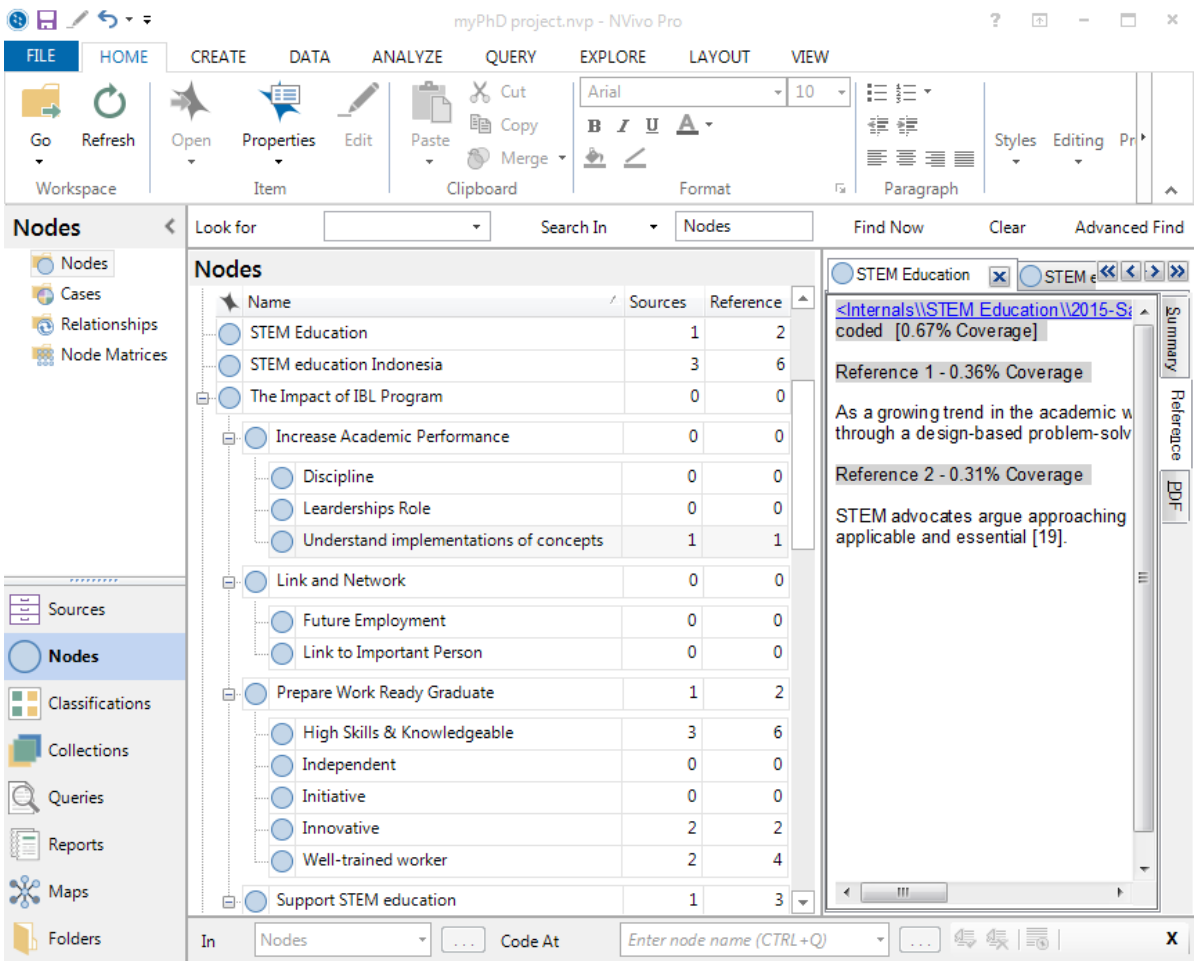

Figure 3.3 Generating codes with NVivo assisted software

Phase 3. Searching for the Themes

The process of generating codes and themes is inductive. It involves repetition to sharpen and to narrow the codes into themes, to examine and evaluate the codes and themes for overlapping and redundancy, and sometimes involves carefully selecting the specific data and excluding other data that is not relevant to the themes of the research question (Creswell, 2014a). Generating the themes from the codes is an active process, whereby careful examination of the codes to collate them into the themes creates potential patterns (Braun & Clarke, 2013).

The themes can be classified into major and minor themes. Major themes represent major ideas, and minor themes represent secondary ideas in the collected

data. For example, the major theme in this study is “IBL impact,” whereas the minor themes include “academic performance,” “self-discipline,” or “work-ready graduate.” To illustrate the coding process in qualitative research, Creswell (2014a) created a visual model, as depicted in Figure 3.4

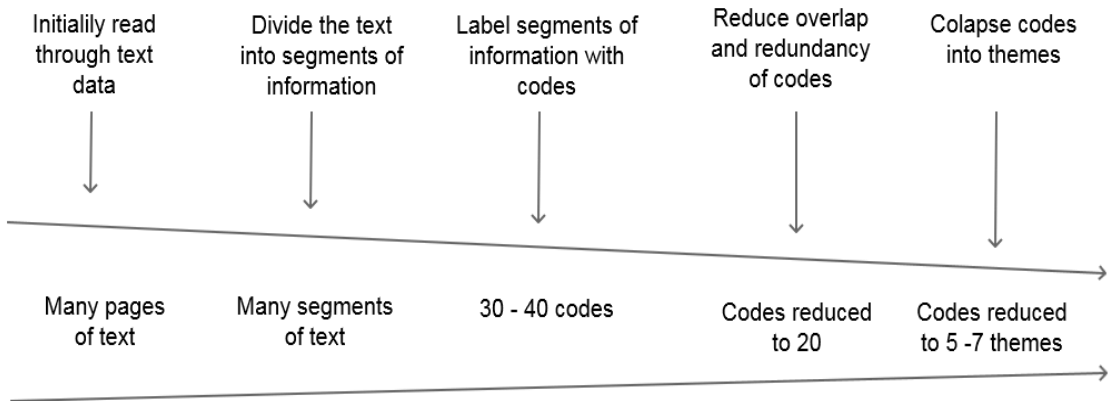

Figure 3.4 A visual model of the coding process (Creswell, 2014a, p. 268).

The present study combines the technique of manual coding with computer assisted coding, as discussed in phase 2. In addition, this study follows the steps to generate themes, as suggested by Creswell in Figure 3.4. At the end of the process, 12 potential themes were successfully derived from the collection of codes. Then these potential themes were evaluated for redundancy and overlapping. After this process, the themes were collapsed into seven major themes: “IBL purposes,” “increase academic performance,” “IBL assessments,” “prepare work-ready graduates,” “create links and networks,” “future employment,” and “support STEM education.”

Phase 4. Reviewing the Themes

In this phase, all the themes that were created from manual coding and Nvivo-assisted coding were re-reviewed. This process is to remove redundancy and to find overlapping themes. Certain overlapping themes were combined to form a bigger theme. For example, the “increase academic performance” and “IBL assessment” themes were combined into “increase academic performance.” Additionally, “create

links and networks," and "future employment" themes were combined into "create links and networks" theme. Thus, the themes were further collapsed into five major themes: "IBL purposes," "increase academic performance," "prepare work-ready graduates," "create links and networks," and "support STEM education."

Phase 5. Defining and Naming the Themes

After phase 4, the next step was to define and further refine the themes that would be used for the analysis (Braun & Clarke, 2006). The process of defining and refining the themes is to identify the core of the themes, that is, what each theme is about, and "what aspect of the data each theme captures" (Braun & Clarke, 2006, p. 92).

In defining the final themes, it was important that the themes were not too diverse and complex but still were able to tell the story about the data in relation to the research questions under investigation. It is important to ensure that each theme was not overlapping too much with each other (Braun & Clarke, 2006).

For this reason, the five themes were refined and renamed as: "IBL purposes," "academic performance," "work-ready graduates," "links and networks," and "STEM education." In this final analysis, the five final themes were defined from the total of 20 major, significant codes. The "IBL purposes" theme was derived from four major, significant codes; the "academic performance" theme was derived from five major, significant codes; the "work-ready graduates" theme was derived from five major, significant codes; the "links and networks" theme was derived from three major, significant codes; and the "STEM education" theme was derived from three major, significant codes. To illustrate these five major themes together with their 20 major, significant codes, a thematic map was created (Figure 3.5).

These five major themes represent the key findings of the present study. In the figure, the blue theme is linked to academic performance, which helps strengthen students' understanding of discipline knowledge. The green theme is linked to professional practice, which helps prepare students for the employment world. The

core knowledge and skills derived from these two themes can help science or engineering students to be better scientists or engineers and become professionally competent graduates.

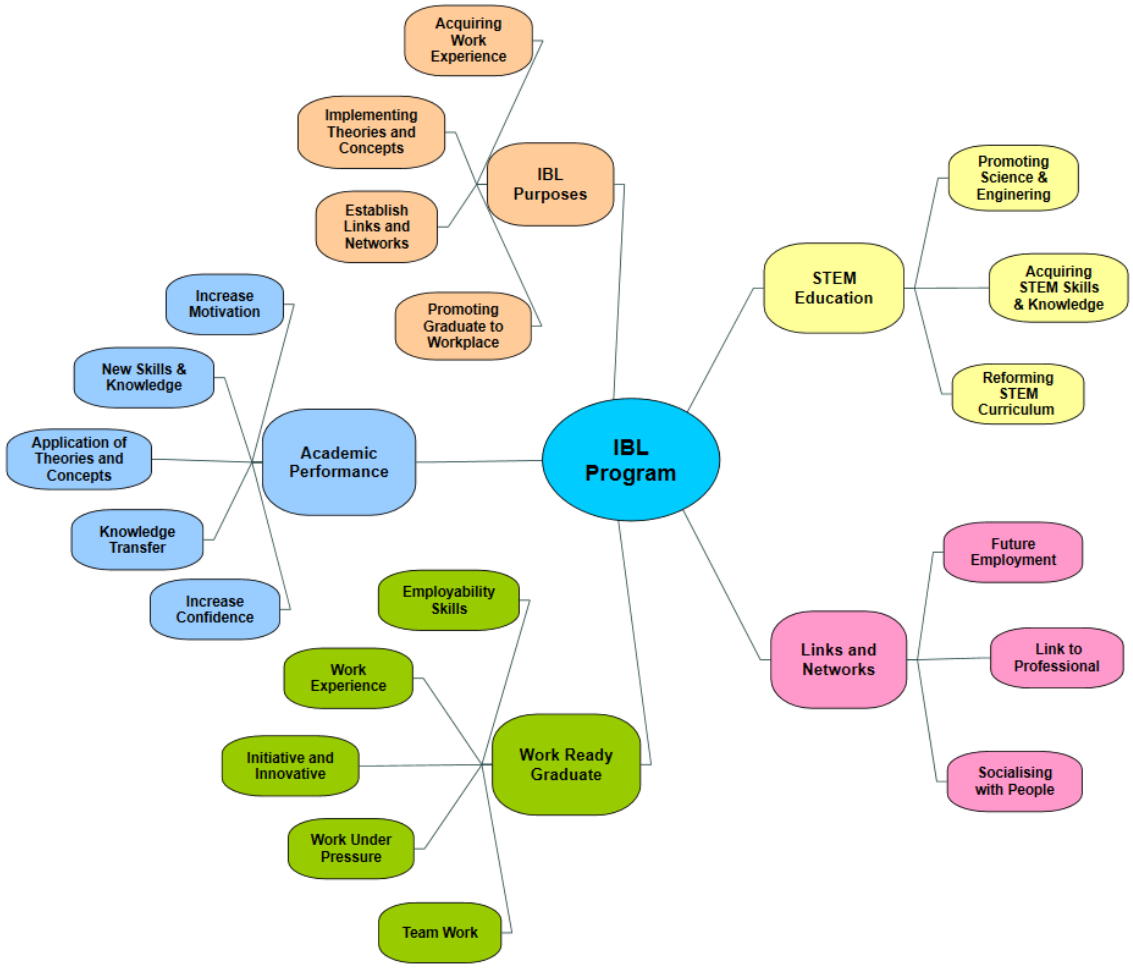

Figure 3.5 A thematic map showing the five major themes along with their major codes.

During the six phases of thematic analysis, there were 132 initial inductive codes and 20 themes generated in phase 2. The inductive codes and themes were elaborated or combined into bigger themes within the next thematic analysis phases (phase 3 to 5). The final inductive codes and themes in the final analysis phase (phase 5) yielded 20 inductive codes and 5 major themes Table 3.4.

Table 3.4. The number of codes and themes generated during the data analysis process

Phase	Inductive Codes	Themes
Phase 2	132	20
Phase 3	52	12
Phase 4	26	7
Phase 5	20	5

Phase 6. Producing the Report

The final phase of a thematic analysis process is to produce a final report. A final report is presented either as a dissertation or a paper, and is a very important part of qualitative research. The main purpose of the report was to represent the findings of the research. A good qualitative research report will contribute to the development of new knowledge and/or enhance existing theory within its study discipline. This study's report is presented as a narrative discussion in the form of a doctoral dissertation. "A narrative discussion is a written passage in a qualitative study in which authors summarise, in detail, the findings from their data analysis" (Creswell, 2014a, p. 278). The narrative discussion is a primary form for representing and reporting findings in qualitative research (Creswell, 2014a).

3.3.5 Validity and Reliability

Validity is an important aspect of qualitative research, because it shows the strengths of such research. Validation verifies whether the findings are accurate from the viewpoint of the researcher, the participant, or the reader of the account (Creswell & Miller, 2000). The reliability of qualitative research can also be observed when the researcher's approach is consistent across different projects (U Flick & Gibbs, 2007).

Use of the term validity in qualitative research may not carry a similar meaning as the use of the term in quantitative research (Creswell, 2014b):

> Validity does not carry the same connotations in qualitative research as it does in quantitative research; nor is it a companion of reliability (examining stability) or generalizability (the external validity of applying results to a new setting, people, or samples) (Creswell, 2014b, p. 201).

To enhance the researcher's ability to assess the accuracy of findings, as well as to convince readers of that accuracy, Creswell (2014b) suggests the use of multiple "validity strategies" (p. 201) such as triangulating different data sources, clarifying the bias, and using external editors to review the entire project.

Triangulation has also been recommenced by Patton (1990) and (Yin, 2003) at various research activities or stages. Triangulation includes: data source (data triangulation); different evaluators (investigator triangulation); different perspectives (theory triangulation); and different methods (methodological triangulation).

To establish the validity and reliability of the evidence while extracting the maximum benefit from the sources (interviews and document analysis), the present study implemented multiple validity strategies, as suggested by Creswell (2014a, 2014b) and Yin (2003, 2014).

The multiple validity strategies were implemented from the beginning of the research study to the end and at various stages of the study. These validity strategies are listed below.

1. Creating an Interview Protocol before the Data Collection Stage.

An interview protocol is a framework which serves as a guideline for the interviews to focus on the topic. In this study, an interview protocol was created and revised before the interviews were conducted. An example of the interview protocol used in this study is presented in Appendix A.

The main purpose of an interview protocol is to optimise the information gathering process during the interview. A protocol has explanations and instructions regarding the interview process, the approximate duration of the interview, a space to

record the credentials of the interviewees, and examples of the interview questions (Creswell, 2014a).

An interview protocol is important to ensure the dependability of the research. Dependability means that a comparable or almost comparable result will be obtained if a researcher replicates the study under similar setup and conditions, while following a well-documented interview protocol (Yin, 2014).

2. Using Audio Recorded Interviews at the Data Collection Stage.

In this study, the interviews were audio recorded to ensure the validity and reliability of the data. By this process, the researcher reduced the chance of errors in interpreting the interviews. Audio recorded interviews provide solid evidence for building the arguments that defend the results and findings of the research. Misinterpretation or overlooking of information from the interviews can occur; hence, the audio-recorded interviews and an interview protocol can ensure that these errors are avoided.

3. Member Checking of the Interview Excerpts

In the process of transcribing, it is possible that the transcriber made mistakes and wrote incorrect words or sentences in the interview script. The purpose of member checking is to cross-check the results or findings with the research participants; for example, whether the results or findings accurately represent the participants' opinions (Creswell, 2014a).

For this purpose, a member checking procedure has been implemented. Fifty percent of the research participants were invited to review the interview scripts and some of the findings related to their interviews. As expected, not all respondents reviewed the transcripts and findings. Nevertheless, more than 50% of respondents who were invited to participate in the member checking process responded to the invitation. The respondents who replied verified that the interview transcripts and findings were accurate representation of their views.

4. Using External Editors for Translation and Back Translation

Using external editors is one of the methods Creswell (2014a) suggests for validating the accuracy of the findings. Adopting this method, two independent professional translators were hired to perform translation and back-translation. The first translator translated the excerpts from Indonesian to English and the second translated the excerpts back from English to Indonesian. Comparison of the Indonesian translation scripts with the original Indonesian scripts verified that 90% of the translations were accurate.

5. Triangulating the Findings at Data Analysis Stage

Triangulation is useful to address a broader array of issues and was considered to have a better quality of data as the finding can be more convincing and accurate as it is based on several sources of information (Uwe Flick, 2015; Yin, 2014). Triangulation of the findings was conducted by examining evidence from both the sources and findings.

In the current study, triangulation was conducted utilising two sources of data: interview data and relevant IBL documents form UWI. For example, a triangulation process was implemented in searching for information on a preferred duration and time for undertaking an IBL placement at UWI. The duration of an IBL placement documented in D3 document (Table 3.3) is between 1-2 months and students were advised to undertake the program during a long semester holiday. This is to avoid a heavy academic workload for students during an active semester.

Upon interviews with UWI students, many of them confirmed that the preferred IBL duration is between 1 and 2 months. They also in agreement with the long holiday arrangement for undertaking a work placement and which would help them to concentrate on their study during an active semester. Therefore, the findings were supported by more than a single source of evidence, thus enhancing the validity of the study (Creswell, 2014b).

6. Creating a Case Study Database

Creating a database is the second principle for ensuring the validity and reliability of the data. A database organises and documents the data collected from multiple sources. There were four components of the case study database: notes, documents, tabular materials and narratives. For researchers, notes can be the most common component of a database (Yin, 2003), and can be from interviews, document analysis and observations. They may also be in the form of handwritten, typed and recorded information in electronic format. Most importantly, case study notes can be stored in a systematic way to enable efficient retrieval of information. In this study, a simple database consisting of relevant IBL documents from UWI, audio-recorded interview files, and relevant scientific publications, were created using NVivo software.

7. Maintaining a Chain of Evidence

Maintaining a chain of evidence allows the readers (as external observers) to follow the derivation of any evidence from initial research questions to conclusions. The chain of evidence will ensure that every single piece of evidence is well recorded and structured appropriately. By making citations to the relevant sections of the case study database, evidence was appropriately recorded in this study. The database reveals the actual evidence and indicates the circumstances under which the evidence was collected.

