# Professional experience, practice-led teaching, and employability

# for

# IT degree programmes in Hong Kong

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by

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# Abstract

The purpose of this doctoral study is to explore how IT practice-led teachers inform their professional experience on the educational experience of IT degree students and the relationship which emerged from this investigation on graduates' employability in the specific context of the IT field which is composed of the primary and secondary IT sectors, operating in the global dimension in terms of talents and markets. A mixed methods approach is adopted in this study, consisting of semi-structured interviews with practice-led teachers, student surveys (course-level and programme-level) and class observations for disciplinary inquiry, and integrated research is used for exploring the topic of project management. Key emerging themes include practice-led teaching profiling and the importance of capital distinctions; co-curricular course design, experiential learning and networking; the organising principle between the first principle's teaching approach and vocational training approach, positioning of educational authenticity and authentic work practices in acquiring applied and practical practices, classroom community of disciplinary inquiry on intellectual project works, and the integrated view on project management among different research instruments.

This study is specific to the context of IT degree programmes with reference to the Hong Kong higher education system. The research implications may be relevant to other contexts whose programme orientations are applied and practical in nature when the notion of knowledge structures for expertise development is considered. This potential is identified in the study. The educational value can be drawn to the possible concepts of educational authenticity and resemblances in the acquisition of professional practices in the university environment.

## List of Abbreviations

| | |
|---|---|
| AIW | : Authentic Intellectual Work |
| BCS | : British Computer Society |
| CEQ | : Course experience questionnaire |
| ELT | : Experiential learning theory |
| GDP | : Gross domestic product |
| GDPR | : The General Data Protection Regulation |
| HP | : The Hewlett-Packard Company |
| IBM | : International Business Machines Corporation |
| ICT | : Information and communications technologies |
| ILO | : International Labour Organisation |
| IEEE | : Institute of Electrical and Electronics Engineers |
| ISACA | : Information Systems Audit and Control Association |
| IS | : Information Systems |
| IT | : Information technology |
| OECD | : The Organisation for Economic Cooperation and Development |
| PMI | : Project Management Institute |
| PMP® | : Project Management Professional® |
| SEO | : Search engine optimisation |
| UNCTAD | : The United Nations Conference on Trade and Development |
| UNESCO | : The United Nations Educational, Scientific and Cultural Organisation |
| USEM | : The Understanding, Skills, Self-Efficacies, and Metacognition (USEM) model of employability through the curriculum |
| WIL | : Work-integrated Learning |
| WTO | : World Trade Organisation |

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# CHAPTER 1 INTRODUCTION

## 1.0 Introduction

In the distant past, universities were viewed as ivory towers with privileged status to nurture elite students. The primary objective of academic research institutions was historically focused to generate new knowledge through the laboratories of academic and scientific research and at that time, the universities had full autonomy on how to develop academic programmes and educate students. When the economies of developed countries started to boom in the late 70s, the role of higher education turned into a pivotal topic for policymakers who started to expect the universities to play an active role in making contributions to economic growth by producing more graduates to become productive workers. This phenomenon becomes very common in many governments all over the world, and this trend carries on to the current knowledge economy or New Economy which is dominated by socio-economic development. The European Union (EU) and the United States (US) are responsible for setting out the top-level initiatives or frameworks to direct the educational policies, allowing the individual member states or nation's states to design their state's educational policy. In the UK, the Dearing Report (1997) envisions a learning society, and the Browne Report (2010) makes recommendations on higher education funding and student finance. In Asia, the teaching medium in the universities of Singapore and Hong Kong is the English language, bringing the cities into the competition.

In Hong Kong, in accordance with the Education Bureau, the government's policy on post-secondary education focuses on providing multiple and flexible articulation pathways for young people. Currently, there are about 50% of the relevant age cohort accessing degree education and the long-term direction is to develop Hong Kong as a regional education hub (EDB, 2022), and such initiative has begun since 2007 (Mok and Cheung, 2011). The University Grants Committee of Hong Kong, the main government funding body, plays a key role in planning and monitoring all the government-funded universities and the agenda of

quality assurance is managed in form of a territory-wide “management audit”, making the fashionable notion of “market sensitive” among the university administrators (Mok, 2000, 161).

The growing trends of the knowledge-based economies in different parts of the world can shed some light on the growing demand in labour markets and the increasing competition in international markets; meanwhile, these market forces strongly push higher education institutions to produce more productive young people to better support the economic performance in the societies. Nowadays, one of the key missions in university education is to nurture the graduates to become smarter and more knowledgeable, and then to become true experts in their respective disciplines one way or the other, making their career aspirations part of the life-enhancing journey while contributing to the field and the society.

## 1.1 Background to the study

The idea of this doctoral research originated from my intention to find ways in helping fresh IT graduates to have a good career start from a graduate job, while the main theme of the study is triggered by one encounter in my first graduate job and one in my further study.

After graduated from university in the UK, I got my first graduate job in a product marketing role at a local IT company in Hong Kong and I was impressed by the hiring manager who offered me the job right after the job interview and even offered me better pay than in my job application. Long years after, I still could recall what he said, “I want you to work happily in the company”. Looking back, it was probably because I was the right candidate and the hiring manager wanted to keep me in the company. Yes, I liked my graduate job because I worked smoothly, with no problems in getting the work done. The manager always assigned me tasks with clear expectations, and sometimes gave me some sample documents like product promotion plans for my reference. Though I was a fresh graduate, I received good support for my work. Starting to join the industry practices and the

marketing “community of practice” in the IT field, the role of my manager was the “old timer” who taught me as a “newcomer” how to perform the job properly and effectively (Lave and Wenger, 1991). About six months later, I was told to attend a meeting with one key product manufacturer and to learn how to get resources and support from the supplier, but it happened I joined their discussion. After the meeting, my manager was impressed by my ability in grasping the insights as a product officer in product positioning in a competitive landscape and sharing my thoughts in the meeting. It was probably due to the benefit of ‘short distance’ support from my supportive senior peers whilst my potential development in the job was ‘in collaboration with more capable peers’ (Vygotsky, 1978). Shortly after that meeting, my manager announced reforming the product marketing team, from the job role as owner of product brands (e.g., Apple, HP, IBM, Microsoft) to the owner of product categories (e.g., laptops, desktops, servers) across different brands. Revisiting that experience, my manager was a smart leader in leveraging the best knowledge and skills of the staff and limiting the staff headcounts for cost savings because product category owners need to possess higher-level skills, like analytical skills and market sensitivity.

The other experience was in the master’s degree course in project management where the instructor arranged a guest lecture conducted by a senior executive from a global bank. The industry speaker shared with us the launch of the bank’s large-scale IT projects, such as the roll-out of the online banking system as one of a few globally at that time. In his sharing session, he did not introduce the top-notch technologies deployed by the bank but rather emphasised the different kinds of considerations that his team needed to be taken into consideration, like the consensus with business users who were the sponsors for the IT project budget and the actual users of the systems. To me, that was an insightful lecture, and it has changed my perceptions about the roles of IT staff in a company, and that has motivated me to take on a new and challenging job as a solution consultant at a later stage, improving the malleability of my self-efficacies (Dweck, 1999).

The above two encounters were invaluable experiences. When I started to think about my research thesis, I revisited my own positive experiences, for instance, a good manager’s

industry experience can help a newcomer to pick up the job efficiently, and an industry guest speaker can give insights to the students, who later made a change in job role within the field. Why the guest lecture could attract me and promote my higher level of thinking and self-reflection because the sharing was contextually relevant and meaningful to me, allowing me to reflect on what he said. Therefore, I show great interest to explore how the professional experience of some practice-led teachers can support the students' learning. On the other side, the market conditions are always changing, and the IT industry is kept advancing; to remain competitive, university graduates do want to always keep employable when changing jobs. Accordingly, it is reasonable to have the research topic of professional experience linked to the notion of the USEM model of employability, which is the model covering the areas of understanding (U), skills (S), self-efficacies (E) and metacognition (M), and that is the current debate topic and also supported by my academic supervisors. Together with my previous working experience in the IT industry, and my familiarity with identifying some relevant research participants in the universities, I would like to explore how teachers with professional experience can influence the learning of their taught students, in what ways and to what extent the IT degree students can be benefited from their practice-led teaching in terms of graduate job and career development, that is, the graduates' employability.

## 1.2 Degree programmes related to information technology

The outlook of the information technology (IT) industry has continuously been robust. Driven by the advanced technological innovations in this digital era, the global economy is enjoying unprecedented economic growth as well as facing unforeseeable challenges. The digital economy, conceptually, "comprises goods and services that either were produced using digital technologies or include these technologies" (Henry-Nickie et al., 2019, 3). Digital technologies are largely becoming the dominant role in affecting the factors of economic growth, national security, and international competitiveness while the information and communications technology (ICT) industry underpins economic performance and contributes to job creation in the digital economy. ICT assets generally

consist of computer hardware, software, internet communications, and broadband infrastructure. Based on the economic study on OECD countries (Spiezia, 2013), it is found that "increased GDP growth and country-specific global competitiveness can be primarily attributed to growth rates in ICT investment" (Henry-Nickie et al., 2019, 3). Reviewing the structural change within the ICT sectors, creates the transformational shift from a manufacturing focus to a service focus, illustrating the corresponding move from a hardware-centric to a software-centric level of growth. The emergence of increasing focus on the ICT service and software sectors leads to changes in workforce demand and supply in the IT industry. Overall, "the proliferation of digital technologies will continue to bring unprecedented structural changes to the U.S. economy, cementing the IT industry's position as a leading source of growth and employment" (Henry-Nickie et al., 2019, 9).

In a broader sense, most of the world nations have been speeding up the adoption of emergent technologies such as cloud computing, artificial intelligence, machine learning and 5G technologies to promote ongoing growth in the region. The report recognises that the aggregation approach in analysing the current IT industry trends is ineffective to provide a complete picture of all sectors in the IT fields, which are comprised of the productions from a pool of different industries in the primary and the secondary sectors. The primary IT sector refers to those firms whose primary outputs "consisted of hardware, software or IT services" (Trauth et. al., 2007, 115; NRC, 2001). The secondary IT sector is defined as those "firms whose primary business is something other than providing IT goods or services" (Simon et al., 2007, 353), or regarded as the IT-intensive industries whose IT employees "work primarily at the applications and user level" (NRC, 2001, 54).

The IT discipline is considered one of the core industry domains to support economic development, and based on the OECD study on GDP measurement, reveals the role that "new technologies play in fostering productivity and economic growth" (Ahmad and Schreyer, 2016, 3). According to the National Research Council (2001, 282, 279), "the IT sector and IT-intensive industries are fundamentally global, both with respect to markets and talent"; and IT professionals are commonly viewed to have wider choices in the job

market because “the universe of IT employers is highly heterogeneous”. The secondary IT sectors (NRC, 2001, 40-41) are observed as “the numerically dominant users of IT talent”; for instance, in the U.S., the percentage of IT staff hired by manufacturing firms, finance and related industries, retail and wholesale trade and government sector were 18%, 11%, 7% and 9% respectively. Combining with those employed in the primary IT sector, “IT workers are necessarily found in all sectors of the economy” (NRC, 2001, 45), implying that firms, both small-and-medium enterprises and large firms, need to have their IT function or IT department to support their business operations.

IT graduates, working in IT firms or as in-house IT staff in the technology-enabled sectors, need to apply what they learned in the universities in their jobs. The emergence of new technologies creates new business models and generates advanced emerging occupations, which are related to those recent and exciting technologies of artificial intelligence, blockchain, Internet of Things, cloud computing, robotic automation and 5G technologies (Henry-Nickie et al., 2019). For example, the job role of ‘data scientists’ is “most closely related to data analyst and statistician”, who are required to handle the big data technology and thus, expected to possess a new set of skills to perform their job like machine learning (Ho et al., 2019, 16).

In this study, the context is IT discipline, and the study scope focuses on those degree programmes related to information technology. The names of the undergraduate degree programmes include information technology, computer science, information systems, information engineering, IT security and so on. All these degree programmes are technical-oriented, and IT degree programmes as the umbrella term is adopted in this study, whereas the design of each degree programme can be focused on the specific stance of IT, such as computer science is a software-driven study, information systems are a relatively less technical but more consultancy-based study, and information engineering is oriented in studying communication protocols on network infrastructure and architecture. However, all these differences do not have an impact on my study as the research focus is not to compare degree programmes but rather, the contextual nature of IT knowledge and skills

acquired in different degree programmes should be aligned because IT jobs require teamwork, team members working together to develop the IT systems and solve the problems together if they arise. Putting them under one umbrella of IT discipline can be advantageous to create a holistic view of IT degree programmes because IT departments or IT projects are made up of different types of IT jobs as a performing team.

## 1.3 Research aims and questions

The overall objective of this study is to explore the academic value of professional experience in university teaching in relation to IT graduates' employability. The teaching staff, who possess long years of industry experience in the IT field, joining the teaching profession in universities, is the relevant and good research source for investigation and understanding. Professional experience is lived, and intrinsic and thus, this research study is rather challenging as Perkins (2006) described it as a 'conceptual submarine' for the students. Through the study of some practice-led teachers of IT degree programmes, it is hoped to elucidate the following:

- their professional profiling whose relationship with practice-led teaching methods and approaches,
- their professional experience's formulation as part of the course materials in the curriculum design, and
- their teaching pedagogy in relation to the graduates' employability.

The main research aim is to explore the teaching pedagogy of practice-led teachers in IT degree programmes and the sub-questions are:

- What is the profile of practice-led teaching in IT?
- How does the IT curriculum design support the graduates' employability?
- In what ways, can the practice-led teaching pedagogy facilitate the acquisition of disciplinary knowledge and skills by IT degree students?

## 1.4 Current academic concepts, models, and theories

Below are the main academic concepts, models, and theories underpinning this study:

- Nature of knowledge and skills: knowledge structures, absorptive capacity
- Capital theories: human capital, social capital, network capital, employability capital, graduate capital
- Curriculum design: The Understanding, Skills, Self-Efficacies, and Metacognition (USEM) model of employability through the curriculum, work-integrated learning (WIL)
- Authenticity: educational authenticity, authentic intellectual work (AIW)
- Experiential learning: experiential learning theory (ELT), networking
- Knowledge transferability: case-based, scenario-based, encapsulation

## 1.5 Research positioning

This research project aims to study practice-led teachers, IT practitioners (see Table 4.1), and their students who study in IT degree programmes in Hong Kong. As for myself, I possess many years of working experience in the information technology field in the capacity of local and regional job roles, related to different marketing positions and client management, most for IT vendors; and also providing support for the project teams and attending their project meetings with clients. Though I am not considered a technical staff, my capability in understanding technologies is good enough to meet the expectations required in the jobs. Therefore, I am an insider, possessing field knowledge and skills, and strong market sensitivity to the IT industry.

Research interviews with the practice-led teachers were conducted in open discussion protocol because the questions are semi-structured, allowing me to ask for more explanations based on some of their responses in the subject matters and their experience

sharing. Therefore, I acted as a "key instrument of research" in conducting the interviews (Cohen et al., 2018, 247). They knew that I understood what they said, and thus they were very eager to share their thoughts and give me more examples as the illustrations. Five out of the six interviews turned up to take longer than the original schedule. Correspondingly, most of the questions in the semi-structured interviews were extended to cover some sub-topics which were brought up by the practice-led teachers during the interview discussions, see Appendix 3.7: Log sheet of the discussion flow. Those sub-topics could supplement the initial set of interview questions, letting me go deeper into the theme of the study and better understand their teaching pedagogy. To some extent, some of the sub-topics were co-created by the interviewee and me, the researcher, during each of the research interviews since I have formed "part of the researched world" in this study (Cohen et al., 2018, 247). I would also like to indicate at the beginning that when conducting the data analysis, my understanding and interpretation are backed by my own experience in the industry. It implies that my role as the researcher cannot be completely objective, whereas I "strive to be impartial" when I "use evidence to reach conclusions" (Newby, 2014, 131). The declaration of the researcher's position in the study is necessary to acknowledge the readers while allowing them to judge the researcher's objectivity.