3.4 Ethical Considerations

This research was considered as a low risk research study, as it did not involve any physical or biological testing of humans or animals. The study was classified as Science - Education research, in which the data collection method is through interview and document analysis. However, according to Merriam (1998), every type of research is bound to have risks that arise from the researcher-participant relationship, whether from the stage of data collection or when findings are disseminated.

Therefore, upon the successful completion of the confirmation of candidature milestone, a low risk human ethical clearance was given by the QUT Research Ethics Committee. QUT's ethics approval number, 1500000732, was granted on 17 December 2015 (Appendix B).

Following ethics approval, correspondent emails and ethics documents were sent to the selected research sites for permission to interview the research participants, in order to gather the necessary documents for analysis and interpretation. Research participants were informed of their participation, consent, and privacy protection.

In addition to ethics approval, every participant was required to fill out the consent form, stating their agreement to participate in the research without intimidation from external parties. Further, to conceal the participants' and institution's identity and to satisfy the QUT ethics requirement, anonymised data and pseudonyms were used in reporting individuals and the institution.

Chapter 4 Results and Findings

4.1 Overview

The results and findings presented in this chapter are the outcomes of the thematic and systematic data analyses presented in Chapter 3. This chapter presents and analyses the findings from the data in four sections, to address the three research questions introduced in Chapter 1.

Section 4.2 discusses the rationale behind the establishment of industry-based learning (IBL) programs in Indonesian higher education (HE) from the perspective of three groups of respondents — HE students, academics who had been involved in such programs, and the students' industry supervisors. The outcomes and findings presented in this section address the first research question: "Why do Indonesian universities establish industry-based learning programs?"

Sections 4.3 and 4.4 examine the impact of IBL programs on Indonesian STEM undergraduate students at the University of Western Indonesia (UWI). The results and findings described in these two sections address the second research question: "What are the impacts of industry-based learning on Indonesian university students, especially on their academic performance?"

The discussion of the results and findings in relation to the second research question focuses on two aspects. First, IBL impacts on the students' academic performance, and the second, the impacts of IBL on students' soft skills, work experience, links and networks. The results and findings describe the immediate impact of the IBL programs when students returned to university study (Section 4.3) and the long-term and broader impacts of IBL on students after their graduation from the university (Section 4.4).

Section 4.5 analyses and evaluates the relationships between IBL programs and the development of STEM education, to address the third and the last research

question of this study: “How does industry-based learning support STEM education in Indonesia?” This section establishes that IBL programs support the development of STEM education in Indonesia.

4.2 The Purpose for Establishing IBL Programs

The first research question asks “Why do Indonesian universities establish industry-based learning programs?” Based on the participants’ responses in this study, there were initially six major reasons why the UWI established an IBL program at their institution. From the data, these six codes were created: ‘acquiring work experience’; ‘implementing theories and concepts’; ‘establishing links and networks’; ‘promoting graduates to the workplace’; ‘seeking new skills and knowledge’; and ‘promoting science or STEM.’

As the analysis continues to data concerning phase 3 and 4 of the program, the number of codes and themes were reduced. A number of related or overlapping codes were collated and aggregated to avoid redundancy. For example, ‘seeking new skills and knowledge,’ and ‘promoting science or STEM,’ codes were eliminated in phase 3 due to overlap with other similar codes from other topics. The findings regarding Indonesian HEIs’ purposes in establishing IBL programs at UWI are summarised in Figure 4.1.

As shown in Figure 4.1, the majority of respondents (students, academics, and industrial staff) perceived that the main purpose of IBL is to prepare Indonesian university undergraduate students to gain work experience (45% of 40 respondents). The second purpose is to implement the theory and concepts learnt at the university (40% of respondents); the third purpose is to establish links and professional networks with industry (8% of respondents); and the last reason is to introduce and promote UWI prospective graduates to the industrial sector for work (7% of respondents). The last two were considered as of less value than the first two purposes. The expectation that industries will recognise that UWI has qualified graduates in particular areas suitable for employment by the companies was a viewpoint predominantly shared by

respondents of an academic background. The following sections will elaborate on the four main purposes for establishing an IBL program at UWI, as depicted in Figure 4.1.

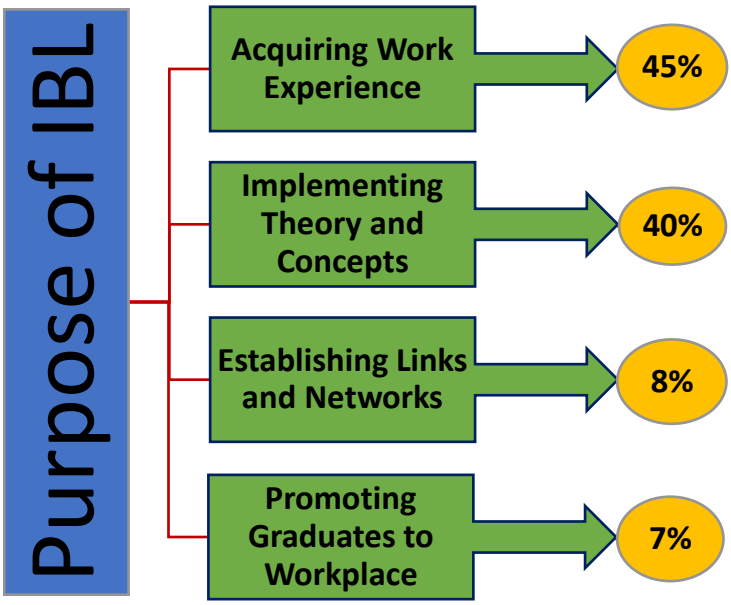

Figure 4.1 The participant's viewpoints on the purpose of IBL programs

4.2.1 Acquiring Work Experience

One of the main reasons for the establishment of an IBL program at UWI is to introduce prospective graduates to the workplace and gain some valuable experience from industrial experts during work placements. This view was expressed by 45% of the 40 participants. Most students and their supervisors in work placements perceived that work experience is one of the most important components to prepare work ready graduates, as exemplified by the following quotation:

> Meanwhile, we are preparing for the students to be ready for the workplace, either (working) for the community or within the industry. This means that if they have a chance to be involved in the IBL program, it will certainly enrich their experience and also their understanding (of working within the industry), not only about the job, but also about the relevant knowledge. (Interviewee 04: academic staff member)

This opinion illustrates that one of the main purposes of IBL at UWI is to prepare students for work after completion of the study. This respondent commented that IBL would "certainly enrich" the students' experience and insight into real workplace environments. It is interesting to note that the respondent also highlighted that the work placement would also enhance the students' knowledge.

4.2.2 Implementing Theories and Concepts

The second most important reason for the implementation of IBL from the respondents' viewpoint is that IBL programs serve as the medium to implement theoretical academic knowledge learnt in the university classrooms. A majority of respondents (40%) believed that the students had acquired fundamental skills and knowledge in their discipline after two or three years of university study. Even though most programs in Science, Technology, Engineering, and Mathematics (STEM) disciplines offer subjects with practical or clinical components through campus workshops or university laboratories, the scale of the practical work was considered small when compared to real work experience in the industry. The following quotation illustrates that the work placement students wanted to put the knowledge they had acquired in the classroom into practice during their placement:

> I want to implement the knowledge that I learnt from the classrooms, and I hope from this work placement, I will acquire some (new) knowledge, create a network and links to professionals. (Interviewee 14: university student)

It is psychologically important for students to experience that they can apply the knowledge and skills learnt in the university in useful and beneficial ways in the real world through their work placement,

> What I understand from my work placement more or less is how to implement the knowledge that we learnt at campus in the work place, and I have acquired some work experience. (Interviewee 16: university student)

The academic staff involved wanted to collaborate in making this experience possible. As one academic staff member put it:

> Thus knowledge of and insight into the industry is important, to understand that what is learnt in the classrooms is very useful for work in industry, especially modern companies, since these companies run their business based on (the development of) knowledge and technology. (Interviewee 04: academic staff member)

The above quotations from both students and academic staff demonstrate that the implementation of knowledge and skills learnt from the university classroom in the industrial work place is one of the main purposes of the IBL program at UWI.

4.2.3 Establishing Links and Network

Securing a well-paid job after graduation is an objective for most university graduates. IBL placements provide opportunities for students to demonstrate their work readiness. Work placements also provide an opportunity to socialise and create links with professionals and leaders of business and industry. Thus it would follow that one of the purposes for the establishment of IBL program at Indonesian HEIs is to create links and networks with professionals.

However, few respondents (less than 10%) mentioned the importance of creating good networks and links as the main purpose for establishing the IBL programs. Some did identify that establishing links and networks with professionals and leaders was one of the purposes for establishing the IBL programs at the Indonesian universities:

> I hope this program will enhance my knowledge and will be useful for my future or for the next semester in relation to other subjects. (During the work placement) I established a network and links with (the people in) the companies, [believing that] if we did well, we would have opportunities to be recruited to work there. (Interviewee 07: university student)

> First, I wanted to apply my knowledge in the work placement, then I had the desire, if I did well in my work placement, to be employed at that place. Since I am in the IT (Information Technology) area, I wanted the benefits of [mixing with] IT professionals in the workplace. (Interviewee 06: university student)

These two quotations suggest that the IBL placement program provided students with opportunities to establish links and networks with people in the workplace, and that they expected that this would benefit them in future employment prospects.

4.2.4 Promoting Graduates to the Workplace

According to a number of academics interviewed, the IBL program could be used to promote UWI graduates. This opinion is illustrated in the following quotation:

> In my opinion, this IBL program is one effort from the university to introduce students to the employment world. This program also serves as an advertisement to potential employers that we have graduates who possess certain skills and knowledge that may be needed by them. (Interviewee 02, academic staff member)

Although this opinion was not overtly expressed in interviews by the majority of respondents (less than 10%), it indicates that one of the underlying purposes of IBL is to promote UWI students to prospective employers. This task is assigned to university staff and forms part of the responsibility of the university. During the IBL programs, the employers were expected to assess the UWI prospective graduates' skills and knowledge, and had the opportunity to employ them as soon as they graduated from the university.

To conclude, from participants' responses, the main purpose of establishing the IBL program at UWI was to give an opportunity to UWI prospective graduates to gain some work experience. The second most important purpose was to implement the knowledge and theories learnt at the university and put these into practice in the workplace. Lastly, another purpose of IBL was to establish links and professional networks and to promote UWI graduates to the employment world.

4.3 Impact of IBL on Students' Academic Performance

As mentioned in Chapter 1, the present study differentiates the term 'academic performance' from 'academic achievement' which is commonly measured by academic scores or grades (Astin, 2012; Haertel, 2013).

Academic performance, in this study, is defined as the ability to apply *theoretical academic knowledge* and *soft skills* properly according to the context; this is regarded as students' *professional competence*. Thus academic performance is more than just scores or Grade point averages (GPAs) in university subjects. It refers to any factors that affect student success at university (Rasberry et al., 2011).

The discussion in this section focuses on the impact of the UWI IBL program on the academic performance (professional competence) of STEM students as future engineers or scientists, rather than on their academic achievement.

The second research question asks "What are the impacts of industry-based learning on Indonesian university students, particularly on their academic performance?"

To answer this research question, a relevant question was prepared in the interview protocol to elicit respondents' perceptions. There were mixed responses from the research participants. Some thought that IBL plays an important role in improving students' academic performance, while others saw no evidence that the IBL program has resulted in an improvement in their performance. The majority of respondents, however, perceived that the IBL program had a significant positive impact on students' academic performance after the completion of the placement program.

This is evident in the interviews where a majority of research participants responded positively to the question on this topic. Among the respondents, 78% (31 out of 40 respondents) stated that the IBL program had a positive academic impact on students. The remaining 22% (9 respondents) responded that there was no observable impact on academic performance or that the impact was very difficult to measure.

The positive impact of IBL on academic performance was reported to include increased study motivation, acquisition of new knowledge, increased discipline, being able to work as a team, and increased general academic ability (as depicted in Figure 4.2).

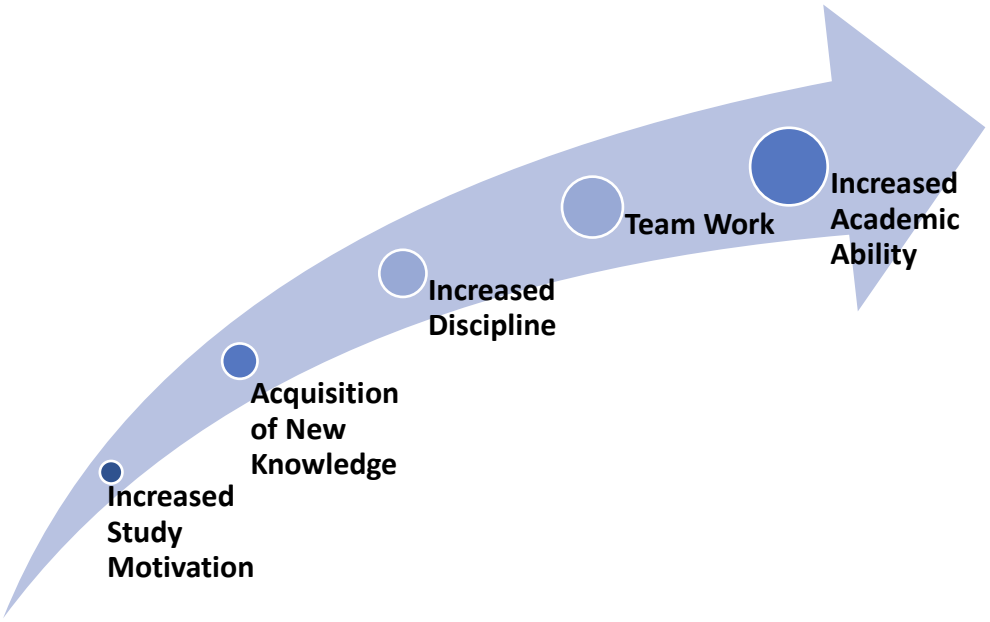

Figure 4.2 The impact of IBL on academic performance

From the interviews with all three groups of stakeholders (students, academics and industrial staff), the majority of stakeholders perceived that there was a significant positive impact of the IBL program on students' academic performance.

A student participant described that the learning of new knowledge while in the IBL program increased their academic performance. They suggested that by knowing and experiencing the real workplace situation, they acquired an understanding of what skills they needed to be well prepared for certain conditions and challenges in the workplace. They commented that they became more proactive and productive in their study at university:

> Perhaps from the academic perspective, there must be an increase (in academic performance). Since we already knew how things are done at the workplace, we will study hard and understand how to work under pressure.

> Thus, we become more proactive and productive (at university) after the work placement. (Interviewee 21: university student)

In a similar vein, an academic staff member suggested that they could assess whether students had learned something from their work placements by examining the student's IBL reports and seminar presentations:

> We can observe the increase in academic performance through the students' IBL report. Each report is presented in a seminar. Thus, we can assess whether a student has really learned something from their IBL placement. If they learn a lot, they will get a good mark for their IBL placement. Conversely, if they do not learn anything, they will not get a good mark for their IBL placement. (Interviewee 02, academic staff member)

Other academics assessed the increase of academic performance when students completed their final projects, as illustrated by this quotation:

> We used the final project as an indicator to assess the students returning from the work placement. During the student's final project, we could see that what they had learnt during the placement would be applied to complete the final project at the highest standard, and they did indeed graduate with a very good grade. (Interviewee 29: academic staff member)

One participant said that some students were using work placement as a stepping-stone for a major project, such as conducting research for their final research project:

> Some of my friends continued their research topics at work placement for their final research project. (Interviewee 21: university student)

However, some academics stated that it is not easy to measure the increase in academic performance after the students return to university. This is because a majority of the students conduct their IBL placements in their final study year when there are no more subjects to be completed. Therefore, measuring the increase in academic performance in the form of GPA, for example, is difficult as there are no further subjects after the IBL that can be used for comparison. The increase in skills

after students return from an IBL placement, however, may be observed when students work in university laboratories:

> To exactly measure academic performance after an IBL placement is a bit difficult. Because here, it is a common practice that the IBL program takes place in the students' final year of study. However, we can observe the (increasing) skills when they are working in a laboratory. When they help new students with their tasks in the laboratory, their skills are demonstrated. (Interviewee 01: academic staff member)

In summary, the majority of respondents perceived that the IBL program had a significant positive impact on the students' academic performance. This impact included increased motivation to study, acquisition of new knowledge through work placement, increased discipline-specific knowledge, increased teamwork skills and increased academic skills.

4.4 Impacts of IBL on the Increase of Students' Soft Skills, Work Experience, Links and Networks

During their work placement and in their affiliation with industry partners, the UWI students received tuition and learned technical industrial skills, knowledge and work experience that were not taught at university. These technical skills, knowledge, and work experience gathered during IBL placement would add to the skills required to satisfy the demands and requirement of the employers.

This section discusses the answer to the second research question "What are the impacts of industry-based learning on Indonesian University students?" with a focus on the increase in students' soft skills, work experience and links and networks.

IBL students may learn a range of new skills including communication skills (Koppi et al., 2010), negotiation skills, management and leadership skills (Lee, 2008), working as a team player, industry regulation and rules, industry best practice, working to strict deadlines to achieve targets and deliverability, and time and stress management (Santosa & Kusumawardani, 2010).

From the data analysis, it was found that there were many themes in the impacts of the IBL placement that increased students' academic performance. For clarity of discussion, the impacts that were almost similar were collated into a general theme, to simplify and avoid redundancy, as suggested in the literature (Braun & Clarke, 2006, 2013; Creswell, 2014a; Richards, 2014).

The codes capturing the impacts of IBL in addition to academic performance were collated into three groups, namely: the impact of IBL on skills and knowledge, the impact of IBL on work experience, and the impact of IBL in creating links and networks with professionals. These, along with the academic impacts are summarised in Figure 4.3.