## 1.6 Significance of the Study

This study starts from the IT practitioner's approach to examining the practice-led teachers' pedagogical approaches in informing their professional experience on the educational experience of the IT degree students for their acquisition of disciplinary knowledge and skills. It is learned that it can be concluded by applying some of the academic theories. Some of the analysis may explain the work of Peeters et al. (2019) in employability capital. IT discipline is an applied and practical profession, demanding close integration between theories and applications through professional practices. Hence, the centrality of IT students' learning is technicality and practicality; whereas "the field of academic information systems is dynamic" because the subject area studied by the students is dynamic (George and Marett, 2019, 222). The contextual barriers, however, create the

teaching and learning gaps between university education and workplace practices, and that is acknowledged by educators, IT practitioners, and employers. Knowledge transfer is the buzzword commonly used by all parties but IT knowledge and skills are seen as easily obsolete.

In the study, the practice-led teachers are the subject to be studied; the capital distinctions denote their strengths and resources while the notions of educational authenticity articulate the values of the practice-led pedagogical approach in the learning process of the IT degree students in university education. The capital dimension is highly relevant in this study as the role of capital conceptions is recognised as the factor for increasing productivity gains whilst the authentic learning experience in the classroom or the lab is precisely meant for students' educational learning experience in professional practices. More importantly, it can facilitate the students to become reflective thinkers in the learning process in the trusted university environment where the students' malleability in self-efficacies is strengthened by allowing them to make mistakes and corrections; these are the self-efficacies (E) and the metacognition (M) in the USEM model of employability through the curriculum (Knight and Yorke, 2002), which in turn, can interact with and influence the other two variables of understanding (U) and skills (S) in the model, supporting the IT graduates' employability. It is achieved by converting their industry experience and professional practices into case-based and scenario-based course teaching materials as applied practices, or lab practices as practical practices; and also, through dialogical communications as authentic experiences for the students to do self-reflections.

In terms of academic relevance in the study, it is found that the concept of network capital (Huggins, 2010) and its relational dimension can be applied between universities and the industry through experiential learning activities as 'bonding ties' (Tomlinson, 2017) in networking between industry speakers or company representatives and the university students; in which the calculative ties (Huggins et al., 2012) can be perceived to be 'soft ties' in forms of potential employment opportunities. In addition, that may contribute to the interpretations of the identification of social capital, not as separate dimensions but loaded

on all dimensions of employability in the conceptual model of employability capital defined by Peeters et. al. (2019).

Moreover, this study is consistent with the theory of educational authenticity proposed by Splitter (2009, 142), which emphasises that disciplinary inquiry in the classroom can allow students to acquire authentic learning experiences and become reflective thinkers without the need to go via real-world experiences whereas ‘‘inquiry-based teaching is not context-free’’. However, this study comes up with ‘the alternative view’ on the pre-condition of related prior knowledge, which is rejected by Splitter who criticises the authentic intellectual work developed by Newsmann et al., (1995), by claiming the possible risks of pouring insert knowledge and subverting the constructive process of the student learning. In this study, the classroom disciplinary inquiry into the students’ intellectual project work after each project presentation in the class is truly an authentic learning experience engaged by the students who can become reflective thinkers. For it is learners-driven teaching, the project work in the context of IT disciplinary area can serve as the students’ related prior knowledge, their knowledge base, turning the dialogical conversations during the question-and-answer session into disciplinary inquiry between teachers, student presenters, and fellow classmates that the constructive student learning would not be subverted as the role of the teacher is more a listener and a facilitator.

In the field of IT disciplinary knowledge and skills, the orientation of the solutions proposed is for problem-solving, demanding the IT professionals to possess some related prior knowledge and that prior knowledge can be some IT theories or some practical experience, that is the concept of absorptive capacity (Cohen and Levinthal, 1990). The concept of knowledge structures between chains of practices and networks of understanding for expertise development can be served for explaining why educational authenticity for IT disciplinary learning requires the learners, the IT students, to possess some related prior knowledge. The same rationale can be applied to supporting the organising principle between academic teaching or the first principle’s approach and vocational training approach on course-level and programme-level. Learning IT concepts and theories,

Johnson's (1987) objectivist view of meaning is regarded as disembodied and received by a human mind rather than shaped by it; whilst Sfard's (1994) constructivist view can be adopted in the learning for solving IT problems as meaning is conferred through the understanding of the learner.

Based on the above understandings derived from this study, the role of related prior knowledge is retained as absorptive capacity, enabling the knowing capability of learners possibly to produce some forms of intellectual capital (Nahapiet and Ghoshal, 1998), and the notion of educational authenticity can contribute to the learning of IT disciplinary knowledge and skills, minimising the issues concerned by the academic scholars of authenticity. Therefore, the intended contribution to knowledge is that the professional knowledge of IT practice-led teaching can become the authentic learning experience for IT students; and this interpretation can be applied to other disciplines which are applied and practical, having similarities in the concept of knowledge structures for expertise development.

This doctoral thesis is organised into five chapters. Chapter 1 introduces the background, and the research aims of the research study, along with a review of the relevant literature in Chapter 2. Chapter 3 provides the rationale for the methodology and research methods adopted in this study while Chapter 4 details the data collected and the analysis of the findings. Chapter 5 discusses the findings corresponding to the literature review and Chapter 6 is the final chapter to conclude the study with some implications for future research work.

# CHAPTER 2 LITERATURE REVIEW

## 2.0 Introduction

Globalisation comprises a set of economic, cultural, social, and political levels in shaping the world. Due to the close interconnectedness between the economic and political levels (Slaughter and Leslie, 1997), it imposes changes in business sectors and the labour market. In the era of knowledge dominance, developed countries are transforming into a "knowledge-based economy where innovative ideas and technical expertise hold the key to the new global competitive challenge" (Brown et al., 2008, 4). Human capital is viewed as "a factor of production" and "growth of human capital is both a condition and a consequence of economic growth" (Mincer, 1984, 195); and it is pivotal that "labour is, of value in itself, can be developed to retain and enhance its value" (Tymon and Stumpf, 2003, 13). As described by Altbach et. al. (2009, 154), in the knowledge-based economies of most countries, higher education is posited as a major engine of economic development; and within the changing global contexts, "national and regional governments increasingly rely on universities to become an anchor in their national and regional innovation systems, which is critical for their survival as knowledge economies". The role of higher education in the 21st century will be explored in this chapter.

In response to economic globalisation, business sectors are looking for innovative ways to improve operations and e-commerce is seen as the most viable option supported by Internet technologies. According to the United Nations' global statistical report, it was estimated that "the global value of e-commerce sales (B2B and B2C) reached almost $26.7 trillion in 2019", representing about 30% of GDP, and B2B e-commerce sales were accounted to 82% of all e-commerce sales (UNCTAD, 2020, 4). With the emergence of new technologies, like frontier technologies, there are both opportunities and challenges arising in the labour market, including the creation of new job groups but some job losses in the low-skilled job categories. In the higher education sector, how can the universities deal with

the challenges in terms of 'academic practice' (Neary et. al., 2012) and also, better support the graduates' employability upon graduation. It is the main theme of this research study.

As for the IT industry, different kinds of technologies have to be applied and deployed before making contributions to businesses and societies and economic growth. According to Patrick et al. (2008), work-integrated learning (WIL) is the curriculum design intended for integrating theory with workplace practices, facilitating the student learning of disciplinary knowledge and skills in a real-world context (Smith, 2012). Besides, situated cognition or situated learning can help to promote a model of instruction with implications for classroom practice (Brown et al., 1989), articulating authentic learning for the students (Herrington and Oliver, 2000). So, the above will be explored to understand how they can provide support for the learning of IT degree students and meanwhile, the teaching pedagogies of educational authenticity (Splitter, 2009), authentic intellectual work (AIW) (Newmann et al., 1996, 2001) and competence-based authentic assessments (Gulikers et al., 2008) will also be discussed in detail. Regarding the graduates' employability, the USEM model of employability through the curriculum (Knight and Yorke, 2002) and the concept of experiential learning (Kolb and Kolb, 2013) will be used for assessing the curriculum design whilst the notion of graduate capital (Tomlinson, 2017) will be leveraged for understanding the practical implications for teaching and learning. The last part will investigate the literature on how knowledge can be retained and transferred whereby can help to understand whether the graduates can apply what they learned in university education in the workplace; if it is feasible, what are the implications in teaching and learning in the IT degree programmes.

## 2.1 The role of higher education in the 21st century

### 2.1.1 Globalisation, the new economy, and the global marketplace

Globalisation is regarded as a set of changes on economic, cultural, social, and political levels in shaping a globalised world (Waters, 1995; Stevenson and Tooms, 2010). Olssen et. al. (2004) characterise the uniqueness between different versions of globalisation: the economic level refers to the formation of a 'world economy', the cultural level to global cultural icons like McDonald's, and the political level to the establishment of powerful global political institutions like World Trade Organisation (WTO). Each version of globalisation is known for its importance but is structurally independent (Waters, 1995). According to Deem (2001, 7), globalisation is drawn largely on the economic version because it is "the global spread of business and services as well as key economic, social and cultural practices to a world market, often through multi-national companies and the internet". Slaughter and Leslie (1997) point out that the interconnectedness between the economic and political levels can impose changes on the business and labour markets, leading to the corresponding adjustments in higher education policies, enforced by politicians and policymakers. Stevenson and Tooms (2010, 9) further posit it as "an organising principle", allowing different versions of globalisation to cooperate while emphasising that "the integration of economic impulses and political ideas has become hugely powerful in a globalised world".

The concept of 'knowledge economy' (Cohen et al., 2000) or 'New Economy' emerged in the studies of the new growth theories in the late 1990s (Pohjola, 2002; Godin, 2004) as there are new patterns of structural changes in the economies of different nations, such as free movements of capital flows and deregulated international trade and investment. Productivity gains are key indices for growth performances (Pohjola, 2002). According to Godin (2004, 687), the long historical studies have exposed "the difficulty of measuring productivity correctly" and there were "limitations of using research and development as an indicator of science and technology"; however, it is the practice of classical economists to adopt the strategy of integrating productivity into the statistics to support for their policy-oriented framework, making their study reports always convincing. Baily and Lawrence (2001) indicate that the driving force for IT innovation originated from the demand for improved technologies within the service industries, but IT investments were unable to be identified as the primary factor in productivity. Rather, it is due to the innovations in products, business practices and technology leading to productivity gains (Farrell, 2003).

When the new economy implies a 'superior economic structure', the ICT industry can be viewed as the internal engine to facilitate the structural economic change in the economies (Pohjola, 2002). Once ICTs are adopted in all economic fields, accompanied by their rapid diffusion, it becomes the state of a 'digitalised economy' (Bukht and Heeks, 2017).

The power of economic globalisation is in the formation of superior economic structures in the world economy (Pohjola, 2002; Olssen et. al., 2004); those capturing these global trends successfully, can eventually outperform their rivals (Pohjola, 2002). The convergence of technological advancements and telecommunications into a single system (Dickens, 1998) has created "a volatile, dynamic, global competitive knowledge-focused society" (Hagen, 2002) in which the operation of the global marketplace is driven by the Internet, through the power of network computing. Kettinger and Hackbarth (2000) define e-commerce as doing business transactions over computer-mediated networks; and according to the global statistical report published by The United Nations, it was estimated that "the global value of e-commerce sales (B2B and B2C) reached almost $26.7 trillion in 2019. This corresponded to about 30% of GDP and represented an increase of 4% from 2018 ($25.6 trillion)". And the global B2B e-commerce sales (over the online market platform and electronic data interchange) were 82% of all e-commerce (UNCTAD, 2020, 4). E-business is interpreted as the new business model (Higgin, 1999), fundamentally transforming a company into a digitally networked enterprise, and heralding the new economy (Kettinger and Hackbarth, 2000, 78) where the success of e-business relies on the readiness of the redesigned business processes and the seamless connectivity to "the expanded enterprise through a universal digital medium to partners, suppliers, and customers", that is, to be supported by business process integration and cross-enterprise involvement with the external parties in the real world. Based on the United Nations' global report (UNCTAD, 2020, 6), there were about "1.48 billion people, or a little over one quarter of the world's population aged 15 and older, made purchases online in 2019. This is 7% higher than in 2018". There were "some 360 million online shoppers made cross-border purchases in 2019 – around one in four of all online shoppers", and these global figures disclose the popularity of making purchases overseas by online shoppers, increasing the need for e-business enterprises integrating with the extended enterprise in their e-infrastructure and business model.

The G20 leaders first acknowledged the opportunity for digitalisation at the 2008 Washington Summit and then five years later, they brought up the discussion of the 'digital economy' at the St Petersburg Summit 2013 for the first time as they discovered the gaps existed in the international taxation framework in handling the growth of online transactions (G20, 2020). Though Rouse (2016) offers the simplest description of a digital economy, an economy based on digital technologies, that can be articulated further as to belonging the worldwide network of economic activities enabled by information and communication technologies (ICT). Per G20 leaders' insight, "the digital economy refers to a broad range of economic activities that include using digitized information and knowledge as the key factor of production, modern information networks as an important activity space, and the effective use of information and communication technology (ICT)", driving for "productivity growth and economic structural optimization" (G20, 2016, 1). Niebel (2018, 205) launched a study to investigate the impact of ICT on economic growth in 59 countries and the findings proved that "ICT still contributes substantially to economic growth not only in developed but also in developing and emerging countries". However, the "G20 members struggle to keep up with the rapid pace of digital innovation" and "many countries experience the growth of digitalisation at different paces" (G20, 2020, para 2).

### 2.1.2 Human infrastructure, human capital, social capital, and network capital

Farrell (2003, 106) points out that "a key dynamic of the real new economy is the virtuous cycle of competition, innovation, and productivity growth". In knowledge-intensive societal environments, interconnectedness can energise the competitive conditions that the market players must look for new ways to innovate the business processes to improve productivity across different sectors. Whilst in a globalised world, competitions can help to encourage the economic sector to place significant considerations in the readiness and sustainability of the talent pool, "the human infrastructure", the term originated from the work of Star and Ruhleder (1996) who conducted the study on technological infrastructure, from which three

out of eight characteristics identified, “embeddedness”, “learned as a part of membership”, and “linked with conventions for practice”, are embedded with social practices and institutions (Sambasivan and Smyth, 2010, 2). This indirect discovery of the human side in infrastructure later has become a new research area, particularly for some IT academic researchers on cyberinfrastructure, and the study focus of human infrastructure is on the living of people in a range of economic and social activities, such as for work, education, and health care, in a civil society. Trauth et. al. (2007) argue that if the retention effort of the young and educated workforce is overlooked, it is possible that the human infrastructure may not be able to support the economic initiatives, though the physical IT infrastructure is ready in the region. Familoni (2006) offers a global view to confirm the pressing role of economic and social infrastructure as the superstructure of development and growth in the nations of both developed and still developing countries. When Kumari and Sharma (2017, 30) apply this ‘socio-economic view’ on infrastructure in their case study on the economic development in India, they claim that “economic infrastructure assists in production functions by lowering production cost and raising the productivity of labour and capital while social infrastructure helps to improve the efficiency and skills of manpower”.

The concept of human capital refers to labour, having a value in itself, who “can be developed to retain and enhance its value” (Tymon and Stumpf, 2003, 13) and the creation of human capital can be achieved by making “changes in persons that bring about skills and capabilities that make them able to act in new ways” (Coleman, 1988, S100). In the knowledge economy, human capital is regarded as ‘the educational attainment of the labour force’ (Benhabib and Spiegel, 1994), or ‘an accumulated stock of skills and talents in the educated and skilled workforce’ (Mathur, 1999) or ‘the competencies and capabilities of the workforce’ (Tymon and Stumpf, 2003), which is positioned as the pre-requisite for economic growth in the region. Based on Benhabib and Spiegel’s (1994, 166) research findings derived by running the growth accounting regressions in aggregate cross-country data, human capital as a factor and its accumulation “fails to enter significantly in the determination of economic growth”, and even the opposite result is shown. Rather, when the growth of total factors of productivity as a function of human capital is suggested as an alternative model, more positive results are found. “Human capital, although itself

produced by human capital and labour, is a significant input in the production of knowledge ideas"; and also, "human beings with knowledge produce more knowledge" (Mathur, 1999, 205). Due to the non-rival and non-excludable nature of knowledge, the resulting spillover effects can "create a wedge between private rewards and social benefits" as there is less market incentive for firms to produce more inventions and innovations, leading to the output level of knowledge "below the social optimum" (Mathur, 1999, 214).