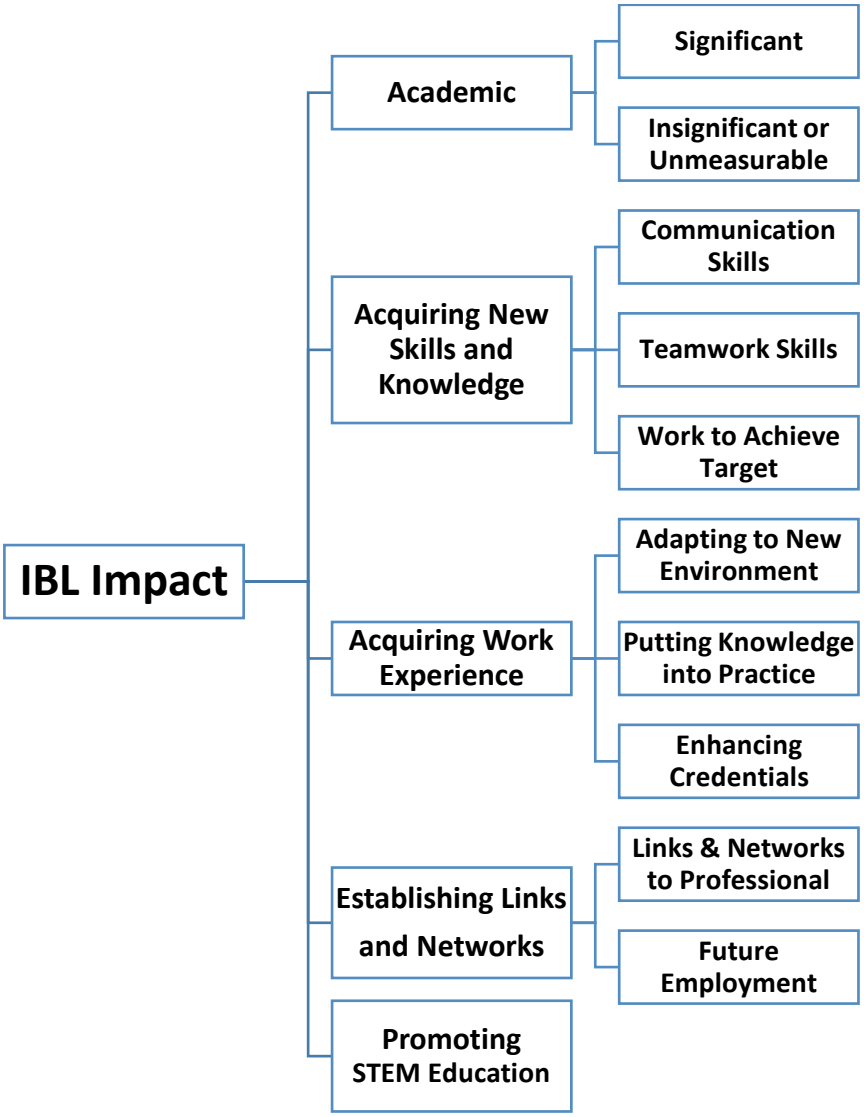

Figure 4.3 Various impacts of IBL program on Indonesian undergraduate students based on respondents' perceptions

4.4.1 Acquiring New Skills and Knowledge

For UWI undergraduate students, one major impact of the IBL placement is that the students acquired a range of new skills and knowledge. There were various skills and knowledge that could be learned by IBL students during their work placement program. In this section, the discussion focuses on three main skills that are collated as three major and significant codes. These are communication skills, working

as a team, and working under pressure. These are articulated into a single theme, "New Skills and Knowledge."

Communication Skills

Most respondents who participated in the study (60%) specified that communication skills are the most important social skills the students learn during their work placements. The following two excerpts from a student and a staff member exemplify this finding.

> How to communicate effectively, for example how to explain IT (problems) to people who do not understand IT; that is, how to explain it with the simplest language that will be easy to understand. (Interviewee 05: university student)

> First, they (students) have to understand how to communicate with employees at the work placement. Then, they need to assess their own skills, what they can do and learn from there. (Interviewee 01: academic staff member)

The above excerpts demonstrate the importance of communication skills in order to be successful in an IBL placement. Students were required to develop these skills during their work placements, in the expectation that the skills would become an asset for life, and that the work placement students who were able to master these skills would gain great benefits from their work placement. This is linked to the pedagogical concept of peer tutoring, whereby in explaining a problem to another, one can develop deeper insight into the problem in hand. Students required to clearly articulate engineering or technology issues are encouraged to be more reflective.

Teamwork Skills

Teamwork is another important skill that students learnt during the work placement. During the IBL program, students were often involved in important projects and often have to work in a team. In this scenario, the students' teamwork

skills were developed as the stakes to work in real teamwork projects are much higher than in the classroom setting, as is reflected in two quotations from a student and a staff member:

> Hmmm… I think this program (IBL) had a very good impact. This good because from the work placement, we can learn and understand what the environment at the workplace is. The professor never taught us about the real workplace environment (at the university). In this program we can learn how to work with people we've never worked with. In order to socialise (with these people), teamwork skills are very important. (Interviewee 24, university student)

> Yes, they need to know what the working environment is at the company they are working in. Thus, they do not just rely on the knowledge they learnt at university, but teamwork is very important. Even though they have (academic) ability, if they cannot work in a team that is a disadvantage. (Interviewee 30, academic staff member)

The above quotations represent the viewpoints of the research participants on the importance of teamwork skills during work placement. The students learnt this skill from day one, in working in activities with their colleagues or supervisors. This is one of a number of important skills needed by undergraduate students to succeed in the employment world when they graduate.

Work to Achieve Targets

A research participant who studied Information Management reported that they had learnt how to set-up (work) targets and how to achieve those targets during their work placement. This skill was repeatedly performed during the work placement and became a habit after the student returned to university life. The student explained in their interview that the IBL placement was a significant milestone for them, as indicated in the following excerpt:

> (The placement is) significant, because during the placement we learnt through a system. We need to make a target, for example within a month or

less we needed to complete a computer program. This (habit) was continued even after we returned to the campus. (Interviewee 05: university student)

A number of respondents stated that the industrial working environment was quite different to the academic environment at university. Compared to the university environment, the work at companies was governed by a set of strict guidelines and procedures that needed to be followed.

In addition to this, industrial missions and goals are focused on running the business and gaining profits. This was observed by students to be vastly different to university missions and goals, which are to provide education and learning experiences. Students could see this factor as a pressure while working in industry. By undertaking work placement, students were required to adapt to the industrial, time pressured working environment and to deliver work targets. This is an invaluable skill that student can acquire during their IBL placements.

4.4.2 Acquiring Work Experience

Students during their work placement benefit from working with experts in their related disciplines. This experience may not be accessible from the university classroom. However, before they can harvest the benefits of industry-based learning, student had to be able to adapt to the new working environment, that is very different to the university setting. The following section describes three important aspects of the IBL placement for the students in their industrial work experience. The theme of "work experience" includes three major and significant codes: adapting to a new environment, putting knowledge into practice, and enhancing students' credentials.

Adapting to a New Environment

The industrial environment and surroundings are very different to the university environment. Many factors of the industrial world differ from the academic setting. For example, the missions and goals of industrial companies include business oriented functions such as selling products or services, and employees are instructed to work towards achieving these goals. In turn, students who conduct their IBL

placement in a business-oriented company need to be able to adapt quickly and adjust their goals to the company's mission and goals.

In the process of learning industrial work ethics and approaches, the students were required to learn how to behave and socialise with the company's leaders and work colleagues in their work placements. Two IBL supervisors, one from industry and another from the university, shared this perception:

> The first thing (students encounter) is the social experience. Because in there (at work placement), it will be apparent whether the students are able to socialise or not with the different types of persons in the workplace. (Interviewee 27: industry employee)

> Thus, for the graduates who have never had experience working in industry, they may be a little bit shocked due to their lack of experience and insights about the industry (environment). (Interviewee 04: academic staff member)

From a supervisor's viewpoint, the IBL students will have acquired useful learning experiences when they complete a work placement in a technology-based industry because they can compare their knowledge gained at university with the IBL program. Students can then determine whether what they have learnt in the classroom will have real implementations in the industry. This perspective was shared by an academic staff member and an IBL supervisor, and is expressed below by the academic:

> I think the work placement program is very important because even though the students had learnt a lot at the university, the industrial world is different to the university classroom. … Thus, the knowledge and insights of the industrial practice are important in order to understand that classroom learning is very useful for work in the industry. Especially in modern companies, since these companies run their business based on (the implementation of) knowledge and technology. (Interviewee 04: academic staff member)

At the beginning of the IBL placement, the first learning experience encountered by students is to know how the company or industry operates. This includes understanding the industry work ethics and operating hours:

> We also learnt about the workplace environment at this public health clinic (PUSKESMAS[8]), what the working hours and the time allocation were, and how the clinic ran. (Interviewee 05: university student)

Putting Knowledge into Practice

In their third year at university, the majority of UWI students have gained knowledge and skills in their respective disciplines. However, this knowledge is not put into practice until they are involved in an IBL program. Students may possess knowledge in the form of theories and concepts, but most of them lack experience in implementing their knowledge in the real world. Although some of the students may engage in practical experimentation in university laboratories, they are rarely involved in large scale industrial projects during their first or second year of study. IBL placement offers them a good opportunity to put their knowledge into practice. The majority of research participants shared this perspective, as exemplified in the following quotations:

> For example, if a student already knew the (theories and) concepts of the electromagnetic fields, then when he did a work placement he would learn how these (theories and concepts) apply in real world applications. If he did not take a work placement, he would never know how the theory (of electromagnetism) is applied in a real work situation. (Interviewee 34: industrial employee, and an IBL supervisor)

> My first learning experience was to learn a new programming language there (at work-placement). There is a programming language called VBA (Visual Basic for Application) that I had never learnt before. However, since we had

[8] District's Health Clinic funded by Indonesian government

> learnt the concept of programming, I could apply (the concepts) into learning a new programming language. (Interviewee 05: university student)
>
> The benefit is that the students can experience for themselves that what they learnt in the classroom has real applications in industry, not only from an imaginative perpective. For example in my discipline, the students can see a real distillation tower. The students may imagine that a distillation tower is very high but cannot be sure how high each one is. When they are at the work placement, they can see for themselves how it looks. (Interviewee 12, academic staff member)

The above quotations illustrated the view shared among the research participants that the IBL placement opportunity can be used to practice or unpack the knowledge students have learnt in the university environment. In the process of practising or putting the knowledge into practice, students may learn something new.

Enhancing Students' Credentials

It is well documented that work placement can offer multiple benefits for university students. Besides the invaluable learning experience, another main benefit of work placement is to enrich the students' credentials. This is one of the most important factors sought after by prospective employers in selecting their prospective employees. This benefit is expressed by a university staff member thus:

> Meanwhile, we are preparing the students to be ready for the workplace either (by working) for the community or the industry. This means that if they have a chance to be involved in the IBL program, it will certainly enrich their experience and insights not only about the job but also about the knowledge. (Interviewee 04: academic staff member)

An industrial employee who had experience in supervising the IBL students hinted that students' acquisition of new skills and knowledge correlates positively with the duration of their stay in the industry; the longer the placement, the better for the students:

> Yes, very clear, in terms of the knowledge and techniques (skills) they (the students) get. The longer the work placement, the more knowledge and skills can be acquired (by students). The second important skill is the soft skills which are related to human interactions, (that is) how to interact with the variety of human characters within a community. (Interviewee 27: industrial employee, also an IBL supervisor)

From the students' perspective, work placement is a milestone to be listed in their curriculum vitae, to enhance their position in a competitive job market:

> Firstly, I can enrich my curriculum vitae (that will be useful) when I graduate. Secondly, I can get work experience even before I graduate (or start working). I can also understand the workplace environment at PERTAMINA[9] and (get) (important) information on how I can be accepted there. (Interviewee 21: university student)

4.4.3 Establishing Links and Networks for Future Employment

A large number of respondents across all three types of stakeholders see work placement as a bridge between the academic and industrial worlds. Work placement is as an opportunity to create a professional link or network with prospective employers soon after students' graduation.

> OK, in my opinion, this work placement program has a huge impact (on students). Not only on their academic achievement at the University but also after graduation. We can see that they gained new knowledge and (established) a trusted network after the placement. If they were good (in the placement), they will be hired either as a contracted employee or as a new (permanent) employee. (Interviewee 03: academic staff member)

> In my view, this IBL program serves as a bridge between the academic world and the industry. I mean that the students may learn the basics of theories but less about the industrial applications or concepts. Thus, an IBL program can be considered as a bridge or link (to the industrial world). Thus, when they

[9] The state owned oil and gas company in Indonesia

> graduate, students will not be too alienated from industrial practices. (Interview 33: industry employee, also an IBL supervisor)

A professional network consists of important industrial contacts including the leader of the organisation. The prospective employer is likely to be encountered in an IBL placement, and the students have the opportunity to meet many people related to their chosen industrial sector:

> Creating a link to information, or maybe a network. Thus, (the work placement) offers the opportunity to create a professional network because, during the placement, the student meets with many people. (Interviewee 34: industrial employee and IBL supervisor)

> Thank God, I received a lot of networking from the PERTAMINA district four Cilacap. I know the manager and still communicate with them. I also acquired a lot of new experience during my work placement that I would not get from the campus. (Interviewee 21: university student).

In an IBL placement, students may bring good technical skills and work experience from non-educational institutions where they have worked previously. During their industry attachment program, students have the opportunity to learn and understand the way companies are run, the industrial organisational culture, and other relevant knowledge. They also learn about the standards and expectations in the industrial sectors. This IBL opportunity provides "authentic experience" (R. Smith et al., 2008, p. 78) for students and will increase their understanding of the work ethics, standards, and expectations of the real world. This gives them a competitive edge to compete for jobs and excel in their future work (Lee, 2008).

In this study, both academic staff and students agreed that the IBL program has a significant impact on students' future employment prospects:

> The impact on further employment is not bad; why? Because with IBL placement, we have gained inside information and understand the tricks to applying for jobs at PERTAMINA or other companies where we did the IBL

> program. Secondly, we have also built a network (during IBL placement), thus when a vacancy becomes available at that place, we are like to be contacted first. Lastly, people will take into consideration (our IBL experience) when they read our curriculum vitae. (Interviewee 21: university student)

In relation to this, a response from a staff participant is interesting:

> Talking about opportunities, some students were not even allowed to leave (the company) and were directly offered jobs. Thus, job opportunities (after work placement) are very high. The number of students offered jobs directly after their placements were more than 50% but some of them considered that the company is not a big company, so they (the students) worked for only 1 to 6 months and then (they) looked for other companies. (Interviewee 01, University staff)

The above quotations demonstrate that during the work placements, students had an enormous opportunity to create a network and link to professionals in their related discipline. These networks and links will be very important after they graduate, and will open opportunities for future employment. Many of the IBL placement students were offered jobs even before they completed their studies. During the work placements, the prospective employers had the chance to assess the students' skills and knowledge and most importantly their work ethic. These qualities could be exhibited by students through standout performances during their work placement, leading to the companies recruiting them in the near future.

4.5 Promoting STEM Education Through IBL

The final research question asks "How does industry-based learning support STEM education in Indonesia?" By using the thematic analysis method explained in Section 3.3.4, the excerpts were manually and automatically (utilising the NVivo software) coded into major and minor codes, which were then evaluated and aggregated into themes relating to the third research question. The themes and their corresponding codes were reviewed to define the final themes. In this process,

redundant themes were collated into a bigger theme. The final coding process resulted in a final theme of "STEM education".

STEM education is intended to prepare university students with the knowledge and skills to fulfil professional roles in the workplace, particularly in scientific and technical roles (West, 2012). The graduates that possess "STEM core" knowledge such as "scientific method, STEM subject knowledge, foundational STEM knowledge and vocabulary" (West, 2012, p. 2), were sought after and valued highly by employers. Other important skills that were valued highly were research skills such as learning and enquiry, technical skills including observation and experimentation, and qualitative skills such as presentation (West, 2012).

Universities can prepare students to be more work ready graduates by facilitating the development of skills demanded by industrial employers through their curricula, learning and teaching processes and other relevant training. Through an industry-based learning program, the universities have a chance to promote their study programs to the industrial world and prospective employers. Thus, IBL can be used as a valuable tool for bridging the gap from study to work.

Students can also use the IBL opportunity to apply the knowledge and skills they learnt in the classroom in the workplace. During the placement, employers can assess the students' STEM core knowledge and skills in relation to the standard required by the company. Thus the firms or companies involved in the IBL program have an early opportunity to recruit the best employee to satisfy their requirements.

Based on a number of excerpts that were coded into the STEM education theme, 65% (26 out of 40) of respondents shared their perception that IBL placement plays an important role in promoting STEM education, particularly in promoting the Science disciplines, as exemplified in the following quotation:

> In my opinion with the IBL program, we can promote our study program (Science). Thus, they (the companies) know what kind of skills and expertise to expect from our graduates. In our study program for example, we have the Geographical Information Systems (GIS) discipline, database discipline and

> data mining. Hence, when we send students for work placement, the industrial partners or firms already know that we have expertise in those areas. (Interviewee 37: academic staff member)

This quotation highlights that one of the roles played by IBL placement is promoting the Science (and Engineering) study programs. The universities' Science and Engineering study programs are part of the STEM education chains at the tertiary education level. In this case, the IBL program promotes the STEM education to the industrial world and provides an opportunity to other prospective STEM students, who can see the benefit of the STEM study programs.

Another respondent shared their opinion that an IBL placement would promote the Science (STEM) field indirectly during the student's work placement, with many STEM discipline graduates working in the industrial sectors:

> Yes, but maybe not a direct impact... this (IBL) does not have a direct impact but will be more obvious when, for example, more Science graduates are accepted in the industries. This of course becomes a strong selling point or good advertisement for the Science study program to the public. (Interviewee 26, academic staff member)

This except shows another viewpoint on the relationship between an IBL placement and employment in terms of promoting STEM education. It is understandable that the popularity of a study program (of STEM discipline) or a field of study will increase if a high percentage of graduates from this study program is employed by reputable companies or recognised institutions. According to the respondents, this phenomenon is a good advertisement for this STEM study program. This is a long process, starting from the teaching and learning system at the university, followed by the students implementing their STEM knowledge and skills in the work placement, and culminating in recruitment by the employers when satisfied with the knowledge and skills of the students. Although the impact is not immediate, it can be understood that the IBL program plays a role in promoting the relevant STEM education program to the outside world.

The above two excerpts exemplify the role of IBL placements in promoting the STEM education program. From the interview data and analysis, the perception that IBL can promote STEM education was shared by 65% of research participants (26 out of 40). The remaining of respondents (35%) perceived that IBL has insignificant contributions in promoting STEM education at workplaces. This opposite opinion was not discarded but further evaluated and been taken into consideration as it could provide valuable information regarding the opposite opinions (rival explanation). This procedure would enhance the rigours of a case study (Yin, 2014).

4.6 Chapter Summary

This chapter has discussed the results and key findings of the present study, drawing on interview excerpts identified by thematic analysis which consolidated themes and codes. These findings have been analysed according to their relevance to the research questions. The relationship between the research questions and the key findings are summarised in Table 4.1.