Social capital is "social and individually held capital" (Huggins et. al., 2012, 207, 209) that can be articulated by an individual's ability to "mobilise their network to enhance personal returns with place-bound environments" or in a "geographic space". For Coleman (1988, S95), social capital is viewed as "a resource for action", denoting social structure as a rational action paradigm and having an influence on the development of human capital. Just like human capital, social capital can facilitate productive activity and "economic performance" (Nahapiet and Ghoshal, 1998, 243), which can be accomplished through a high level of trustworthiness and trust within a group. Sociologists see actors acting in a "social context" where their actions are also "shaped, constrained and redirected by the social context"; whereas economists see actors acting in their self-interest for "maximising utility". There are three forms of social capital, "obligations and expectations" within the social environment, "information channels" inside the social structure, and "social norms" accompanied by sanctions (Coleman, 1988, S119, S105); for a person gives up the self-interest for the sake of the interests of the collectivity, that is "work[ing] for the public good", this property of social norm can differentiate it from the other two forms.

Regarding mutual recognition within networks, Bourdieu (1986) identifies "durable obligations" coming from one's feelings of gratitude, respect, and friendship or from the institutionally guaranteed rights obtained through membership in a family, a class, or a school. Additionally, social status or reputation is a significant form of social capital, derived from joining "membership in specific networks", especially for those networks with "relatively restricted" membership (Bourdieu, 1986; Nahapiet and Ghoshal, 1998, 243). Other scholars following Coleman, however, argue that social capital is "an investment in

social relations" made up of individuals or actors to enhance their expected returns through personal access to the embedded resources in the social environment (Lin, 2001, 17). It implies that social capital carries the perceived value inherited in the 'social structure' (Coleman, 1988) or 'interpersonal social networks' (Dasgupta, 2005), generated through socialisation and sociability in the form of community participation (Borgatti and Foster, 2003). Alternatively, social capital can be defined as "a resource for persons" (Coleman, 1988, S98) in the creation of a localised trust, or "the stock of accumulated resources that one can access based on the relationships that can aid or be leveraged in accomplishing an end or furthering a pursuit" (Tymon and Stumpf, 2003, 12). Huggins (2010) acknowledges the resources embedded in relationships where the potential for information is inherited in social relations (Coleman, 1988) and agrees with Tymon and Stumpf's view on the important factor in one's ability to access by highlighting the value of resources accessibility in addition to its acquisition.

Huggins (2010, 348) proposes the notion of network capital where the perspectives of social capital and network resources are refined to become "inter-firm networks". This concept conveys two characteristics, the structure and content of relationships (Adler and Kwon, 2002), following the 'structural-relational embeddedness' (Granovetter, 1992) introduced by Nahapiet and Ghoshal (1998) who state that the structural dimension is the pattern of connections like the size and spread of the network, and the relational dimension is the nature or strength of connections. The distinction between social capital and network capital is that the former is generated by social networks focusing on the resource value created through "interactions between network actors based on a logic of sociability and social expectations" while the latter is formed through 'calculative' (Williamson, 1993) networks as means of capturing the resources embedded "within inter-firm networks based on a logic of business and professional expectations" (Huggins, 2010, 348). Therefore, the formation of 'network ties' (Scott, 1991) in inter-organisational networks, or 'knowledge networks' (Nahapiet and Ghoshal, 1998; Maggioni and Uberti, 2009) can be served for enabling the access and exchange of knowledge underpinning firm-level innovation. The motivation behind the firms' investment in these network ties is the expected economic benefits (Hite and Hesterly, 2001) or economic returns (Huggins, 2010). Inter-organisational

knowledge networks, through a complex set of interactions between internal and external actors, are crucial in the firm's innovation process where an individual or organisation can take more effective action (Drucker, 1989), as well as treated as a key element underlying the "economic success and competitiveness of regions" (Huggins et. al., 2012). Huggins et. al. (2012, 223) researched knowledge-based sectors, following OECD's definition, across three different regional settings on their investment in knowledge alliances, and the finding "confirms the role of strategically developed inter-organisational network forms as innovation catalysts". Moreover, for those firms having more knowledge-rich environment, non-localised networks are observed to be more supportive during the innovation process (Garnsey and Heffernan, 2005), indicating that more advanced local and regional economies are rather aggressive to establish their global knowledge networks to strengthen the knowledge base (Lorentzen, 2008).

### 2.1.3 The roles of universities as knowledge-based institutions in the 21st century

In the new economy, knowledge and innovative ideas are critical components of economic advantage, with 'intellectual capital' (Stewart, 1997) being a pivotal resource and human capital being highly appreciated as drivers for economic development (Florida and Cohen, 1999), that can be further supported by social capital (Huggins, 2000) linking up the interactions and relations among individuals and firms in developing the network capital (Huggins et. al., 2012) in global knowledge networks (Gertler and Levitte, 2005). With respect to the educational perspective, globalization is defined by Altbach and Knight (2007, 290) as "the economic, political, and societal forces pushing the 21st century higher education toward greater international involvement". Higher education, reacting to it or not, is affected by a changing world because globalization implies the provision of instant and extensive information that can weaken the place of higher education as a "provider of knowledge" (Neary et. al., 2012, xi). Hence, the traditional values of "collegiality, trust, and professional discretion" (Deem, 1998, 52) in higher education that characterise "academic

practice" (Neary et. al., 2012, 53) are also facing challenges since the role of higher education is expected to bring contributions in the nation's economic development.

The economies, particularly in the advanced countries, are now demanding "knowledge workers" (Tymon and Stumpf, 2003, 12), labelled as the people who can access and use significant portions of information from the extensive pool of resources. Knowledge workers are rather successful because they can learn fast and share with others in need and can "access the most relevant information" by differentiating it from that of the non-relevance and their success is largely built on the possession of highly adaptive problem-solving skills in dealing with technology and people, in addition to possessing a set of skills and tools. Mincer (1984, 195) highlights the importance of university education, which can "involve not merely the transmission and embodiment in people of available knowledge, but also the production of new knowledge; and its diffusion generates worldwide economic growth". The growing number of students graduating from universities year-on-year, supported by government policies to increase the literacy of the citizens, and the growing world population on the whole, these knowledge-based institutions can serve the ongoing supply of new pools of talent workforce in the economy once the university graduates start to enter the labour market. That is why Hagen (2002) said that universities are targeted by policymakers to aid economic regeneration because they are the largest 'knowledge-based institutions' in the regions.

Education is generally perceived to be critical to economic success in a global economy and education policy is central to addressing the educational purpose in a nation. This pair is inevitably linked to broader political philosophies and ideologies (Adams, 2014) as the purpose of education is "fundamentally bound up with wider questions about the nature of society" (Bell and Stevenson, 2015, 146). When universities are obligated to agree to increasingly "marketized practices", Neary et. al. (2012, 49) caution that the nature of the teacher-student relationship is seen to have been changed, and even the "professional identity" of teachers (Mclntyre, et al., 2019, 164) can be reframed by labelling 'good teacher' as the "compliant employee". Along with some of the published articles, below are

some highlights about the direction of higher education in the EU, the UK, the US, Asia Pacific, and Hong Kong.

As for the European Union (EU) 2020 strategy, both the education and training initiatives have become the main focus for policymakers to improve the existing stock of skills in the nation-states. According to Humburg et. al. (2013, 2), the EU plans for reducing school drop-out rates by having 40% of young people successfully attain a degree certificate by 2020 in the member states. Through the improved coordination of national and European policy, the EU aims at "smart, sustainable, inclusive growth" in the people's skillsets, leading to "an improved knowledge base in the population", and "bridging the gap between the worlds of education and work". This strategic plan releases the vision of the EU leadership team in the field of education but not specifying what exactly the educational institutions need to do.