Table 4.1. The summary of emerging results and key findings

Sections	Research Questions	Key Findings	Relevant Themes and Codes
Section 4.2 The Purpose of IBL	1. Why do Indonesian universities establish industry-based learning programs?	The University of Western Indonesia (UWI) established the IBL program to: - equip students with valuable work experience, - implement theories, - establish links and networks with professionals, and - introduce students to workplaces.	Theme: IBL Purposes Codes: acquiring work experience, implementing theories and concepts, establishing link and network, promoting graduates to workplace
Section 4.3 Impact of IBL on students' academic performance	2. What are the impacts of industry-based learning on Indonesian university students, particularly on their academic performance?	Direct impact of IBL on students' academic performance are as follows: - increased motivation for study - acquisition of new knowledge - increased discipline - increased team working ability - increased academic ability in general	Theme: academic performance codes: increase motivation, new skills and knowledge, application of theories and concepts, knowledge transfer, and increase confidence.
Section 4.4 Impact of IBL on the increase of students' soft skills, work experience, link and networks.		The impact of IBL on the increase of students' soft skills, work experience, link and networks: - acquiring new skills and knowledge such as communication, team work, and working to achieve targets. - acquiring valuable work experience such as ability to adapt to workplace environment, chances to implement knowledge and theories, enhancing students' credentials. - establishing links to professional networks for future employment opportunities.	Theme: work ready graduates' codes: employability skills, work experience, initiative and innovative, work under pressure, and teamwork. Theme: Links and networks Codes: future employment, link to professional, socialising with people
Section 4.5 IBL program to promote STEM education	3. How does industry-based learning support STEM education in Indonesia?	The IBL program supports STEM education by: - exposing the skills and expertise of IBL students to the industrial world or prospective employers. - increasing the number of STEM discipline graduates that are accepted by reputable companies.	Theme: STEM education Codes: promoting Science and Engineering, acquiring STEM skills and knowledge, reforming STEM curriculum

Table 4.1 synthesises the key findings and answers to the research questions, from the purpose for establishing IBL programs at Indonesian universities, the impact of such a program on university students academically and non-academically, to the relationship between the IBL program and STEM education development.

Chapter 5 Analysis and Discussion

5.1 Overview

This chapter relates the key findings of this study, as discussed in Chapter 4, to the findings of relevant research studies presented in Chapter 2. The discussion focuses on three main areas discussed in the literature and studied in detail in this research: the globally accepted purposes for the establishment of the IBL program (Section 5.2); how the IBL placements enhance the students' academic performance and employability skills (Section 5.3); and the relationships between the IBL program and STEM education development (Section 5.4). The final section (Section 5.5) concludes the discussion.

5.2 The Major Purposes for Establishing IBL programs

The literature identifies three common purposes for IBL programs at higher education institutions (HEIs). (1) To increase the employability of graduates (Daniel & Daniel, 2015; Gomez et al., 2004; Patrick et al., 2008); (2) To provide students with valuable work experience (Brooks, 2012; Tran & Soejatminah, 2016); and (3) To provide opportunities for students to establish links and networks with professionals that will be useful for them after graduation (Blicblau et al., 2014; Blicblau et al., 2016; Silva et al., 2016).

The purposes for establishing IBL programs at HEIs, however, are not limited to these common reasons. Other purposes are to allow students to implement the theories and concepts learned in the classroom in real workplaces (Orrell, 2011; Wandahl et al., 2011), and to provide students with different learning experiences (Duignan, 2002; Nagarajan & McAllister, 2015; Santosa & Kusumawardani, 2010).

The key findings from the interview excerpts quoted in Chapter 4 show that there were similar purposes for establishing IBL programs at the participating university. For example, a large percentage (45%) of the academic staff members and students who participated said that the main purpose for establishing IBL programs at UWI was to equip the students with some valuable work experience. This perception is in line with the second most common purpose for establishing IBL programs at Australian universities in the studies reviewed (Brooks, 2012; Tran & Soejatminah, 2016). Thus the viewpoints of the majority of the current research respondents confirmed the literature findings.

The other key findings of this study regarding the purposes for establishing IBL programs at UWI are to provide to the students with opportunities to establish links and networks to professionals, and to implement the theories and concepts learned at the tertiary institution in the workplace.

These findings were also reported in the literature. For example, researchers argue that WIL placement students are presented with an opportunity to create links and networks with professionals and business leaders (Blicblau et al., 2016; Silva et al., 2016). The students are also given a chance to implement the theories and concepts they learned in the classroom in the workplace (Orrell, 2011; Wandahl et al., 2011).

The findings concerning the purposes for establishing IBL programs at Indonesian HEIs reveal that there are some similarities between UWI and other universities in more developed countries. In the absence of a body of literature that specifically discusses the purposes for the establishment of IBL programs at Indonesian HEIs, this finding is compelling. It is noteworthy that most universities in developing countries have limited resources in research and development (Lakitan et al., 2012). In more developed countries such as Australia, universities have access to better financial resources and networks with industries for implementing UIP and IBL programs than are available to Indonesian universities.

One interesting comment regarding the purpose for establishing IBL programs at UWI was from an academic staff member, who mentioned that IBL could be used as an advertising opportunity to promote UWI students to prospective employers. The implication of this statement is that the IBL students were not only receiving skills and knowledge from the work placement, but also contributing skills and knowledge to the industry they were placed in. This means that potential IBL students should possess a certain level of skills and knowledge before they start the work placement program, so that they can contribute to the development of the workplace while at the same time gaining work experience. This practice is not unusual for IBL students in Small and Medium Enterprises (SME) or firms (Santosa & Kusumawardani, 2010).

Analysis of participants' perceptions of the IBL programs at UWI, validated by similar findings in the literature on the purpose of IBL programs, have provided an answer to the first research question: "Why do Indonesian universities establish industry-based learning programs?"

The answer to this research question can be summarised as follows: the purposes of the IBL programs discussed here are: (1) to introduce prospective graduates to the workplace where they can gain some valuable work experience and guidance from industrial experts during their placement; (2) to implement the theoretical academic knowledge learnt in the university classrooms; (3) to provide opportunities for students to establish links and networks with professionals and leaders of business and industry; and (4) to promote students' capabilities to prospective employers.

The following section discusses how the findings of the study answer Research Question 2: "What are the impacts of industry-based learning on Indonesian university students, especially on their academic performance?" In order to do so, the specific findings are summarised and related to relevant points in the studies reviewed in Chapter 2.

5.3 Enhancing the Students' Academic Performance

Holt et al. (2004) argue that students with IBL experience are significantly more mature in their behaviour and more confident in the classroom. Students have "a great deal of depth in all sorts of thing" including how to present themselves in class, how to engage deeply in the discussion of certain topics, and understanding workplace ethics (Holt et al., 2004, p. 5).

As a result of their academic training in university classrooms, the majority of STEM graduates have developed strong technical skills (Blicblau et al., 2014). However, to compete in an increasingly competitive current job market, the STEM student also needs to develop generic employability skills, or soft skills such as communication, teamwork, management and leaderships skills. IBL placement provides enormous opportunities for students to develop these important skills, and mastering them increases students' academic performance; these observations are confirmed by the interview outcomes and findings of this study.

The findings of the present study have shown that the IBL programs at UWI have encouraged a positive attitude in the students towards their learning. This addresses the second research question (RQ): "What are the impacts of industry-based learning on Indonesian university students, particularly on their academic performance?" The analysis of findings explains the impact of IBL programs on the STEM undergraduate students, in particular the impact on their academic performance.

The majority of stakeholders perceived that IBL program play a significant role in enhancing the students' academic performance. This is evidence from the interviews, in which 31 out of 40 respondents (78%) shared this view, as discussed in Section 4.3. The range of benefits varied for individual students. These include increased motivation for study, acquisition of new knowledge, increased discipline, improved teamwork capability and academic ability in general (Figure 4.2).

5.3.1 Opportunity for Acquiring New Skills and Knowledge

In their work placements, students have the opportunity to strengthen their soft skills or behavioural skills. These include communication skills (Rajibussalim, Sahama, & Pillay, 2016), time management, taking leadership roles, and understanding the workplace culture (Maire, 2010). Other soft skills are showing initiative, and personal organisational skills —two important skills for university graduates. These skills are often not taught at the university, or missing from the higher education curriculum. The students in IBL programs can be assisted to acquire these skills through learning strategies such as assigned project work under the guidance of an industrial project supervisor.

These learning experiences have been observed by Fleming (2010), who argues that students' initiative and organisational skills may develop during project work in a placement with an industrial organisation. This learning experience results in the increase of the students' self-sufficiency and development of their self-confidence.

In their affiliation with industry partners, students receive lessons in the form of technical skills (knowledge application) that are not available in the university classroom. The technical skills gained from learning in the field usually satisfy the job market's demands. IBL students may learn a range of new skills, including communication skills (Koppi et al., 2010), negotiation skills, management and leadership skills (Lee, 2008), working as a team player, industry regulations and rules, industry best practice, strict deadlines, and deliverability, as well as time and stress management (Santosa & Kusumawardani, 2010).

The majority of the participants from the student group pointed out that communication skills are the most important social skills they learned at their placements:

> How to communicate effectively, for example how to explain IT (problems) to people who do not understand IT, that is how to explain it in the simplest language that will be easily understood. (Interviewee 05: university)

The above quote indicates that IBL students are often faced with the problem of how to deliver their ideas and expertise to the client in work placements. In this situation they have to learn and adapt an effective communication skill. This skill helps them to satisfactorily complete the tasks assigned to them during the work placement.

This is one good example of how STEM students are able develop an important skill during their work placement. Similarly, they can develop other important soft skill capabilities such as negotiation, leadership and management, teamwork, and time management. These skills, often regarded as professional competence, will certainly enhance the students' academic performance when they return to university study. What is more important is that these professional competence skills will also enhance their chances to compete in an increasingly competitive job market in Indonesia and around the world and will make them better engineers or scientist.

5.3.2 Transfer of Knowledge and Experience

A survey at German universities has shown that partnerships between universities and industrial firms resulted in the exchange of knowledge in both directions (Meyer-Krahmer & Schmoch, 1998). Researchers have found that IBL plays an important role in transferring skills and knowledge to students (Lee, 2008; Nurdin, 2012). Some of this knowledge includes the ability to take the initiative in socialising with other professionals, to increase one's network of professional contacts, and to manage financial activities (Lee, 2008).

Evidence of the two-way transfer of knowledge in IBL programs is also found in this study. An academic staff member commented that the transfer of knowledge in IBL programs can happen in many ways, including by observation:

> Of course, if (students) did not gain some skills, at least they acquired some knowledge (in the work placement). For example, in students' work placement at PLN[10], even though they were not asked to perform the task of

[10] PLN: Perusahaan Listrik Negara (State owned electrical company in Indonesia)

> installing an electricity meter, they were asked to observe how the work is done in the field. (Interviewee 02: academic staff member)

Another academic staff member stressed that relevance of IBL topics to the study programs at university is an important factor that affects students` ability to learn new skills and gain new knowledge:

> Whether students gain new knowledge and skills in their work placement depends on the place where they did their placement. Some (students) get a lot (of knowledge) but others do not. As our study program is in Information Systems, student learned a lot if their IBL placement was in IT-based institutions such as TELKOM[11]. However, (they) did not get much if they were placed in government institutions. (Interviewee 01, academic staff member)

The above two quotations exemplify the process of knowledge transfer for the UWI's STEM undergraduate students during the IBL programs. The process of knowledge transfer varies between students, as indicated in the second quotation. It also depends on the relevance of the student's study program or discipline and the nature of the placement. The more relevant the placement field is to the student's field of study, the more skills and knowledge can be gained by students.

5.3.3 Preparing for Work Ready Graduates

There are growing employer and public expectations that the universities will produce work-ready graduates. In response to this expectation, many universities have refined their curricula to accommodate more courses that integrate a large proportion of work-integrated learning into their programs.

Victoria University in Melbourne, for instance, has established a program called Learning in the Workplace and Community (LiWC). The students of this program undertake 25 courses within the institution, with access to situated learning.

[11] State owned telecommunication company in Indonesia

The differences between this program and traditional courses are: (1) LiWC courses focus on enriching students' learning experience through workplace learning; (2) there is more engagement with the industrial sector within the curriculum; and (3) there is a smooth transition to the workplace for students (Woodley & Beattie, 2011). Other universities such as Massey University in New Zealand have redesigned their curricula to emphasise work-integrated learning (Martin et al., 2012).

A recent study suggests that IBL placement will increase the students' ability to be more organised and productive, hence increasing their academic potential and performance. The valuable skills and learning experience gained will benefit students when they return to the university to complete their studies (Rajibussalim et al., 2016).

Work placements also provide an opportunity for students to enrich their personal and professional attributes and enhance their employability after graduation (Martin et al., 2012). IBL placement gives students an advantage over their rivals when seeking employment, since employers understandably favour graduates who have work experience in their resume over applicants with no work experience.

A work placement in which students learn new skills and knowledge by working with industrial experts is a different kind of experience from the process of learning in academic classrooms. IBL placement is an opportunity for the students to experience different ways of learning and be exposed to completely new learning contexts. Work placement usually involves the practical aspects of doing the work by themselves under the supervisor's instructions. While learning in a traditional classroom, students learn a body of knowledge in the form of theories and concepts, whereas in a work placement it is more a case of learning by doing or practical implementation of the body of knowledge.

Other studies have reported that IBL placement has various positive impacts on students, increasing their academic performance and providing opportunities for future employment. This study of UWI's STEM undergraduate students highlights the

differences between IBL learning experience in the workplace and classroom learning experiences at UWI in term of preparing them for the challenges of the workplace.

For example, an interview with a UWI student (Section 4.3) reveals that the IBL program had prepared them to be a more 'work ready graduate.' During his IBL program, the student was able to understand and experience a real work situation and acquired an understanding of what skills are needed to be well prepared for the challenges of the employment world.

5.3.4 Enhancing Students' Learning Experience

This section discusses the findings of the research related to the students' learning experience. The findings have been drawn from the data collected in the interviews with relevant stakeholders. The interviews threw light on various learning experiences of the respondents during their IBL placement interactions.

Work placement research within the last ten years has indicated that IBL placement and informal learning offer an alternative method of effective and efficient learning that can improve the performance of either individuals (placement students) or companies (Sarvi & Pillay, 2015). In the research field of situated learning, researchers have found that humans effectively learn most of the tasks and the skills for their jobs, not through lecture-based learning in the classroom, but through experience (Sarvi & Pillay, 2015).

Since the industrial environment differs to the university environment, the learning experience is also different. The students' learning experience is no longer limited to listening to and understanding concepts and theories in the classrooms and laboratories; they have the opportunity to apply the theories in practice.

They also have opportunities to work with leading industrial experts and use cutting-edge technology tools and equipment in their work placements. IBL placements enhance students' learning experience in many respects.

As a result of work placements, STEM undergraduate students at UWI have experienced a different learning setting from their university studies. First, they were required to adapt quickly to industrial environments, where they learnt that the missions and goals of industry are different to university goals, and to adapt the ways they learned accordingly. This certainly enhanced and enriched the students' learning experience in positive ways, as acknowledged in the interviews with stakeholders, both academic staff member and university students (Section 4.4.2).

IBL offers students the opportunity to implement the knowledge they have learnt at university in practice. During their two years of university study, UWI undergraduate students had gained adequate technical skills and knowledge in their respective study programs. During their IBL programs, they were able to implement these skills and knowledge in real work environments. Thus they could see and understand how to apply their learning to solving real work problems on a bigger scale in industrial settings.

The next section discusses how this study answers the third research question in the context of the research literature, that is: "How does industry-based learning support STEM education in Indonesia?"

5.4 The Role of IBL in Promoting STEM Education

Studies suggest that there is a need for reform of the universities' STEM curricula to provide more opportunities for students not only to learn the discipline-related knowledge but also to apply this knowledge in real work environments (Breiner et al., 2012; Henderson & Dancy, 2011; Prinsley & Baranyai, 2015a; Rayner & Papakonstantinou, 2015). STEM curriculum reform is foreseen as a way to diminish the issue of the STEM graduate shortages faced by the business and industrial sectors (Prinsley & Baranyai, 2015b; West, 2012).

While the call for reform of STEM education curricula at HEIs is recognised in both developed and developing countries, implementation of reform is urgently needed in Indonesia. There is a severe shortage of talented STEM graduates in

Indonesia (Tong & Waltermann, 2013). The lack of qualified STEM graduates who possess the skills demanded by businesses and industries in Indonesia is predicted to last for the next decade if appropriate preventive actions are not initiated now. The shortage of talent is not only at senior management levels, but also affects entry and middle management levels (Tong & Waltermann, 2013). Therefore, recent research on IBL that indicates a positive relationship between industry attachment programs (IBL) and graduate's readiness for the employments is acknowledged by academics and business persons. From the stakeholders' viewpoints in this study, IBL programs, if managed properly, can offer a solution to the scarcity of qualified STEM graduates.

This raises two questions: first, how to utilise IBL programs to maximise the benefits? Second, how to advocate to industrial and business partners that IBL programs may solve the shortfall of qualified STEM graduates? The answers to both questions are related.

As discussed previously, researchers cited in the literature review in Chapter 2 have proposed some solutions to the first question. Enacting STEM curriculum reform will allow more opportunities for students to apply their knowledge in real workplaces instead of just in the classroom (Prinsley & Baranyai, 2015a; Rayner & Papakonstantinou, 2015). This will increase the students' work-readiness and give them an advantage over their competitors. Another approach is to design a national strategy for work integrated learning (WIL) (as in Australia) that encourages a large scale government involvement in regulating WIL programs and providing the necessary funds to run the programs effectively (Universities Australia et al., 2015).

These two solutions can also be applied to the Indonesian context. The STEM curricula in Indonesia are long overdue for reform that allows increased implementation of IBL programs, incorporating practical training to increase the STEM skills and knowledge of Indonesian HE graduates. The Indonesian HEIs supported by the government can also take the initiative in developing a national strategy that effectively regulates the implementation of IBL in Indonesia. Salim and Al-Arief (2011) suggest HEI priorities that are in line with these solutions. The authors

suggest that HEIs should prioritise their efforts to address the skills gaps of Indonesian university graduates and to optimise the number of university strategic research programs that foster economic growth in Indonesia.

The second question, how to convince industry and business sectors that IBL programs can be used to minimise the dearth of skilled STEM graduates is more difficult to answer. Although in theory the business and industrial sectors realise that industrial work placement is important to address the scarcity of skilled and competent employees, particularly in STEM areas, the companies may perceive that the placement programs are of more benefit to students or universities than to them. For this reason, the business and industrial sectors may expect universities to play the main role in educating and training their students with the necessary work skills.

A body of literature suggests that IBL programs can play an important role in increasing graduates' employability by prospective employers (Prinsley & Baranyai, 2015a; Rayner & Papakonstantinou, 2015; West, 2012). Hence, IBL programs offer an alternative way of addressing the shortage of qualified university graduates ready for professional roles in industry. However, IBL students need to demonstrate their motivation, skills, and knowledge, particularly STEM skills and knowledge, to prospective employers at the workplaces. Hence, IBL placement students are expected to work hard and learn fast during their placement programs in their chosen industry. They need to demonstrate that they are capable of solving difficult problems and completing the tasks assigned to them satisfactorily. By demonstrating their capabilities, the IBL students can promote themselves, their respective STEM study programs, and their HE institutions.

The above argument in the literature supports the findings of the present study. One of the UWI academics stated in an interview (Interviewee 37) that by working hard and showing their skills and expertise, IBL students play an important role in promoting their Science study program and institution (Section 4.5).

As mentioned previously, employers value STEM knowledge and skills highly (Prinsley & Baranyai, 2015b; Rayner & Papakonstantinou, 2015). From employer perspectives, STEM qualified employees need to understand how to improve their company's business. Employer perceptions of STEM qualified people tend to be positive overall (Prinsley & Baranyai, 2015b). In one survey of employers' perceptions of STEM qualified people, 384 of 466 employers agreed that employees with STEM qualifications were valuable assets for their business (Prinsley & Baranyai, 2015b).

Despite the business and industrial sectors' high valuation of the importance of STEM trained graduates, there are not many opportunities for companies to assess graduates' STEM knowledge and skills before an official recruitment. Therefore, IBL programs provide a good opportunity for business and industry executives to select the best candidates as their future employees. Recruitment staff in business and industry have a unique opportunity to recruit and retain the most talented and skilful students even before they graduate from universities (Fifolt & Searby, 2010). Work placement students, on the other hand, have a great opportunity to advertise themselves as talented and competent STEM students.

One of the key findings of the present study is the confirmation that IBL programs can promote STEM education at universities. Among the respondents, 65% (26 out of 40) respondents confirmed this finding. Some participants, however, perceived that the promotion of STEM education through IBL programs is indirect and will be apparent in the near future when many STEM graduates are employed by industry. When more IBL trained graduates are employed by reputable companies they act as ambassadors for their respective STEM study programs. This is a good advertisement for the STEM study programs, STEM education, and universities.

5.5 Conclusion

This chapter has highlighted that there are similarities in the purposes for establishment of IBL programs in universities in developed countries such as Australia and universities in Indonesia, which represents the East Asian region. For example, the two main purposes found in the literature for universities around the world to establish IBL are to provide work experience and to give opportunities to students to create links and networks with professionals. This is in line with the key findings of the present study, drawn from the perceptions of Indonesian university stakeholders.

Concerning the impact of IBL programs on the students' academic performance, the majority of stakeholders (78%) perceived that IBL programs play a significant role in enhancing students' academic performance. The benefits include increased motivation for study, acquisition of new knowledge, increased discipline, teamwork capability, and academic ability in general. This key finding is supported by the literature (Holt et al., 2004).

This chapter also confirms the importance of STEM education curriculum reform to allow students not only to learn the knowledge but also to implement it in real world environments, such as within industrial settings. While the need for STEM curriculum reform is recognised in both developed and developing countries, implementation of reform is urgently needed in Indonesia. The findings of the present study suggest that IBL programs can play an important role in promoting STEM education in two ways: by exposing the STEM skills and expertise of IBL students to business and industry; and by increasing the employment of STEM graduates in industry and business. These two solutions will help to promote STEM education in the future.

Chapter 6 Conclusion and Future Work

6.1 Overview

This study has investigated the purposes for establishing industry-based learning (IBL) programs at Indonesian universities, the academic and non-academic impacts of such programs on the students, and the role of IBL programs in promoting Science, Technology, Engineering, and Mathematics (STEM) education in Indonesia. This study utilises a qualitative method to explore the perspectives of Indonesian higher education institution (HEI) stakeholders on the industry-based learning discourse, and offers some insights into the development of knowledge and pedagogy in this discipline. This chapter concludes the present study, and is organised as follows. Section 6.2 presents a conclusion of the study in reference to the research questions, Section 6.3 highlights the contributions of the present study, Section 6.4 provides some recommendations to relevant institutions in Indonesia, Section 6.5 highlights the limitations of the study and concluded by Section 6.6 with the directions for future research.

6.2 Conclusion

This study investigates how industry-based learning (IBL) can be used as an opportunity to enhance and enrich STEM students' learning experience. Since industry's environments and aims are significantly different to the university's classroom environment, the learning experience gained by IBL students is likely to differ significantly from the campus learning experience. Industrial learning experiences can offer motivating and effective learning situations, due to better work-related facilities and a demanding environment that forces students to adapt to different industrial standards.

The study adopts the case study method, utilising semi-structured in-depth interviews to collect thick descriptions and information from the research participants regarding their experience of IBL programs at Indonesian universities. Relevant documents regarding IBL were analysed as a secondary method for data collection, and to triangulate the findings to ensure the validity and rigour of the research process. There were 40 participants involved in the research study. They were recruited from ten STEM departments within the University of Western Indonesia (UWI). Since the interviews were conducted in *Bahasa Indonesia*, the excerpts needed to be translated into English. To ensure the accuracy and trustworthiness of the data, a back-translation procedure was also performed. The data was analysed thematically with the assistance of NVivo 11 software.

The research study was guided by three research questions. Regarding the first research question (RQ1) on the purposes for establishing IBL program at Indonesian's university, this study found that there were four main purposes: (1) to equip students with valuable work experience; (2) to implement theories and concepts; (3) to establish links and networks with professionals; and (4) to introduce students to appropriate workplaces.

The second research question (RQ2) examines the impact of IBL programs on Indonesian university students, particularly on their academic performance. The findings suggest that the impact was significant. The programs increased the students' motivation for study, acquisition of new knowledge, discipline, and teamwork ability. The other key findings relating to RQ2 suggest that IBL programs can: strengthen students' soft skills capability, such as communication and teamwork skills; enrich students' work experience; and provide opportunities for students to establish links and networks to professionals.

On the third research question (RQ3) regarding how IBL programs supports STEM education in Indonesia, the findings suggest that IBL can promote STEM education in Indonesia in two ways: by exposing the STEM skills and expertise of IBL

students to business and industry; and increasing the number of STEM graduates recruited into reputable businesses and firms in Indonesia and overseas.

The impact of IBL placements on the students' learning experiences and the development of their perception of themselves as competent future scientists and engineers was very positive. This key finding was revealed in the interviews with the research participants of the three groups of stakeholders in the research study, namely UWI STEM undergraduate students, UWI academic staff members, and industry employees. Most of the respondents (78%) agreed that the work placements had increased the students' readiness to enter the workplace and enhanced their skills, knowledge, and experience in certain areas.

From the university's viewpoint, workplace learning offers an opportunity for students to apply their theoretical knowledge to real world situations and prepare to become job-ready graduates. These students had both gained knowledge, skills and experience of the industrial world, and had contributed to the outcomes of industry's activities.

This study contributes to a growing body of work that explores industry-based learning (IBL) within university-industry partnerships (UIP) by focusing on Indonesian universities, which have different conditions and challenges to universities in Australia and other developed countries. IBL practices in Australia put more emphasis on the development of HEI curricula and the improvement of IBL program in the quest for best practice.

In the Indonesian context, the implementation of IBL and UIP programs mostly focuses on how universities (academic staff and students) can contribute to solving industrial problems and at the same time, how the students can learn from this process.

The impact of IBL on undergraduate students at Indonesian universities can be considered under several themes: academic performance, learning new skills, transfer of knowledge, and future employment. These impacts, although not always easy to measure, tend to be very positive. Across the three groups of stakeholders interviewed

(STEM undergraduate students, academic staff members, and industry employees), the responses provided compelling evidence of positive outcomes. The majority of stakeholders (31 out of 40) perceived that IBL placements had increased the students' ability to be more organised, productive and proactive in their university studies. The students had also learned new skills and transferred new knowledge during their IBL placements in several ways, including observation, learning by doing, and preparing reports and presentations. Regarding the impact of IBL placement on future employment, most of the respondents suggested that networks and relationships built during the placements program would be very useful in looking for jobs in the future.

The research findings provide useful insights and offer new understandings of the practices and influences of IBL programs on students at Indonesian universities, as perceived by the stakeholders. The research contributes to existing knowledge by providing empirical evidence of the impact of industry-based learning programs on undergraduate university students' performances, specifically in Indonesian universities. The outcomes and findings of this study will benefit Indonesian HEIs by providing evidence-based knowledge that can be utilised to improve the quality of IBL and UIP programs and inform the Indonesian HE authorities of the best approaches to enhancing their IBL programs.

6.3 Contribution of the Research

The findings of this study provide useful insights and new understandings into the impact of IBL programs on Indonesian university students. The research makes a significant contribution to the literature in the area of industry-based learning, university-industry partnership, and STEM education, particularly in the context of higher education institutions in Indonesia. In the context of the scarcity of credible literature that specifically reports the implementation of IBL programs at HEIs in Indonesia, this research study sheds light on the current implementation and impact of industry placement programs (IBLs) on STEM undergraduate students in Indonesia.

Some key findings of this study confirm the findings of previous studies. For example, regarding the purposes for the establishment of IBL programs at universities around the world, there were two similar findings: (1) to provide students with valuable work experience (Brooks, 2012; Tran & Soejatminah, 2016); and (2) to provide opportunities for students to establish links and networks with professionals (Blicblau et al., 2014; Blicblau et al., 2016; Silva et al., 2016). Further, this study adds two new purposes, based on Indonesian university stakeholders' perspectives: (3) to implement the theoretical academic knowledge learnt in the university classrooms; and (4) to promote students' capabilities to prospective employers.

The last two findings suggest that as well as sharing purposes for the establishment of IBL programs at universities with other such programs around the world, there are two main purposes that are unique to the universities in Indonesia, from the stakeholders' perspectives. This may be because stakeholders perceived that STEM undergraduate students at Indonesian universities do not have many opportunities to implement their theoretical academic knowledge apart from these placement programs. Hence, they see the purpose of IBL program as enabling students to apply their theoretical knowledge in real workplaces (purpose #3). At the same time, an IBL program can be utilised as a medium for showing prospective employers that Indonesian STEM undergraduate students are capable of solving industrial problems and completing the difficult tasks assigned to them (purpose #4). However, unfortunately, the specific purposes for the establishment of IBL programs at Indonesian universities were not found in the literature review. The reason for this is that there was lack of literature that specifically discussed the implementation of IBL programs within Indonesian context at Indonesian universities.

This study also contributes to knowledge of industry-based learning by providing empirical evidence of the impact of IBL programs on Indonesian STEM undergraduate students, as perceived by Indonesian HE stakeholders. The empirical evidence of IBL's positive impact on Indonesian STEM undergraduate students was confirmed by 78% of participants of the study, as discussed in Section 5.3. The

majority of respondents attested that the IBL programs had helped students to develop strong technical skills (employability skills) or soft skills and motivation. These employability skills include communication skills, management and leadership skills, teamwork skills, and increase in academic ability in general. These findings corroborate the findings of previous studies such as by Blicblau et al. (2014); Koppi et al. (2010); and Lee (2008).

The IBL programs had also helped to equip Indonesian STEM undergraduate students with valuable work experience, and provided opportunities to establish links and networks with the professionals in similar areas of interest. The work experience and links and networks provide students with an authentic experience of real workplaces and give them a competitive edge over their competitors in competing for employment after graduation (Lee, 2008; R. Smith et al., 2008).

In regard to STEM education, the findings of the present study provide new insights into this area in the Indonesian context. This study provides evidence-based knowledge that IBL programs can be utilised to promote STEM education. Of the 40 respondents who were interviewed, 65% of them perceived that IBL placement plays an important role in promoting STEM education in the workplace during and after placement.

During IBL placement, the STEM students demonstrated their ability to solve difficult industrial problems. By applying their skills and knowledge to completing the job to the highest industry standard, they promoted themselves and their STEM study programs respectively. After placement, if the companies are convinced of the students' STEM skills and knowledge, they might recruit them as employees. Such recruitment promotes the student and the STEM study programs, and adds to the perceived value of the programs. Thus more students will be attracted to studying in these programs, especially if the students are recruited by a reputable firm.

Amidst the shortage of skilled university graduates that can fulfil the increasingly demanding professional needs of industries in Indonesia (Tong &

Waltermann, 2013), the findings of this study can inform Indonesian HEI authorities and industry partners of an alternative way to address the severe shortage of skilled workers, especially in STEM industries, equipped to take on leadership roles in Indonesian service and industrial sectors.

Indonesian HE authorities have the option of reforming their IBL and STEM education curricula to reflect the best practice in IBL programs for STEM undergraduate students. By improving the IBL programs at HEIs to the highest standard and strengthening university-industry collaboration programs, Indonesian HE authorities can support the development of reliable and skilful university STEM graduates to meet the needs of Indonesian service and industrial sectors. As previously stated, employers value graduates with high proficiency in STEM skills and knowledge (Prinsley & Baranyai, 2015b; Rayner & Papakonstantinou, 2015). This proactive approach is expected to overcome or at least diminish the issue of severe talent shortages in Indonesia that has the potential to undermine the country's recent impressive economic performance (Tong & Waltermann, 2013).

6.4 Recommendations

Based on the findings, this study offers six recommendations to relevant Indonesian HEI authorities, the Indonesian government, and Indonesian HE stakeholders, as follows:

1. To diminish the problem of the severe shortage of skilled STEM graduates in Indonesia, Indonesian HE authorities along with the Indonesian government are encouraged to reform IBL and STEM curricula at the national level to provide more opportunities for STEM undergraduate students, not only to gain knowledge but also to apply their knowledge in the real workplace.

The findings of this study suggest that IBL programs have increased Indonesian STEM university students' work-readiness and give them an advantage over their competitors. These findings are supported by the literature, which suggests that IBL programs can increase students' STEM skills and knowledge and minimise the problem of qualified STEM graduate shortages (Prinsley & Baranyai, 2015b; West, 2012).

Through implementing best practice in IBL programs, it is expected that Indonesian universities will be able to produce high quality STEM graduates whose skills and knowledge can satisfy industrial requirements and are able to fulfil increasingly important leadership roles in Indonesia.

2. The findings of the present study also suggest that IBL programs can reduce gaps and mismatches between the skills of Indonesian STEM university graduates and the skills that are required by industries in Indonesia. Therefore, it is recommended that every STEM study program at Indonesian universities should oblige their students to undertake an IBL program as a compulsory unit rather than an elective one. This unit will be assessed according to the highest standard to satisfy industry requirements.

3. As revealed in the interviews, a number of STEM students raised concerns about the difficulties they faced in finding a suitable industry for their IBL placement, and also the lack of funds available for IBL operational costs, especially when the placement was not near the area where they lived. Therefore, it is recommended that Indonesian universities establish a task force that helps students to find and liaise with relevant industries or institutions that suit the students' study programs or background knowledge.

4. It is also recommended that IBL task forces in Indonesian universities liaise and negotiate with industrial partners to provide a limited source of funds for students' operational costs, such as transportation, temporary accommodation, and food allowance during their placement.

5. Another concern raised by HEI stakeholders in the interviews was the lack of communication between the university's IBL supervisors and the IBL supervisors in industry. Therefore, it is recommended that the university create a policy that encourages IBL supervisors from both university and industry to be proactive and meet regularly to provide the best possible supervision of their IBL students.

6. The final recommendation is that there is a need for a unified assessment mechanism for IBL programs at the national level to enhance the quality of the programs nationally and to enable national supervision and evaluation towards establishing best practice in IBL program at universities in Indonesia.

6.5 Research Limitations

While the research for this study was conducted with rigour, inevitably some limitations were encountered. First, due to difficulties in obtaining approval from some Indonesian universities, the scope of the research and participants' backgrounds were limited to the Science, Technology, Engineering and Mathematics students of the Faculty of Science and the Faculty of Engineering at the University of Western Indonesia (UWI). There were ten schools and departments of STEM related disciplines involved in this research study, as listed in Table 3.1; future research could usefully include more schools and departmemts within STEM disciplines. This research provides a framework that may be extended to examine the impact of IBL programs on a larger scale involving more departments, faculties, and higher education institutions (universities) in Indonesia or even South East Asian countries. By

widening the scope, future research may capture richer data on students' learning experiences in the workplace and may uncover different outcomes and insights into Industry Based Learning, particularly in the Indonesian context.

Second, due to distance and the time constraints, only limited research observations could be conducted during the students' studies at UWI campus. The research data might be further enriched by carrying out observations directly during students' placements in industry, although this would require further ethics and industry approvals from the relevant firms.

Finally, another limitation of this study is that the body of literature that reports and discusses the implementation of IBL program in Indonesian context at the Indonesian universities is surprisingly scare. The current available citations on this topic do not necessarily explain in detail what the impacts of the IBL program are on students' academic performance, and how IBL programs directly support STEM education in Indonesia. More research is needed into this particular aspect to fill these gaps.

6.6 Direction for Future Research

Reflecting on the limitations mentioned in the previous section, future research on IBL programs can use the current research findings as a basis. Firstly, more research sites, faculties, and universities in Indonesia can be studied. Although the nature of qualitative research based on case studies limits the number of participants in the study, a greater variety of participants can enhance the richness of the interview data. A broader scale of research and richer variety of data can also be achieved by varying the locations of the data collection to represent the western, the central, and the eastern parts of Indonesia. This is important, since the majority of high ranking universities are located in Java, which is the central part of Indonesia. Therefore, the development of IBL programs among the top ranking and the lower ranking universities may differ significantly.

Secondly, the richness of the IBL data can be enhanced by adopting a quantitative method to complement and verify the outcomes and findings of the qualitative analysis. A mixed research method may offer useful insights from different angles on the implementation of IBL programs at Indonesian universities.

Thirdly, research may need to broaden its scope by exploring the future STEM skills and knowledge that are relevant to Indonesian industrial requirements. Current understandings of the STEM skills and knowledge required to compete in increasingly competitive job markets may differ according to academic and industry perspectives. To find the meeting point between the two, in the future, similar research will need to delve deeper into the industrial sector, with a an emphasis on helping students to be better scientist or engineers while preparing them to be work ready graduates. Thus, understandings of STEM skills and knowledge according to industry standards can inform higher education institutions' curriculum development.

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Appendix A: Interview Protocol

Interview Protocol for STEM undergraduate students: English version

Study Title:
The impact of Industry-Based Learning programs on Science, Technology, Engineering, and Mathematics students: a case study of Indonesian higher education.