In the UK, higher education is directly driven by the government's educational policies in every aspect. For instance, Dearing Report (NCIHE 1997) presents the UK vision of higher education development in the coming 20 years, recognizing the pivotal role of higher education in contributing to commercial success in a globalized economy while at the same time, "acknowledging traditional role of the university and the importance of widening participation still further" (Neary et. al., 2012, 46). Thirteen years later, the Browne Report's (2010) recommendations, once translated into policy, create tensions in government funding allocation in university teaching. However, the prime role of teaching in universities is not questionable because "universities are first and foremost geared to generating advanced knowledge through research at the same time as they disseminate that knowledge through teaching" (Dearlove, 2000, 263). Neary et. al. (2012, 104), hence, expose the foreseeable issues of negative impact on teaching quality and the peer review systems which "will not, therefore, be able to withstand the power and pervasiveness of the post-Browne quality agenda, reinforced by the discipline of market forces", pushing the academics to "internalize the new discourse and adapt their practice accordingly". Nationally, there is a UK-wide programme, the Knowledge Transfer Partnerships (KTPs)

launched over 40 years, aiming to “helping businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK Knowledge Base” through the cooperation between universities, businesses, the UK government, and other sectors (Moscardini et. al., 2022, 815).

In the US after World War II, one of the nation’s key education policy objectives was to achieve the mission of diversification, allowing different types of institutions to better serve a diverse set of students and social needs. “All government functions that are not specifically described as federal are reserved for the states by the US Constitution, which is silent on education” (Eckel, 2008, 178), is echoed in the study conducted by Moscardini et. al. (2022, 817) that the set of patterns in higher education like low state subsidies “in the early decades of the twentieth century are persisting today” and it is “the weight of history to matter considerably in state-level indicators regarding higher education (Goldin and Katz, 1999)”. Due to the increasing economic pressure, the relationship between states and their institutions is becoming rather complicated; according to the US Higher Education Policy, it mentions that “many states are now setting explicit objectives for their colleges and universities to contribute to, if not to be the centrepiece of, state or regional economic development efforts” (Eckel, 2008, 181). The National Governors’ Association (2007) in the US shows that most governors are expecting the increasing role of public universities to fuel the engines of the new economy by offering the innovations necessary for the generation of new ideas and skilled workers. Aronowitz (2000) reveals that learning is no longer the focus in the American higher education system as the primary goal of education is to facilitate the student’s identification with social and cultural authorities so that they can be trained for specific occupations or skills.

In contrast, Altbach and Umakoshi (2004, 19, 20) point out that “nowhere in Asia have the early stages of contemporary economic development been dependent on higher education”. Universities were traditionally educating the elites and thus, “governments invested little in higher education”. In the 1980s, the expansion of universities in Asia was largely driven by the emerging middle classes, “those seeking upward mobility in society”

and those developed countries, such as Japan, South Korea, Taiwan, and Singapore were no longer competitive enough when compared with lower-wage economies. Therefore, they were "forced to move toward becoming 'knowledge-based economies'" where the governments have started to see higher education as a key factor in national economic survival. Since then, higher education access and endorsement have grown more dramatically in Asia than in any other area of the world (Moscardini et. al., 2022). In the Asia Pacific region, universities in Hong Kong, Singapore, Malaysia, Australia, and Japan have kicked off the effort of internationalisation, following the global trend in marketisation, corporatisation, commercialization, governance, and management (Ng and Tang, 2008). Regarding the direction of higher education policies, the universities in the region are "greatly shaped by the institutes and practices of Western countries, especially the USA and UK, but also Pacific countries, notably Australia". In the example of the University Grant Committee of Hong Kong (UGC), which served as the main government funding body and was seen as the executive arm of the government in higher education (Mok, 2000), the reviews on research, teaching, and governance, including both the instruments and the assessment criteria adopted by the Committee, are mainly borrowed from the West, including the UK, the US and Australia (Mok and Cheung, 2011). Ng (2012, 450) expresses that universities in Hong Kong, Singapore, Malaysia, India, and South Korea are running in line with "the Anglo-American paradigm".

Since the early 1990s, the Hong Kong government has started higher education reform and "a landmark decision was made in 1989" to increase the number of students entering the undergraduate programmes from 6 per cent to 18 per cent in the 1990s and such "rapid expansion was completed by 1995" (Mok, 2000, 156), turning from an elitist system to a massive expansion in higher education in a short period. The quality assurance movement in the higher education sector was started in 1994 and viewed as the Hong Kong government's correspondence in both the wider global policy context and the context of local policy. The UGC's initiative on the development of centres of excellence within UGC-funded universities attracted more than 41 applications in November 1998 but only 5 of the applications were selected, showing that "more market-oriented principles and strategies" (Mok, 2000, 161) or Clark's (1983) typology of "market model" of governance identified in

the US, the UK, Australia, and Hong Kong (Shin and Harman, 2009, 8), are considered in the higher education sector of Hong Kong.

Based on the above government policy-related scenarios, the role of higher education has already intertwined with the economic agenda of the governments to support economic growth; and it is applicable in both developed and developing economies. The economic role of universities, in both types of economies whether government funding is allocated or not, is explicitly expected while this role is commonly measured by the number of university students who graduated each year. Those high-level strategic plans, educational reports, and white papers being described as "government policy drivers" (Neary et. al., 2012, 53), are used for predicting both the kinds of knowledge and skills and the supply of the educated workforce to be required for fulfilling the future needs of the society. In this sense, it is seen as the expected socio-economic role played by the universities. In the academic world, it has always been "characterized by centers and peripheries" (Altbach et. al., 2009, 10), whilst the strongest universities are "seen as centres" because of "their research prowess and reputation for excellence".

Accelerated by the impact of globalisation, the academic world becomes more complex when rankings, particularly international rankings, are more than a number. It challenges the status of universities, demanding them to find "their footing on the global higher education stage" (Altbach et. al., 2009, v) because these world league tables are posited as the benchmarking tool for higher education institutions (Hazelkorn, 2007), influencing the decision-making processes of many higher education institutions. Hence, universities and their offered degree programmes are, indeed, automatically entered into the political world of university ranking league tables, such as QS World University Rankings®, Times Higher Education World University Rankings (THE), and The Academic Ranking of World Universities (ARWU). Having a higher position in these league tables, the university is almost equivalent to winning a worldwide reputation, with better quality of staff and students, and probably attracting more public and private resources. Articulating to the country level, it would mean the third-party endorsement of its academic excellence and the more the number of

universities are at the top rank, the more global competitiveness the country is (Altbach and Balan, 2007). Under this academic-political setting, if the name of a university does not appear in any one of these league tables, could that university claim itself as part of the global university circle? It looks like a very difficult question to be answered. Hence, it becomes clear that universities are playing the triple 'economic-social-political' role as a whole. In the 21st century, higher education institutions are becoming increasingly crucial as an economic and social institutions to nurture more young people and equip them to be the knowledge workforce, as well as, acting as the ongoing direct support during the process of economic transformation in the nations.

Referring to the university institution level, Aronowitz (2000) votes for the notion of a "knowledge factory" and Jacoby (2001) coins it as an "academic factory", driving for true higher learning in universities and advocating for dismantling the idea of 'corporate university'. Such dismantling is commented on as "a biting critique of the corporatisation of higher education could have remained merely a pedantic diatribe against the non-critical manufacture of credentials as econometric worth and wealth for the elite" (Aronowitz and Burney, 2001, 157). Jacoby (2001) warns that if the higher education system surrenders independence, allowing learning in favour of more training, the needs of a democratic state will be overlooked. Universities in Europe are viewed as the key drivers of a knowledge-based society, with the European Commission (EC) placing them at the heart of Europe's knowledge triangle of research, education, and innovation. In terms of higher education policy, it is in "the centre of EU policy with the goal to create a 'Europe of knowledge' (Lisbon European Council, March 2000)" (Humburg et al., 2013, 2); whereas the universities experiencing the profound changes in responding to the macro-environmental factors (e.g., shifting demographics, internationalisation) need to "maintain its relevance" (Speight et al., 2020, 97). Higher education is observed to take on a slow journey towards re-conceptualising to be a 'sustainable university' because both sustainability literacy and digital literacy have started to move up the higher education agenda, though facing "the challenge of securing space within the "crowded" curriculum" (Speight, 2017, 2). Increasingly, the Internet becomes the dominant infrastructure for knowledge and information, acting as a repository and as a global platform for knowledge exchange

between people. Moscardini et. al. (2022, 821) appreciate seeing the transformation in the universities as "it is imperative for their survival", whereas "the multiple and diverse responsibilities of higher education are ultimately key to the well-being of modern society" (Altbach et. al., 2009, xxi).

## 2.2 Tensions of employability on graduate labour market, academic credentials, and employers' expectations

### 2.2.1 Tensions between massification of higher education, student mobility and employability

The changing demands in the knowledge economy, the digital economy, and the rising AI-enabled 'gig-economy' (UNCTAD, 2021, xix; ILO, 2016), intensified by the globalised competitive environments because of the rapid diffusions of new technology adoptions in businesses and individuals, all of these are imposing tremendous pressures on knowledge economies to strategize for economic development and growth and so do the higher educational institutions react for "survival" (Altbach et. al., 2009, 154). The rapid expansion of student enrolments in higher education in different parts of the world has been viewed as a universal phenomenon as policymakers leverage the educational policy to enlarge the pool of knowledge-based workforce and to minimise the size of the low literacy labour force in the nation for achieving the economic goals. Taking the UK as an example, "in 1950 only 20,000 degrees were awarded against a total of 500,000 today" (Moscardini et. al., 2022, 815). If such large volumes of student enrolments cannot be delivered within the existing operational and resource parameters by the universities, this kind of expansion can create tension between mass higher education and the quality of the teaching services delivered (Giannakis and Bullivant, 2016). Such tension raises concerns about the quality of higher education emerged as a 'world-wide phenomenon' (Akalu, 2016, 260) as what Vught and Westerheijden (1994, 357) challenged, "the extrinsic values of higher education have driven many governments to policies of quality control in higher education. The increasing costs of

higher education systems had to be legitimised by clearly definable societal benefits". In addition, the knowledge economy enhances "global mobility" of international students, encouraging "academe plans a central role in mobility" to attract students coming from other parts of the world (Altbach et. al., 2009, 2).

The trend for the massification of higher education, however, seems to be irreversible and the impacts are far-reaching, leading to an "overcrowded graduate labour market" (Anderson and Tomlinson, 2021, 675) and "credential inflation" (Tomlinson, 2008, 55). Based on the OECD statistics quoted by Pavlin and Svetlik (2014, 419), between 1997 and 2010, the age group of 25-64 years old with tertiary education increased "from 21 to 30 per cent" in the OECD countries. In the EU-21 countries, the increase was expanded "from 18 to 28 per cent" (OECD, 2012). In several developed countries such as Canada and the USA, the proportion of tertiary educated "exceeded 40 per cent". Similarly, in the European Union (EU) 2020 strategy, one of the key targets is to attain 40 per cent of young people who can complete a study in higher education by 2020 (Humburg et al., 2013). In Asia, the patterns behind the rapid expansion in the higher education sector and the fast-growing student enrolments in higher education are very different from the West; according to Asian Development Bank (2011), one of the major drivers is closely related to the marketisation and privatisation of higher education. "Without sufficient state funding, the growing 'privateness' in higher education is becoming a far more popular trend in Asia" (Mok and Neubauer, 2016, 6).

For the good of economic value and competitive advantage, it is government policy that is driving the transformation of educational systems from elite-centric to mass higher education to fulfil the demands of industries and employers. The question is whether there are enough job vacancies available in the labour market for graduates. According to the UNESCO data published in 2009 (Altbach et. al., 2009, viii-ix), more than 2.8 million students are studying outside their country of origin in 2007, and the estimated figures will reach 7.2 million internationally mobile students by 2025. The patterns of international student mobility show that students in Asia prefer to study in North America, Western Europe and

Australia and on the contrary, the students within the European Union are encouraged to mobility within the member states. "Globally, international student mobility largely reflects a South-North phenomenon" (Altbach et. al., 2009, ix). If the cohorts of degree programmes are oversized, the employment prospects can become scarce to the graduates; which can expose the issues to "societies facing workforce surpluses in some areas and shortages in others" (Altbach et. al., 2009, 104). Once this issue is escalated to the international level, it can create a potential imbalance in the supply and demand of the global workforce, possibly "leading to high numbers of unemployed and underemployed college and university graduates" (Altbach et. al., 2009, 68).

### 2.2.2 Tensions within higher education credentials and linking to graduate-level jobs

Higher education credentials are the 'currencies' (Tomlinson, 2008) presented as crucial for economic development as they can help to satisfy the changing needs of the knowledge-driven economy. However, the direct and linear relationship between the expansion of educational credentials and economic development underpinning the human capital model (Becker, 1993) is far from realistic and Tomlinson (2008, 49) criticises that there are "markedly different understandings about the role of higher education credentials as a source of economic growth, and the role of credentials in individual employability and labour market outcomes". The difference in the above understandings is contributed by considering education and training as an investment that can yield social and private returns (Ashton and Green, 1996), leading to the direct contrast to the positional conflict and credentialist interpretation of the relationship between educational qualifications and employment (Brown, 2000). The exponents of the credentialist model argue that the rise in academic credentials does not necessarily represent a genuine economic demand for more highly qualified labour, making the spread of educational credentials add little or no value to individuals' human capital but creating more pressure on them to acquire further qualifications for job access. The distinction between what is needed 'to get jobs' and what is needed 'to do jobs' (Tomlinson, 2008) suggests there are different stages in the career

development of individuals whereas the realisation in ease-of-movements between jobs is interpreted as 'movement capital' (Trevor, 2001).

The growing number of university graduates has created a paradigm shift in higher education credentials in some ways. The "graduate-ness" associated with higher education credentials has traditionally served as a "status confirmation" for the middle classes who can gain the positional advantage in the labour market through their social networks (Brown, 2000) and often, can enjoy the "legitimised educational and occupational advantage" (Tomlinson, 2008, 51) or named as 'cultural capital' (Tomlinson, 2017). Collins (1979) portrays it as the "mechanisms of social closure, limiting access to good jobs" (Adams and Demaiter, 2008, 353). Influenced by the trend for mass higher education systems, degree credentials become a popular academic achievement attained by more young people nowadays, creating tension among those who previously had the positional advantage over jobs but now are taking a relatively declining credential status, making the formally institutionalised cultural capital become "less potent in shaping access to employment" (Tomlinson, 2017, 343). Another shift is the increasing demands for soft skills, or "behavioural competences" (Tomlinson, 2008, 51) during the recruitment and selection process; based on the content analysis of 1,000 job advertisements in graduate recruitment databases, Bennett (2002, 457) found out that the majority of the respondents cited the adding of "interpersonal skills" in the profile specifications on job advertisements as "logical motives". That can pose new challenges to the university graduates' skills and competence in the early stage of entering the labour market (Brown and Hesketh, 2004) since these logical motives are rather subjective, subject to the interpretations of the interviewers in the recruitment process.

Due to the increasing global market competition and the demand for innovations, employers have shown less attachment to academic credentials, which have been traditionally presented in form of degree certificates acting as the indicator of knowledge level and intellectual ability in the graduates' employment. They are now becoming more interested in the candidates' attributes and skills, particularly soft skills like teamwork and

work experience (Harvey, 2000), treating these graduate attributes as the key selection criteria during the hiring process. In other words, a degree certificate is no longer a complete ticket to getting a graduate job and it alone is not enough to hit the "first-base" or a "tick in the box" in the recruitment process (Harvey, 2000; Tomlinson, 2008). Elias and Purcell (2013) echo it by questioning the reliance on the supply of graduates to indicate the market demand as it has increasingly become an unmatched scenario, especially when facing the pressures from the massification of higher education.

The definition of a graduate job is a controversial topic around graduate jobs versus graduate-level jobs and there is no consensus about what constitutes a graduate job (Green and Henseke, 2016). In the UK, it is the first destination graduate survey, inclusive of any employment in a six-month period (HEFCE, 2001), being criticised for creating the possibility to pervade the graduate labour markets if institutional discrimination existed (Knight and Yorke, 2002) but Pool and Sewell (2007) consider it as the simplistic approach of measuring graduate employability though accepting it as a very vague and imprecise indication of what the student has gained. Harvey (2001) also prefers to log it as the "first-destination returns" in the job type categorisation in his research project, acknowledging the considerable pragmatic pressure in keeping it simple for measuring graduates' employability. Likewise, it is suggested by Mason et al. (2009, 10) that "data on employment status six months after graduation may in fact be useful indicators of future labour market prospects". The notion of a graduate job is defined as any job that a graduate does in the UK by The Association of Graduate Recruiters, Harvey (2000) welcomes this definition for it reflects the diversity of graduate employment. On the contrary, it is strongly criticised as a pointless tautology by Green and Henseke (2016) who devise a set of time-horizon of skills with the term of graduate job incorporated, starting from a substantial portion of the skills already acquired in the university education, through the years after graduation the additional skills acquired in the workplace. Graduate-level job, Harvey (2001) refers to it as fulfilling work or career-oriented, requiring the graduates to possess graduate skills and abilities at work. Similarly, Knight and Yorke (2002) necessitate the requirements for graduates in possession of understanding, skills, and personal attributes to perform adequately in such a job.