Interviews Discussion Guide
Duration: 30 - 60 minutes

I. Introduction (3-5 mins)

- Greeting

  Name:
  Position:
  Education:
  Date and time of interview:
  Place of interview:

- Introduction to the project overall
- Purpose of the interview
- Confidentiality
- Consent process
- Individual opinion and experience (no right or wrong answer)
- Focus on the students and staff experience related to industry-based learning program
- Audio recorded

II. Prompt Questions: (20-60 mins)

The following questions are illustrative of the type of questions to be used during the interview. This list is not exhaustive other questions may be asked depending on the points raised by the participant. The focus is on creating a more natural free flowing dialogue or conversation with the participant and not a formal stilted interview. Every effort will be made to ask the questions in a natural and unobtrusive way. This may mean the questions are not asked in any particular order and some questions may be missed and other new questions added depending on the conversation flow. General probe questions will also

be used to elicit further information from participants about the responses they provide.

III. Participants are grouped into two categories:

A. University students

B. University academics staff member and industry employee

IV. The interview questions guide:

1. Could you tell me about yourself and your study program and department?
2. Have you ever participated in the work placement program?
   i. When did you participate in this program and in what capacity?
   ii. Did you voluntarily ask to participate in the program or is it a requirement of your study program (department)?
3. How do you define the work placement program?
4. What is your motivation to participate in a work placement program?
   i. What do you expect from this program?
   ii. What achievement do you expect after the completion of work placement program?
5. In your opinion, is there any benefits of work placement program?
   i. If yes, what are they?
   ii. If no benefits, can you explain why?
6. What skills or expertise do the students need to prepare before they coming into a work placement?
7. In your opinion, do the skills and knowledge that students learnt at university can be applied at the work placement?
8. Did you learn any new skills during your work placement? For example the skills that were not taught at your university (college).
   i. If you did, can you give examples?
   ii. If you didn't learn anything, can you explain why?
9. Do you think, the work placement programs have an impact on your academic performance?

10. What other impacts of a work placement on students?
11. What do you think about the role of supervisor? As we know, there are counsellors on campus and counsellors in the workplace, who has a bigger role in supervising work placement students?
12. What do you think of the main difficulty during your work placement?
13. Do you think the duration of the current work placement is sufficient? If not, what is an ideal duration for a work placement in your opinion?
14. How to improve the quality of the work placement program?
15. Do you think that the work placement program can be used to promote Science, Technology, Engineering, and Mathematics (STEM) education?

V. Conclusion (5 mins)

- Giving opportunity to participant to ask question if any.
- Thank the research participant.

Interview Protocol for academic staff and industry employee: English version

Study Title:
The impact of Industry-Based Learning programs on Science, Technology, Engineering, and Mathematics students: a case study of Indonesian higher education.

Interviews Discussion Guide
Duration: 30 - 60 minutes

I. Introduction (3-5 mins)

- Greeting

  Name:
  Position:
  Education:
  Date and time of interview:
  Place of interview:

- Introduction to the project overall
- Purpose of the interview
- Confidentiality
- Consent process
- Individual opinion and experience (no right or wrong answer)
- Focus on the students and staff experience related to industry-based learning program
- Audio recorded

II. Prompt Questions: (20-60 mins)

The following questions are illustrative of the type of questions to be used during the interview. This list is not exhaustive other questions may be asked depending on the points raised by the participant. The focus is on creating a more natural free flowing dialogue or conversation with the participant and not a formal stilted interview. Every effort will be made to ask the questions in a natural and unobtrusive way. This may mean the questions are not asked in any particular order and some questions may be missed and other new questions added depending on the conversation flow. General probe questions will also be used to elicit further information from participants about the responses they provide.

III. Participants are grouped into two categories:

A. University students

B. University academics staff member and industry employee

IV. The interview questions guide:

1. Could you tell me about yourself and what is your current position at your institution/workplace?
2. Have you ever participated in the work placement program?

iii. When did you participate in this program and in what capacity?

iv. Did you voluntarily ask to participate in the program or appointed by your department?

3. How do you define the work placement program?
4. What is your motivation to participate as a mentor (supervisor) of the work placement program?

iii. What do you expect from this program?

iv. What achievement do you expect after students completed a work placement program?

5. In your opinion, is there any benefits of work placement program?

iii. If yes, what are they?

iv. If no benefits, can you explain why?

6. What skills or expertise do the students need to prepare before they coming into a work placement?
7. In your opinion, do the skills and knowledge that students learnt at university can be applied in the work placement?
8. Did the students learn any new skills during their work placement? For example the skills that were not taught at the university or college?

iii. If they did, can you give examples?

iv. If they didn't learnt anything new, can you explain why?

9. Do you think, the work placement programs have an impact on the students' academic performance?

10. What other impacts of a work placement on students?
11. What do you think about the role of supervisor? As we know, there are counsellors on campus and counsellors in the workplace, who has a bigger role in supervising work placement students?
12. What do you think of the main difficulty the main difficulty in supervising work placement students?
13. Do you think the duration of the current work placement is sufficient? If not, what is an ideal duration for a work placement in your opinion?
14. How to improve the quality of the work placement program?
15. Do you think that the work placement program can be used to promote Science, Technology, Engineering, and Mathematics (STEM) education?

V. Conclusion (5 mins)

- Giving opportunity to participant to ask question if any.
- Thank the research participant.

Interview Protocol for STEM undergraduate students: Indonesian version

Panduan Interview Bahasa Indonesia untuk Mahasiswa
Durasi: 30 - 60 minutes

Judul Penelitian:
Dampak dari Industry Based Learning program (Kerja Praktek) pada Mahasiswa Sains, Teknologi Informasi, Teknik dan Matematika: Studi kasus di Perguruan Tinggi di Indonesia.

English Title:
The impact of industry-based learning programs on Science, Technology, Engineering, and Mathematics students: a case study of Indonesian higher education.

I. Pendahuluan (3-5 menit)

- Perkenalan

  Nama:
  Pekerjaan:
  Pendidikan:
  Tanggal dan waktu interview:
  Tempat Interview:

- Penjelasan tentang riset
- Tujuan riset
- Kerahasian data
- Masalah consent
- Pendapat Individu dan pengalaman peserta interview
- Fokus kepada pengalaman mahasiswa dan staff tentang IBL
- Direkam secara audio.

II. Penjelasan dan Pertanyaan Interview (20-60 mins)

Berikut ini adalah contoh-contoh pertanyaan yang akan digunakan dalam interview. Pertanyaan-pertanyaan ini berupa panduan dan dapat dikembangkan sesuai kebutuhan selama interview. Dalam interview diusahakan agar prosesnya berlangsung secara normal dan lancar. Sehingga ada kemungkinan pertanyaan ditanyakan tidak berurutan dan ada pertanyaan yang akan dilewatkan tergantung

dari respon dari peserta interview. Pertanyaan ini juga bisa dikembangkan lebih lanjut untuk mengali informasi yang lebih detil dari peserta interview.

III. Peserta Interview dibagi kedalam dua kategori:

A. Mahasiswa

B. Staff pengajar dan karyawan dari industri.

IV. Panduan pertanyaan interview untuk mahasiswa (grup A)

1. Tolong sebutkan jurusan, fakultas dan universitas dimana anda kuliah.
2. Pernahkah anda berpartisipasi dalam program KKP (magang)?
    i. Kapan dan dimana anda mengikuti program magang tersebut
    ii. Apakah kendalanya jika anda ingin mengambil program magang tersebut?
3. Bagaimana anda mendefinisikan program KKP (magang)?
4. Kenapa anda berpartisipasi dalam program KKP (magang)?
    i. Apa yang anda harapkan dari program magang tersebut?
    ii. Apakah harapan anda tersebut tercapai setelah magang?
5. Apakah anda merasakan manfaat dalam program magang tersebut?
    i. jika ya, apa manfaat yang anda rasakan?
    ii. jika tidak ada manfaat, bisa anda jelaskan mengapa?
6. Menurut anda, skills (keahlian) apa yang perlu dipersiapkan oleh mahasiswa untuk mengikuti program magang tersebut?
7. Apakah ilmu dan keahlian yang anda pelajari di kampus dapat diterapkan di tempat magang?
8. Apakah anda mendapatkan ilmu dan keahlian (skills) baru selama program magang ini?
    i. Kalau iya, apa yang anda dapatkan?
    ii. Kalau tidak, apa yang anda dapatkan?
9. Menurut anda, apakah program magang mempunyai dampak terhadap pencapaian akademik mahasiswa di kampus? Apakah dampaknya?

10. Menurut anda, apakah program magang mempunyai dampak lainnya?
11. Bagaimana peran pembimbing, baik pembimbing di kampus maupun pembimbing di lapangan? Mana yang lebih berperan?
12. Apakah kesulitan utama anda ketika magang?
13. Berapa lama anda magang dan apakah durasi (waktu) yang disediakan sudah sesuai/cukup? Kalau tidak, menurut anda berapa lama waktu magang yang ideal?
14. Menurut anda, bagaimana cara meningkatkan kualitas program magang?
15. Menurut anda apakah program magang (KKP) ini bisa digunakan untuk mempromosikan Sains, Teknologi Informasi, Enginering (Teknik) dan Matematik (STEM)?

V. Rangkuman (2 mins)

- Memberikan kesempatan bertanya kepada peserta interview.
- Terima kasih kepada peserta interview.

Interview Protocol for academics staff and industry employee: Indonesian version

Panduan Interview Bahasa Indonesia untuk Akademik Staff dan Karyawan Industri
Durasi: 30- 60 minutes

Judul Penelitian:
Dampak dari Industry Based Learning program (Kerja Praktek) pada Mahasiswa Sains, Teknologi Informasi, Teknik dan Matematika : Studi kasus di Perguruan Tinggi di Indonesia.

English Title:
The impact of industry-based learning programs on Science, Technology, Engineering, and Mathematics students: a case study of Indonesian higher education.

I. Pendahuluan (3-5 menit)

- Perkenalan

  Nama:

  Pekerjaan:

  Pendidikan:

  Tanggal dan waktu interview:

  Tempat Interview:

- Penjelasan tentang riset
- Tujuan riset
- Kerahasian data
- Masalah consent
- Pendapat Individu dan pengalaman peserta interview
- Fokus kepada pengalaman mahasiswa dan staff tentang IBL
- Direkam secara audio.

II. Penjelasan dan Pertanyaan Interview (20-60 mins)

Berikut ini adalah contoh-contoh pertanyaan yang akan digunakan dalam interview. Pertanyaan-pertanyaan ini berupa panduan dan dapat

dikembangkan sesuai kebutuhan selama interview. Dalam interview diusahakan agar prosesnya berlangsung secara normal dan lancar. Sehingga ada kemungkinan pertanyaan ditanyakan tidak berurutan dan ada pertanyaan yang akan dilewatkan tergantung dari respon dari peserta interview. Pertanyaan ini juga bisa dikembangkan lebih lanjut untuk mengali informasi yang lebih detil dari peserta interview.

III. Peserta Interview akan dibagi kedalam dua kategori:

A. Mahasiswa

B. Staff pengajar dan karyawan dari industri

IV. Panduan pertanyaan interview untuk staff atau karyawan (grup B)

1. Tolong sebutkan peran dan tempat anda bertugas (seperti jurusan, fakultas dan universitas atau Instansi lainnya).
2. Pernahkah anda berpartisipasi dalam program KKP (magang)?
    i. Kapan anda berpartisipasi program KKP (magang) dan dalam kapasitas apa?
    ii. Apakah anda mengajukan diri untuk membimbing KKP atau ditunjuk? (oleh siapa?)
3. Bagaimana anda mendefinisikan program KKP (magang)?
4. Kenapa anda bersedia berpartisipasi dalam program KKP (magang)?
    i. Apa yang anda harapkan dari program magang tersebut?
    ii. Apakah harapan anda dapat melihat harapan tersebut tercapai setelah magang?
5. Menurut anda, adakah manfaat dari program KKP (magang)?
    i. jika ya, apa manfaat yang anda rasakan?
    ii. jika tidak ada manfaat, bisa anda jelaskan mengapa?
6. Menurut anda, skills (keahlian) apa yang perlu dipersiapkan oleh mahasiswa untuk mengikuti program magang tersebut?
7. Menurut anda, apakah ilmu dan keahlian yang dipelajari di kampus dapat diterapkan di tempat magang?

8. Menurut anda, apakah mahasiswa mendapatkan ilmu dan keahlian (skills) baru selama program magang ini?
    i. Kalau iya, sebutkan contohnya?
    ii. Kalau tidak, mengapa?
9. Menurut anda, apakah program magang mempunyai dampak terhadap pencapaian akademik mahasiswa di kampus?
10. Menurut anda, apakah program magang mempunyai dampak lainnya ?
11. Menurut anda, bagaimana peran pembimbing, baik pembimbing di kampus maupun pembimbing di lapangan dalam program magang? Mana yang lebih berperan?
12. Apakah kesulitan utama dalam membimbing mahasiswa magang?
13. Apakah anda merasa waktu (durasi) yang disediakan untuk magang sekarang sudah sesuai/cukup? Kalau tidak sesuai, menurut anda berapa lama waktu magang yang ideal?
14. Menurut anda bagaimana cara, meningkatkan kualitas program magang?
15. Menurut anda apakah program magang (KP) ini bisa mempromosikan Sains, Teknologi Informasi, Enginering (Teknik) dan Matematik (STEM)?

V. Rangkuman (5 mins)

- Memberikan kesempatan bertanya kepada peserta interview.
- Terima kasih kepada peserta interview.

Appendix B: Ethics Application and Approval

Ethics Application

University Human Research Ethics Committee (UHREC)

APPLICATION FOR REVIEW OF NEGLIGIBLE / LOW RISK RESEARCH INVOLVING HUMAN PARTICIPANTS

NOTE
- *All answers should be written **in simple and non-technical language** that can be **easily understood by the lay reader**.*
- *You must provide an answer to each questions – **N/A is not acceptable**.*

SECTION A: RESEARCH PROPOSAL OVERVIEW

A1 Summary Information

A1.1 **Project title** (200 character limit including spaces)

The Impact of Industry-Based Learning on Students' Academic Performance: A Case Study of Indonesian Higher Education

A1.2 **Brief project summary in LAY LANGUAGE** (i.e. plain English)

The collaboration between universities and industries has become increasingly important for the development of Science and Technology. This is particularly more prominent in the Science Technology Engineering and Mathematics (STEM) disciplines. Literature suggest that the key element of University-Industry Partnership (UIP) is the exchange of knowledge that is mutually beneficial for both parties (Gertner et al., 2011; Meyer-Krahmer & Schmoch, 1998). One real example of the collaborations is Industry-Based Learning (IBL) in which university students are coming into industries to experience and learn how the skills and knowledge acquired in the classroom are implemented in workplaces. This research will investigate the impacts f IBL program on students' academic performance upon their return to university life.

A1.3 **Provide an overview of your research participants and their involvement** (max 250 words)

The purpose of this question is to gain a sense of who the participants will be, and what you expect them to do within the research

This study identifies three group of participants of the study:

1. University students who has experience in IBL program.
   This is the first group of participants. Students with IBL experience are the main target of participants in this research project. They will voluntarily be asked to participate in the interview and questionnaire.
2. University staff who have supervised a student in an IBL program.
   The second group of participants are the academic staff who had involved in the IBL program as a supervisor for students. The data will be collected from this group through interview.
3. Employees of organisation involved in IBL programs.
   The third group of participants will be staff or employees of organisations that accepted

students for participating in an IBL program at their organisations. The data from individuals within this group will be collected in an interview.

Among all stakeholders, the centre of attention is on students who involved in the IBL program. The other stakeholders are supporting elements that help students to achieve the best possible outcome in their IBL program.

There are two selection criteria that will be used to select the participants:
1. Be the current students within the STEM disciplines and academic staff (sessional, contract and full time) of selected universities and staff from industry partners who had experience in supervising the Industry Based Leaning (IBL) programs. These groups are essential for the proposed research since they are the individuals who has been experience the teaching and learning in the STEM disciplines. This study will explore their lived experience.
2. Students must have involved in the Industry Based Learning (IBL) program and for the university and industry staff they must have supervised IBL students. This study is about exploring the lived experience of students and staff who involved in Industry Based Learning program, therefore the participants must have involved and experienced the IBL programs previously.
The participants' IBL experiences will be explored in face to face interview with the researcher

A1.4 **Provide a summary of the merits of this proposed research (in LAY LANGUAGE) including the aims / hypotheses / research questions** (refer to Section 1 of the National Statement, NS1.1, when preparing your response)**.**

- Include potential contributions to the body of knowledge and methodological rigor (max **250** words).Briefly provide evidence that the proposed research is based on knowledge of the relevant literature, and provide a list of key references. You may also attach a research plan / methodology which does not substitute for the summary above – this attachment should be no longer than **6** pages.**NOTE:** Unless proposed research has merit (and the researchers who are to carry out the research have integrity) the involvement of human participants in the research cannot be ethically justified.

The University-Industry Partnership has increasingly become an important feature of modern universities (Breen & Hing, 2012; Lind et al., 2013; Malfroy, 2011). Universities are now encouraged to enhance their collaboration with outsiders such as industries and manufacturers (Lind et al., 2013). This is to position the institutions as an agent of change to innovation and creativity while also maintaining its status as contributor to social well-being of society (Malfroy, 2011). The universities are also expected to recognise the need to equip their graduates with practical skills and working knowledge required in competing for job opportunities (Holt et al., 2004). Researchers suggested that the University-Industry Partnership can be in many sectors but the main dominant sector is in the research sector (Lind et al., 2013; Malfroy, 2011).

The IBL program can play an important role in equipping STEM graduates with the necessary skills, knowledge, and experience to enter workplaces (Mehta & Sun, 2013; Tong & Waltermann, 2013). However, to what extend the IBL program can enhance the students' academic performance after their return to university is less articulated in the literature. This research, therefore, aims to investigate the impacts of the IBL program towards the students' academic performance.

A1.5 **Why should this be considered a negligible OR low risk application?**

Refer to Chapter 2.1 of the National Statement when preparing your response and note that:

- 'Negligible risk research' describes research in which there is no foreseeable risk of harm or discomfort; and any foreseeable risk is no more than inconvenience (e.g. filling in a form, participating in a street survey, or giving up time to participate in research)**.**

- 'Low risk research' describes research in which the only foreseeable risk is one of discomfort (e.g. minor side-effects of medication, the discomforts related to measuring blood pressure, and anxiety induced by an interview).
- Research in which the risk for participants is more serious than discomfort (e.g. where a person's reactions include pain or becoming distressed) the research cannot be considered low risk.

Chapter 2.1 of the National Statement on Ethical Conduct in Human Research (available at http://www.nhmrc.gov.au/book/chapter-2-1-risk-and-benefit) describes that 'Low risk research' is research in which the only foreseeable risk is one of discomfort (e.g. minor side-effects of medication, the discomforts related to measuring blood pressure, and anxiety induced by an interview). This research on IBL project is considered to be low risk research because the only foreseeable risk if any is minor participants' discomfort when attending the interview in which participants must decide the place and the time that best suit both participant and interviewer.

A2 Potential Risks and Benefits (refer to Chapter 2.1 of the National Statement when preparing your response)

A2.1 Describe ALL the identified potential risks and who may be affected by these risks e.g. researchers, participants, participant community and / or the wider community. Ensure all risks mentioned at A2.1 are discussed here, and that the risks and their management are consistent throughout the application and are discussed where applicable in the Participant Information Sheet and Consent Form.

When gauging the level of risk ensure you take into account:

- The kinds of harm, discomfort or inconvenience that may occur.
- The likelihood of these occurring.
- The severity of any harm that may occur.
- The choices, experience, perceptions, values and vulnerabilities of different populations of participants will also be relevant.

There is very limited and small potential for risk beyond normal day-to-day living and the inconvenience of participating in the interview and questionnaire. Since this research is utilising a case study through interview and questionnaire for data gathering, the only foreseeable risk involve in this research is minor participants' discomfort when deciding the place and the time for attending the interview and participating in questionnaire. This can be minimised by contacting participants early and giving sufficient time for participants to consider for participating in this study.

A2.2 How are the risks to be minimised? And how will they be managed if they were to occur during the study or arise after the completion of the study?

NOTE: The greater the risk to participants in any research for which ethical approval is given, the more certain it must be both that the risks will be managed as well as possible, and that the participants clearly understand the risks they are taking on. Ensure all risks mentioned at A2.1 are discussed here, that the risks and their management are consistent throughout the application and relevant information is included in the Participant Information Sheets and Consent Forms.

Potential participants will be clearly informed that participation is voluntary and they can withdraw at any time. To minimise the risk of participants' discomfort, participation in the study can take place at a time and a place that is convenient and comfortable to the participant. Participation will not involve any physical, legal, social, psychological or any other risk. Participants will be advised before participating in the project and at the commencement of the interview that the focus of the research is on exploring their experience in the IBL programs and its impact on their academic performance at the university.

A2.3 What are the potential benefits of the research and who would benefit from these?

- Benefits of research may include, e.g. gains in knowledge, insight and understanding, improved social welfare and individual wellbeing, and gains in skill or expertise for individual researchers, teams or institutions.
- Some research may offer direct benefits to the research participants, their families, or particular group/s with whom they identify. Where this is the case, participants may be ready to assume a higher risk than otherwise.

It is expected that the research findings will offer useful insights and create a new knowledge in the field of STEM education and collaborative learning. The research will contribute to existing knowledge by providing empirical understanding of the impact of Industry-Based Learning on students' academic performance. These outcomes will contribute to Indonesian Universities by providing evidence based knowledge that can be used to improve the quality of their University-Industry Partnership program and inform Indonesian higher education authorities and their industrial partners of an alternative approach to enhance their IBL programs.

A2.4 How do the benefits justify the risks?

- Research is ethically acceptable only when its potential benefits justify any risks involved in the research.

The potential risks associated with participating in the project are minimal. The benefits outweigh the potential risks involved. The participant's involvement in this project can be regarded as their contributions to the development of IBL program at their education institutions and regions. The findings can offer useful insights and knowledge for a better understanding of how the IBL program impacting the student's academic performance at Indonesian higher education institutions. The findings can also be used to enhance the quality of their university's partnership with the industry partners.

A3 Other General Information

A3.1 Where will the data be collected? (e.g. on site at QUT or other location)

NOTE: If you would like to conduct your study at the premises of an external organisation/association please ensure you provide a copy of your intended approach letter which requests their support/permission for this, or provide evidence of this if already gained.

	QUT	X	Other – details:	Indonesian Universities, Indonesia

A3.2 Is the QUT Human Research Ethics Committee (UHREC) the primary or only ethics committee reviewing this proposal?

If **NO**, provide details of any other institutional HREC involved and the role of each institution (including QUT) in the project. If the project involves more than one institution that also has a HREC, please provide details on the role of QUT UHREC; whether arrangements can be put in place for to minimise multiple review; arrangements for communication of the roles/responsibilities between the institutions HRECs, e.g. who will monitor etc.

Yes

A3.3 What are the estimated timeframes for the project? (dd / mm / yyyy)

NOTE: Data collection cannot commence until you have received formal written UHREC approval.

Start of project	19 January 2014	**Start of data collection**	
End of project	31 January 2017	**End of data collection**	

SECTION B: PARTICIPANT OVERVIEW (refer to Chapter 2.2 of the National Statement when preparing your response)

B1.1 Who will be approached to participate? Clearly outline each participant group.

Provide details of the potential participant pool. If you are accessing secondary data please provide full details, including whether permission has been sought. If you are accessing Queensland Health data, you should determine (http://www.health.qld.gov.au/ohmr/) if it is necessary for you to submit a QH application (under the Public Health Act).

This study identifies three keys participant of the study:

- university students who participate in IBL programs
- university staff of where students undertaken the study
- employee of host organisations involve in IBL programs

B1.2 How many participants do you need for your study and approximately how many will you need to approach?

The study requires ten to twenty students but recruitment emails or letters will be distributed to around 60 students. In regards to academic staff and employees, between five to ten academic staff and employees will be asked to participate in the study and the recruitment letter will be prepare accordingly. The participants will be contacted via letter and/or email. The email addresses or postal address of students and university staff as well as the staff from industry supervisors are all obtained from related schools/departments of participating universities.

B1.3 How will potential participants be identified and approached?

NOTE: If you would like to recruit participants via an external organisation/association please ensure you provide a copy of your intended approach letter which requests their support/permission, or provide evidence of this if already gained.

The consent form will be provided to participants via email when their interview time is confirmed. They will be asked to return the signed form at the time of their interview. The researcher will also have copies of the consent form available at the interviews.

B1.4 How will the participants provide their consent to participate?

Outline the consent process you will use, what type of consent will be requested (i.e. specific, extended or unspecified – see NS2.2.14), what material will be provided to participants, how long participants will have to consider their decision to participate and what discussion will occur with participants.

NOTE:

- A person's decision to participate in research must be voluntary and informed i.e. not forced, coerced or obtained by improper inducements AND based on sufficient information and adequate understanding of both the proposed research and the implications of participation in it (the purpose, methods, demands, risks and potential benefits of the research).
- The process of communicating information to participants and seeking their consent should not be merely a matter of satisfying a formal requirement. The aim is mutual understanding between researchers and participants. This aim requires an opportunity for participants to ask questions and to discuss the information and their decision with others if they wish.

The consent form will be provided to participants via email when their interview time is confirmed. They will be asked to return the signed form at the time of their interview. The researcher will also have copies of the consent form available at the interviews.

B1.5 Will the project involve participants who are unable to give voluntary or informed consent?

If **YES**, what special arrangements will be put in place to protect your participants' interests/welfare?

These questions refer to research involving:

- Children and young people whose particular level of maturity has implications for whether their consent is necessary and/or sufficient to authorise participation (see Chapter 4.2 of the National Statement).

- Persons with a cognitive impairment, and intellectual disability, or a mental illness (permanent or temporary) which impacts upon their ability to supply voluntary and informed consent (see Chapter 4.5 of the National Statement).
- Persons who are highly dependent on medical care, e.g. unconscious or unable to communicate their wishes (see Chapter 4.4 of the National Statement).
- Covert observation of behaviour, particularly if this relates to sensitive, contentious or illegal activity consent (see Chapter 2.3 and Chapter 4.6 of the National Statement).

NOTE: Where participants are unable to make their own decisions or have diminished capacity to do so, respect for them involves empowering them where possible and providing for their protection as necessary.

No

B1.6 Do you propose to screen or assess the suitability of the participants for the project?

If **YES**, clearly state and explain the criteria (inclusion and exclusion, as applicable) for selecting potential participants.

Yes, the participants will be asked to self-select for the study based on two criteria. They must:

1. Be the current students within the STEM disciplines and academic staff (sessional, contract and full time) of selected universities and staff from industry partners who had experience in supervising the Industry Based Leaning (IBL) programs. These groups are essential for the proposed research since they are the individuals who has been experience the teaching and learning in the STEM disciplines. This study will explore their lived experience.
2. Students must have involved in the Industry Based Learning (IBL) program and for the university and industry staff they must have supervised IBL students. This study is about exploring the lived experience of students and staff who involved in Industry Based Learning program, therefore the participants must have involved and experienced the IBL programs previously.

B1.7 Will participants be offered reimbursements, payments or incentives?

If **YES**, also provide the specific details (type and value), how and when it will be provided and whether its offer could compromise the voluntary nature of the consent obtained from participants.

NOTE: Details of these should be provided on the Participant Information Sheet.

- It is generally appropriate to reimburse the costs to participants of taking part in research, including costs such as travel, accommodation and parking. Sometimes participants may also be paid for time involved. However, payment that is disproportionate to the time involved, or any other inducement that is likely to encourage participants to take risks, is ethically unacceptable (NS2.2.10)
- Decisions about payment or reimbursement in kind, whether to participants or their community, should take into account the customs and practices of the community in which the research is to be conducted (NS2.2.11)

No reimbursements, payments or incentives will be offered to participants.

B1.8 Do you, or others involved in facilitating or implementing the research, have a pre-existing relationship with the proposed participants? Could this result in the proposed participants feeling obliged or coerced into participation?

Refer to Chapter 4.3 of the National Statement and the QUT Research Data Collection in Classrooms or Lecture Theatres guidance when considering/preparing your response.

If **YES**, describe this relationship and how you will address the special ethical issues this raises (e.g. potential coercion in recruitment). Also outline what special arrangements will be put in place to protect the interests / welfare of potential participants.

NOTE:

- Pre-existing relationships may compromise the voluntary nature of participants' decisions, as they typically involve unequal status, where one party has or has had a position of influence or authority over the other.
- Examples may include relationships between employers or supervisors and their employees; teachers and their students; carers and people with chronic conditions or disabilities or people in residential care or supported accommodation; etc (see Chapter 4.3 of the National Statement for more examples).
- While this influence does not necessarily invalidate the decision, it does mean that particular attention should be given to the process through which consent is negotiated.

It is possible that the participants may be peers or academic staff from the researcher's previous workplace. The recruitment materials will clearly state that participation is voluntary and the decision to participate or not will not impact on existing relationships.

B1.9 Will you conduct a debriefing session at the end of the research or at the end of each participant's involvement?

If **YES**, please provide the details of this session. **NOTE:** Such a session is required for research involving deception (see Chapter 2.3 of the National Statement), and may be appropriate if the research is likely to cause discomfort to participants.

No, but at the end of the interview, participants will be advised on the process involved in the study following their interview

B1.10 Consider providing feedback to participants as this is encouraged by the National Statement.

Will feedback and/or the research results be reported to participants?

- If **YES**, explain how this will be done and in what form this reporting will occur.
- If **NO**, explain why the participants are not to be provided with such a report.

The participants will be advised that the feedback will be reported to the university management and the possibility that the result will be published in academic journals or/and conferences. A summary of outcomes of the research can be provided to interested participants through email.

SECTION C: DATA MANAGEMENT

C1 Future Use of Data

C1.1 Is it likely / possible that any of the data collected will be used by you, or others, for any research other than that outlined in this application? See Chapter 2.2 and Chapter 3.2 when preparing your response.

If YES, describe below and ensure this is outlined in all your participant information sheets and consent forms.

- Participants should be fully informed of the possibility of any future use of data collected and their 'extended' or 'unspecified' consent gained. Failure to do this may restrict the future use of the data.
- Any restrictions on the use of participants' data should be recorded and the record kept with the collected data so that it is always accessible to researchers who want to access those data for research.
- Please note that data sharing is increasingly being encouraged to gain maximum benefit from research, so a **YES** response is encouraged in most cases. If **YES**, describe below and ensure this is outlined in all your Participant Information Sheets and Consent Forms.

Yes, it is possible that the data collected will re-used for the research purpose related to the project.

C2 Procedures & Protection

C2.1 What data collection procedures will be utilised?

Place an '**X**' in the relevant boxes below **AND** provide a copy (draft or finalised, labelled as such) of the relevant instrument, protocol or other written form used to guide (e.g. interview questions/guide) or collect data (e.g.

survey) or include an explanation of the method by which the data will be collected. Clinical experimental measures / tools or creative works are considered "Other Instrument".

X	**Questionnaires/Surveys**	X	**Archival records**
X	**Interviews**		**Focus groups**
	Other instrument – provide details:	(If there is insufficient space below, provide details in an additional separate document)	

C2.2 Have the data collection procedures been previously approved by QUT or are they an academic standard instrument? If **YES**, provide brief details on prior approval or where instruments have been used previously, e.g. under a similar research context

Yes. Semi-structured interviews through case study are common method of data collection in information system research at QUT.

C2.3 In what form will the human data be collected, stored and used/reported?

In each row, indicate which form of data (eg. interviews, questionnaires etc) applies for your study.

At least one column must be completed in each row but if different data are in different forms, you will need to complete more than one box in each column or row.

	Individually Identifiable i.e. Data from which the identity of a specific individual can be reasonably ascertained eg. name, image, date of birth, and/or address.	**Re-Identifiable or Potentially Re-Identifiable** i.e. Data from which identifiers have been removed and replaced by codes, but it remains possible to re-identify individuals, eg. by using the code or linking different data sets.
Collected	Yes	No
Stored	Yes	No
Used/Reported	No	No

C2.4 Is this project funded?

If **YES**, outline what rights the funder of the study will have to data obtained from the study, and in what format e.g. aggregate reports only, access to raw data or other. **NOTE:** Any access by the funder should be made clear to participants.

No

C2.5 How will confidentiality of the study records be protected during the study and in the publication of results?

NOTE: If you intend to identify participants or organisations, this needs to be made clear on the Participant Information Sheet.

Participants will be individually identified on the audio recording of each interview, however, no personal information that may identify the interviewee is presented in the transcription. Once they are transcribed, the recordings will be stored in an individually identifiable manner. In no circumstances that the names will appeared or reported in the results or publications.

C2.6 Is this a collaborative project?

If **YES**, also provide brief detail on data-sharing arrangements e.g. open – all parties have access to each other's data; partial – data held by collaborator completing particular component.

No

C2.7 **Who will own the resulting research data and the created intellectual property?**

Place an '**X**' in the relevant box/es below – at least one box must be checked. If relevant you can check more than one box, ie QUT and an external organisation. Please refer to the D/3.1 Intellectual property (IP) policy for further information.

	QUT STAFF – QUT is the owner of IP created by staff members in the course of their employment.
X	**STUDENT/S** –The IP generated is personally owned by the student if not assigned to QUT or other organisation.
	BOTH QUT & STUDENT/S – If the IP for the student project has been assigned to QUT, ownership of data and IP is shared. – **Please confirm an IP agreement has been signed by both the student and supervisor.**
	EXTERNAL ORGANISATION – Give details:

NOTE: QUT requires an IP agreement to be in place if IP ownership is to deviate from that described in D/3.1 Intellectual property (IP) policy. Please contact the relevant section of the Division of Research & Commercialisation if you require any further assistance.

C3 Storage & Security

Ensure you refer to the QUT Data Management Checklist **BEFORE** completing this section.

- Data should be stored in a locked filing cabinet at QUT and/or electronically on a QUT mainframe drive.
- Data must not be stored solely at home.

C3.1 **X** **YES** **Confirm that your research data and other records will be stored for the required period.**

Refer to the Guidelines for the Management of Research Data at QUT

C3.2 **HARD/PAPER COPIES...** (e.g. **signed consent forms**, are required to be kept for **15 years** as per the Qld State Archives Schedule)

Qld State Archives:

http://www.archives.qld.gov.au/Recordkeeping/Governance/Pages/Default.aspx

University Sector:
http://www.archives.qld.gov.au/Recordkeeping/GRKDownloads/Documents/Universities.pdf

C3.2.1 **What is the location/s of storage?** (i.e. QUT room/building location and/or offsite storage location)	Level 10, GP S- Block, QUT Garden Point Campus
C3.2.2 **How will access to the stored data be controlled?**	Consent forms will be kept in a locked filing cabinet.
C3.2.3 **Who will have access to the stored data?**	The researcher and his PhD supervisor.

C3.3 **ELECTRONIC DATA...**

C3.3.1 **What is the location/s of storage and back-up?** (i.e. a secure computer/server and/or offsite storage location)	Files will be stored on the researcher's personal storage and backed up on a QUT network drive.
C3.3.2 **How will access to the stored data be controlled?**	Password protected files
C3.3.3 **Who will have access to the stored data?**	The researcher and his PhD supervisor.

Participant Information and Consent Form

Queensland University of Technology Brisbane Australia	**PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT – Interview –**

The Impact of Industry-Based Learning on Students' Academic Performance: A Case Study of Indonesian Higher Education

QUT Ethics Approval Number 1500000732

RESEARCH TEAM

Principal Researcher:	Rajibussalim	PhD student
Associate Researcher:	Dr Tony Sahama	Supervisor
	School of Electrical Engineering and Computer Science,	
	Science and Engineering Faculty,	
	Queensland University of Technology (QUT)	

DESCRIPTION

This project is being undertaken as part of PhD research project for Rajibussalim.

The purpose of this research is to develop an understanding of what are the impact of Industry-Based Learning (IBL) on student's academic performance at Indonesian Higher Education Institutions.

You are invited to participate in this project because either you are current Indonesian university students or current university staff or employee of industrial partner institutions who have been involved in the Industry-Based Learning.

PARTICIPATION

Your participation will involve an audio-recorded interview at a location suitable to you and/or using Skype if you are university staff or industry employee who are not able to meet face to face. The interview will take approximately 60 minutes of your time.

The following questions are representative of the ones you will be asked during the interview:

Do you find any benefits of doing IBL program?

What kind of skills students need to prepare to attend the IBL program and why?

How do you describe your whole experience after attending the IBL program?

Do you learn any new knowledge and skills during your IBL program?

Do you think these skills will enhance your academic performance at university?

Your participation in this project is entirely voluntary. If you agree to participate you do not have to complete any question(s) you are uncomfortable answering. Your decision to participate or not participate will in no way impact upon your current or future relationship with QUT or your university/Institutions. If you do agree to participate you can withdraw from the project at any time without comment or penalty.

EXPECTED BENEFITS

The research output may not benefit you directly but it is expected that the research findings will offer useful insights and knowledge about the impact to IBL program on students of the Science Technology Engineering and Mathematics (STEM) discipline at your university. The research will contribute to existing knowledge by providing empirical understanding of the impact of Industry-Based Learning on students' academic performance. These outcomes will contribute to Indonesian Universities by providing evidence based knowledge that can be used to improve the quality of their University-Industry Partnership program and inform Indonesian higher education authorities and their industrial partners of an alternative approach to enhance their IBL programs.

RISKS

There are minimal risks associated with your participation in this project. It is important to note that the focus of the research is on the participant experience when undertaking or supervising the IBL program

The research team does not believe there are any risks beyond normal day-to-day living associated with your participation in this research.

PRIVACY AND CONFIDENTIALITY

All comments and responses will be treated confidentially unless required by law. Any data collected as part of this project will be stored securely as per QUT's Management of research data policy.

Your interviews will be audio recorded:

- It is not possible to participate in the research without being audio recorded.
- You will not have the opportunity to verify your comments and responses prior to final inclusion.
- The recordings will be transcribed and the audio recordings will be retained until the project is completed, at which point they will be destroyed.

- The recordings will only be used to assist with analysis, and will not be used for any other purpose.
- The recordings and transcriptions will only be available to the research team.
- Participants name will not appear in transcription.

CONSENT TO PARTICIPATE

We would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

If have any questions or require further information please contact one of the researchers listed below.

Rajibussalim	**rajibussalim@hdr.qut.edu.au**	**+61 7 3138 6462**
Tony Sahama	**t.sahama@qut.edu.au**	**+61 7 3138 1131**

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Advisory Team on +61 7 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Advisory Team is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.

Queensland University of Technolo Brisbane Australia	CONSENT FORM FOR QUT RESEARCH PROJECT – Interview –

The Impact of Industry-Based Learning on Students' Academic Performance:

A Case Study of Indonesian Higher Education

QUT Ethics Approval Number 1500000732

RESEARCH TEAM CONTACTS

Rajibussalim	**rajibussalim@hdr.qut.edu.au**	**+61 7 3138 6462**
Tony Sahama	**t.sahama@qut.edu.au**	**+61 7 3138 1131**

STATEMENT OF CONSENT

By signing below, you are indicating that you:

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw at any time without comment or penalty.
- Understand that if you have concerns about the ethical conduct of the project you can contact the Research Ethics Advisory Team on +61 7 3138 5123 or email ethicscontact@qut.edu.au.
- Understand that the project will include an audio recording.
- Agree to participate in the project.

Name .....

Signature .....

Date .....

***Please return this sheet to the investigator*.**

Ethic Approval Letter

Raji Rajibussalim

From:	QUT Research Ethics Advisory Team
Sent:	Thursday, 17 December 2015 5:06 PM
To:	Tony Sahama; Raji Rajibussalim
Cc:	Janette Lamb
Subject:	Ethics application - approved - 1500000732
Attachments:	UHRECSTANDARDCONDITIONSOFAPPROVAL-HUMANRESEARCH.DOC

Dear Dr Tony Sahama and Rajibussalim

Project Title: The impact of Industry-Based Learning (IBL) on students' academic achievement: A case study of Indonesian higher education

Ethics Category: Human - Low Risk
Approval Number: 1500000732
Approved Until: 17/12/2017
(subject to receipt of satisfactory progress reports)

We are pleased to advise that your application has been reviewed and confirmed as meeting the requirements of the National Statement on Ethical Conduct in Human Research.

I can therefore confirm that your application is APPROVED.
If you require a formal approval certificate please advise via reply email.

CONDITIONS OF APPROVAL
Please ensure you and all other team members read through and understand all UHREC conditions of approval prior to commencing any data collection:
> Standard: Please see attached or go to
http://www.orei.qut.edu.au/human/stdconditions.jsp
> Specific: None apply

Decisions related to low risk ethical review are subject to ratification at the next available UHREC meeting. You will only be contacted again in relation to this matter if UHREC raises any additional questions or concerns.

Whilst the data collection of your project has received QUT ethical clearance, the decision to commence and authority to commence may be dependent on factors beyond the remit of the QUT ethics review process. For example, your research may need ethics clearance from other organisations or permissions from other organisations to access staff. Therefore the proposed data collection should not commence until you have satisfied these requirements.

Please don't hesitate to contact us if you have any queries.

We wish you all the best with your research.

Kind regards

Janette Lamb / Debbie Smith
on behalf of Chair UHREC
Office of Research Ethics & Integrity
Level 4 | 88 Musk Avenue | Kelvin Grove
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Appendix C: National Strategy on WIL

National Strategy on Work Integrated Learning in University Education

1. Provide national leadership to expand Work Integrated Learning (WIL)	
Enabling approaches	**Actions**
1.1 Collaborate in driving an expansion in WIL opportunities.	**a.** Partners advocate for the implementation of this National Strategy on WIL. **b.** Partners build support for WIL around shared, complementary objectives and interests, engage their membership, identify issues requiring attention and seek resolution. **c.** Agree a common language and interpretation of WIL (what it is and is not) which is readily understood by all participants.
1.2 Ensure mechanisms are in place to enable collaboration, implement the Strategy and strengthen the partnership.	**a.** Partners develop and report publicly on progress in implementing the National Strategy on WIL, and to **b.** Partners ensure the work agenda is informed and supported by their executive and relevant advisory bodies and that other key stakeholders – including, for example: the Office of the Chief Scientist; the Business-Higher Education Roundtable (B-HERT); profession or industry-specific bodies – are engaged actively in the agenda.
1.3 Engage the support of political leaders and policy makers.	**a.** Promote the agenda to relevant portfolio Ministers and their agencies, and secure their agreement to **b.** Identify WIL champions (or ambassadors) from across sectors and government. **c.** Convene a high level roundtable of business, employer, university and relevant Commonwealth government portfolios to identify and develop a coordinated cross-portfolio approach to progress the National Strategy (*See Item 3.1*).

	d. Ensure developments in WIL complement other government policy and investment priorities - including in Higher Education policy; the Industry Innovation and Competitiveness Agenda; the Reform of the Federation White Paper process; VET reform; implications of Free Trade Agreements (FTAs); proposed re-vitalisation of a national Careers Development Strategy; the review of immigration and visa programmes; state and territory policies and programmes where appropriate. e. Contribute to national surveys and the development of performance indicators to assess and monitor the extent and satisfaction of student and employer participants in WIL, noting the need to: • agree a common language and interpretation of WIL (Action 1.1c) • complement the Quality Indicators in Learning and Teaching (QILT) initiative (announced in the 2014-15 Budget) and related surveys on satisfaction and outcomes and • contain the associated reporting cost and burden.
1.4 Establish a national profile of current WIL activity to inform next steps and future growth opportunities.	**a.** Develop a work program to systematically collect data and establish a baseline of the spread and extent of WIL activity undertaken, student participation and demand as part of a university course in Australia: • Draw on existing research and information, such as base-line data collected by the Office of the Chief Scientist on STEM subjects during 2014. • Identify existing mechanisms and opportunities to collect additional information needed to establish the baseline profile.
2. Clarify government policy and regulatory settings to enable and support growth in WIL	
Enabling approaches	**Actions**

2.1 Align government policy and regulation to support growth in WIL.	a. Work with Commonwealth agencies to convene a roundtable of business, employer, university and other relevant stakeholders to identify and develop a cross-portfolio agenda to enable growth in WIL and address regulatory impediments (including unintended impacts associated with unaligned policy): • Scope to include taxation arrangements impacting on employers and universities; income support for students; treatment of 'work experience' under the Higher Education Administrative Guidelines.
	• Involving (for example) the Department of Education and Training, Department of Industry (including the Office of the Chief Scientist); Department of Employment (including the office of the Fair Work Ombudsman); Australian Taxation Office; Department of Immigration and Border Protection. • Seek government commitment to convene the roundtable during 2015. **b.** Ensure information about the workplace relations status of WIL participants is accurate, clear and readily available to facilitate appropriate placements (continuing work with the Fair Work Ombudsman to clarify distinctions between *vocational work-based placements* and *unpaid work).* Address areas of potential confusion and emerging issues regarding workplace relations and workplace-based WIL – including (as required) employment status and obligations; workplace health and safety; workplace insurance and liability; and issues related to sensitive personal/commercial/other material.
2.2 Ensure reliable information is available to students and employers to support the integrity of interactions involving third party providers arranging internships.	**a.** Noting the increasing presence of third party providers seeking to engage with universities and students to access internships for payment, develop and disseminate resources, including guidelines on the efficacy, risks and benefits, role and operation associated with third party providers. (*Refer 5.2d and 8.1d*)
3. Build support - among students, universities, employers across all sectors and governments - to increase participation in Work Integrated Learning	
Enabling Approaches	**Actions**

3.1 Ensure clear, concise and accessible information about WIL is available.	**a.** Collate, develop (as needed) and promote access to tailored information resources about: • What WIL is – including examples illustrating the breadth of discipline, settings and approaches employed. • Roles, responsibilities and expected outcomes for i) employers ii) students and iii) universities participating in WIL and what each can expect in terms of the parties engaged.
3.2 Promote the benefits of WIL.	**a.** Articulate the value proposition of WIL for each key WIL target audience (e.g. The practical benefits for – such as completion of short term projects, workforce planning and recruitment, industry promotion: For students
	– the practical application of learning, development employability skills and cultural awareness, indust connections etc.). b. Develop a national communication and engagement strategy – including examples of WIL; who benefits and how; case studies; how to get involved. c. (Subject to resourcing capacity, possibly drawing on existing programmes aimed at promoting business and skills development) Develop tailored strategies in priority areas – for example: • Promoting STEM, working through the Industry Working Group established by the Office of the Chie Scientist; • SME participation in WIL; • Particular students cohorts e.g. Indigenous studen students with caring responsibilities; • Rural / regional; and • Specific industry/sector participation – such as agribusiness, high end manufacturing, informatio and communications technology (ICT), financial services, etc.
3.3 Improve the capacity of students and employers to prepare for and engage in WIL.	a. Establish good practice guidelines, including pre-participation expectation and outcome guides, support materials, processes and sample templates to support effective WIL practice (noting relevant work is currently being supported by the Commonwealth Office of Learning and Teaching).

	b. Ensure specific learning objectives of the WIL experience, including 'soft skills', are assessed as part of the experience and are understood and agreed by all parties involved prior to commencement (e.g. interpersonal skills, team work, organisational skills, understanding the workplace environment).
	c. Investigate a framework to assist in facilitating partnerships between universities and employers
3.4 Draw on available research to improve the quality of WIL experiences and the levels of participation in WIL.	a. Collate and promulgate the extensive research and knowledge available on WIL. b. (Subject to resourcing) Use research findings to develop and implement pilots in sectors and situations where impediments have been identified but which offer strong prospects for benefit and growth (e.g. STEM; SMEs and select industry sectors; remote and regional; international students; multi-disciplinary projects and placements).
	c. Develop a coordinated, prioritised WIL research agenda across government, with an immediate emphasis on expanding and broadening WIL (drawing on work undertaken by the Office of Learning and Teaching, Department of Industry and the Office of the Chief Scientist). **d.** Draw on available research and practice to develop pilots and effective implementation. **e.** Research the effects of WIL participation on student and graduate motivational and attitudinal change and resilience effects. **f.** Develop a national research and evaluation framework for WIL in the medium term to refine effective practice and build the evidence base for targeted future investment (possibly including models to quantify the costs, benefits and maximise the return on investment of WIL practice).
4. Ensure the investment in WIL is well targeted and enables sustainable, high quality experiences, stakeholder participation and growth	
Enabling Approaches	**Actions**

4.1 Identify the costs and benefits (including return on investment) with WIL for all stakeholders; and promote a sustainable resourcing / investment system.	a. Work with government agencies to undertake a comprehensive assessment of the value of WIL in terms of student outcomes; employer benefits; employer/university engagement; professional and workforce development; and the economy; and considering: • An assessment of existing financial and other support mechanisms, and their effectiveness; • Employer/ business incentive structures; • WIL resourcing arrangements in universities; • Student support programs; • Best practice, innovative approaches that ameliorate the costs of WIL; and • Opportunities to develop and promote **b.** Advocate for coherent policy and investment structures that effectively support WIL activities and partnership. **c.** Work with government to identify existing resources to enable progress of the National Strategy.
5. Develop university resources, processes and systems to grow WIL and engage business and community partners	
Enabling Approaches	**Actions**
5.1 Strengthen WIL capacity and practice in universities.	a. Develop and promote a WIL leadership and guidance framework – a resource to assist universities to develop and tailor WIL activity – including aspects such as policy and resourcing, culture, external engagement, pedagogy, curriculum development, WIL logistics, implementation, assessment, evaluation and quality assurance, staff capability and practitioner professional development. b. Identify and profile examples of best and innovative university support for WIL practice and engagement: • To resource and embed WIL as a core function/priority in university operations; and

	• To facilitate engagement of academic staff in WIL activities, through performance agreements, incentive structures or other mechanisms. c. Rewards and recognition: identify and profile examples of effective reward and recognition frameworks that include and promote work integrated learning.
5.2 Promote employer engagement and improve access and support.	a. Identify the resource implications associated with effective industry engagement and implementation b. Review university access and response processes and strategies to enable external parties to better identify, navigate and contact appropriate staff – considering coordination, referral and brokerage approaches and options; arrangements within universities, across relevant discipline areas nationally; and the university sector as a whole. c. Review existing on-line resources to improve useability, currency and comprehensiveness of information, including resourcing requirements. d. Review and report on the use and potential of third party intermediaries and brokerage organisations, including charging, quality assurance and regulatory arrangements.
5.3 Increase accredited WIL content in course curricula.	**a.** Review a range of WIL activities undertaken as unit(s) of a university course to: • Assess the relevance to curricula requirements (including authenticity, integration of theory and practice, alignment with learning outcomes and assessment); • Identify whether the activity is mandatory or optional; and • Identify whether the activity is a) formally assessed and b) for credit. **b.** Pending the findings in 5.3a) work with stakeholders to promote incorporation of appropriate WIL experience into accredited course curricula. **c.** Identify good practice approaches and examples of industry and community input to curricula development, involving: • A review of course curricula development processes and practices; • Identification of issues that promote or impede assessment of WIL as 'for credit' in curricula; and

	• Key stakeholders, including senior university academic leaders, academic boards, TEQSA, professional accreditation and employer/industry bodies, graduates and students, in the process.
5.4 Strengthen university collaboration around WIL.	**a.** Identify and promote mechanisms to enhance university collaboration around resource development for WIL.
5.5 Strengthen capacity through increased professional development available to the sector.	**a.** Identify and promote mechanisms to increase professional development and access to development opportunities for WIL practitioners, and academic staff.

6. Build capacity for more employers to participate in Work Integrated Learning

Enabling Approaches	Actions
6.1 Increase employer participation in WIL.	**a.** Business and employer peak bodies promote WIL and the benefits to members and provide support based on evidenced based research supporting the business case for WIL.
	Subject to resourcing:
	b. Develop WIL communications and resources tailored for employer audiences, including clear expectations and support resources/arrangements for work-based supervisors - such as a 'handbook' including examples of successful models, guidelines, check-lists, templates, pre-placement/project agreements and sign off arrangements, reliable university contact/support mechanisms, feedback mechanisms.
	c. Develop and make available examples of WIL best practice, including innovative and diverse approaches including university based business-identified projects and on-line and virtual WIL options.
	d. Employers and universities collaborate to develop options to: • ease administrative loads associated with establishing WIL placements (such as facilitating streamlined student and employer matching); • investigate options to better align placement (or project) scheduling and duration to optimise participation opportunities and learning value for

	the student; minimise workplace disruption/optimise employer benefit; and • facilitate the input of employers into placement design.
6.2 Increase Small and Medium Enterprise (SME) participation in WIL.	**a.** Draw on available research and stakeholder expertise to develop, trial and increase WIL • Develop tailored information and resources, case studies, support and engagement options (e.g. university- based projects, tied to enterprise need, multi-enterprise and/or multi-discipline projects and virtual/on-line options).
6.3 Develop WIL in specific and priority sectors.	**a.** Develop and trial pilots in priority industries/sectors to accelerate WIL growth in: • Enterprises in the five key sectors identified for Industry Growth Centres under the Government's *Industry, Innovation and Competitiveness Agenda* (specifically targeting food and agribusiness; mining equipment, technology and services; oil, gas and energy resources; medical technologies and pharmaceuticals; and advanced manufacturing) – noting the Industry Growth Centres are charged with setting strategies and delivering outcomes, including enhancing workforce skills, and have a goal of forging links between industry and Australian research; and • Areas of prolonged and/or anticipated major skills shortage or mismatch – such as Science, Technology, Engineering and Maths (STEM) subjects (e.g. physical sciences); Information and communications technology; Financial and Insurance services. **b.** Work with relevant industry bodies and university Deans groups to develop specific discipline, context and host support material. **c.** Investigate and promote entrepreneurship and innovation skills development through based WIL, such as: • pilots that bring entrepreneurs, start-ups and innovative SMEs together with universities, enabling them to access cross-discipline capacity and to direct WIL activity to meet a specific business need.

6.4 Build and track employer engagement.	**a.** Incorporate employer participation trends in data collection, research and evaluation strategies – *noting it is part of a broader data collection strategy and contains reporting burden (Refer action 1.4).*

7. Address equity and access issues to enable students to participate in WIL

Enabling Approaches	Actions
7.1 Improve access and equity for students to take-up WIL opportunities.	**a.** Develop and disseminate principles, guidelines and implementation strategies to increase access and • the extra costs for students (e.g. housing and transport expenses and foregone earnings) often associated with participation (particularly placements); and • assistance in managing caring responsibilities, health or other personal needs; and considering factors such as location, re-location, age, visa requirements for students, caring responsibilities etc.

8. Increase WIL opportunities for international students and for domestic students to study off-shore

Enabling Approaches	Actions
8.1 Increase opportunities for international students to participate in WIL.	**a.** Develop and disseminate principles, guidelines and implementation strategies to increase access and **b.** Address issues identified as constraining opportunities for international students to participate in WIL; **c.** Encourage employer preparedness to accept international students, by: • Raising awareness among employers of the benefits of, support for and positive models of engaging international students in WIL (projects and placements); and • Work with government agencies to ensure coherent and clear information is readily available for employers and others about the status of international students regarding placements, post-study work rights, visas, and the reciprocal objectives and benefits of government programmes to promote student mobility and employability *(See Issues 1.3(d) and 7.1).*

	d. Work with ACEN and other key stakeholders to review the role and operation of third party providers to developing guidelines for universities with students paying to intern overseas.
8.2 Improve the capacity for international students to participate in WIL opportunities.	a. Develop resources to increase the preparedness of international students to participate in WIL, including: • Preparing students for the specific workplace and cultural aspects of the host or partner industry and employer; • Tailoring support and contact details for employer supervisors and contacts, including language/translation supports if required; • Assessing language proficiency and mechanisms to address these – e.g. Intensive language units; engaging in group or team based WIL where members can facilitate effective communication; • Develop additional tailored student supports; and • Examine possible incentives for employers to take on international students
8.3 Support access to credit bearing off- shore placements for Australian students.	**a.** In the context of Australian government programmes to promote student mobility and associated experience, work with government agencies, relevant accreditation bodies and professional associations to ensure off-shore experiences are embedded in course curricula and accredited where possible.