### 2.2.3 Tensions on graduate employability between employers' perception and universities

"Employability levels fluctuate with capital demand" (Williams et al., 2016, 897) whereas the mismatch between the competencies developed in higher education and those that are favoured by employers is also acknowledged, creating tensions in the supply and demand of university graduates. Among the challenging concerns over employability, the priority is always on addressing the demands of employers "towards promoting the ready insertion of graduates in the labour market". In the 21st century, "academia is more than a promoter of employability", particularly when market demands can shift so rapidly, and the definition of degree programmes cannot be determined by the market (Abelha et al., 2020, 7). Per the desk research (Humburg et al. (2013, 86) investigation on the employability of university graduates, there are two contrasting perspectives obtained from the EU employers. One is the primary focus of higher education to "produce generalists because the world changes so fast that specific knowledge is soon rendered obsolete". Another perspective focuses higher education on developing "true experts" whose domain knowledge is the basis for professional expertise but admitting that "cannot be developed without content". Due to the issues of specific knowledge being obsoleted easily because of the fast-changing world, it is found that there is "a tendency for policy to focus more on key competences" while general academic skills (for example, learning to learn) are considered as an alternative by the employers (Humburg et. al., 2013, 10). Searching for true experts, the employers further request the university students acquire the field-specific knowledge content in the development of their general academic skills because it is "practically impossible to acquire general academic skills without applying it to a specific context, and vice versa" (Humburg et. al., 2013, 86). It is acknowledged that the acquisition of specific knowledge is fundamentally interwoven with general academic skills as well as professional expertise.

The above two perspectives from the employers though are contradictory, the findings reported that in nearly all the focus groups, the participants agreed that the main goal of higher education is to support university students in developing key competencies, in

addition to general academic skills and professional expertise. In addition to the above two ideals but polarised candidate credentials, the UK employers flexibly create the third type of ideology, 'competent-person' in the middle of the two poles to help fill in the job vacancies if no right candidate can be identified in the hiring process. The earlier study on graduate selection processes conducted by Brown et al. (2004, 92) criticises the decisions made by these types of employers as "stylized, commodified and ultimately embodied within individuals in such a way as to render the process of selecting individuals in the labour market process open to new levels of subjectivity". Ingram and Allen (2019) refer to those hired graduates as "social magic", whose credentials are magically enhanced by employers (Anderson and Tomlinson, 2021) when they perceive them as potential graduate candidates in their "talent pools" and hire them for the jobs (McCracken et. al., 2016, 2749).

## 2.3 Employability and IT workforce development

### 2.3.1 Employability in terms of process model and resource model

Due to the tremendous economic pressures enacted from the spectrum of globalisation and the effects of internationalisation, the themes of employability have recently come to be interpreted as the 'process model' (Forrier et. al., 2009, 2015) or the personal 'resource model' on employability (Peeters et. al., 2019). These models have leveraged and further advanced from the notion of movement capital (Trevor, 2001) in the labour market. Employability, through a process model, is to "secure employment against the background of changes in the pattern of individual careers and the labour market"; therefore, Forrier et al. (2015, 56) describe it as "an individual's chance of a job in the internal and/or external labour market" and the meaning of a "chance" is a 'job transition'. This chance is arguably triggered by three factors, the individuals' "mobility to assess the realisation of this chance (i.e., job transitions)", the set of "personal strengths in the form of knowledge, skills and attitudes that influence this chance (movement capital)", or the consideration of "individuals' appraisals of this chance (perceived employability)". A dynamic research study

of 643 Dutch-speaking employees confirmed that “past job transitions increase movement capital” and the researchers suggest that “self-selection could be an alternative explanation” (Forrier et. al., 2015, 62) and so does the importance of personal strengths in employability agenda.

The conceptual “employability capital” (Peeters et. al., 2019, 79) can be seen as advancing the employability agenda to the next level, through the construct of an employability matrix made up of employability distinction and capital distinction. “Employability distinction” refers to the purpose of personal resources, differentiating between job-related, career-related, and development-related. “Capital distinction” refers to the categorisations in the forms of human and social capital. This model is perceived as “more accurate to capture the combination of obtaining and retaining employment” (Peeters et. al., 2019, 80). However, Trevor (2001, 621) emphasises that “the actual ease of movement of the individuals in the job market is simultaneously determined by factors at the market level (general job availability) and the individual level (movement capital)” whereas Forrier et. al. (2009; 2015, 61) criticise that the conceptual movement capital may be potentially “biased towards an agency perspective (over) emphasizing the importance personal strengths”. In terms of resource alignment in employability, following that of Peeters et. al. (2019, 81), the sets of personal resources or capital are “those that can help the individuals to attain their goals”; that is, the purposes are to perform jobs or to make job transitions and thus can influence the employability of individuals (Trevor, 2001), whereas the type of capital specifies the ‘nature of capital’, referring to those resources that can promote an individual’s chance to obtain and retain employment. Peeters et. al. (2019, 81), therefore, identify the ‘competences tied to employability’, which can be categorised into three separate classes within the employability dimension: “job-related (specific and generic) competences guarantee the present job; career-related competencies are important in view of potential other jobs in the near future, and development-related competencies in view of shaping a long-term career”.

Peeters et. al. (2019, 87-88) carried out research work on an extensive literature review and adopted a Q-sorting study with 29 subject matter experts in mapping measurements onto the conceptual framework and the study results show support for the conceptual framework, but with three issues identified. First, there were no items identified as the specific job-related skills category in the initial framework, causing the collision with the other category of generic skills measurement that led to the location of measurement gap for specific job-related skills. Second, it is found that capital-related categories are more difficult to be differentiated when compared to employability-related categories. Third, items on social capital loaded on all dimensions of employability cannot be identified as separate dimensions; the potential explanation may be due to the difficulty in allocating this kind of capital to an employability category.

### 2.3.2 Technology-enabled sector, new knowledge areas and new job groups

Coping with the accelerating impacts of global competition, "innovation and knowledge can be identified as key components of strategic advantage" and the power of digitalisation creates a new era of digital and information age (Brennen and Kreiss 2014). In the realm of the technology sector, "the workforce reality is that IT professionals work both inside and outside the information technology industry" but there is a clear distinction between the primary and secondary IT sectors (Trauth et. al., 2007, 112, 118). The emerging cutting-edge frontier technologies, such as artificial intelligence, robotics, and biotechnology, boost the creation of a "gig economy" (UNCTAD, 2021, 43) where frontier technologies are used to provide services via digital platforms, creating 'location-based' and 'cloud-based' gig work whose work tasks can be performed anywhere via the Internet, but the nature of gig work is typically placing workers 'on insecure terms'. New technology trends can lead to the creation of new job roles and new job groups, in addition to the expansion of the existing IT work types. The growth in e-businesses, enabled by cyber infrastructures, is demanding a new job role in the senior executive category, "Chief Technology Officer (CTO)", who charters for all aspects of technologies in the organisation, particularly cyber infrastructure whilst the new job groups are related to "data security, data storage, Internet, and wireless

technologies" (Reich and Nelson, 2003, 40). According to UNCTAD statistics, the forecasts for the increasing frontier-technology-related jobs are very substantial and significant, for instance, "by 2035, the global 5G value chain is expected to support 22 million jobs" in the areas of "network operations, core technology and components providers" (Rayome, 2019; UNCTAD, 2021, 19). Therefore, planning for IT workforce development is rather complex and challenging.

The emergence of the electronic platform and e-commerce alters the business models and service models traditionally adopted in many industries, driving them to develop technologically empowered organisational infrastructures and business operations. Based on the study of Reich and Nelson (2003), CIOs are described as top business people who understand IT (Murphy, 2000) and their insights on e-businesses expose three major changes to be imposed in the future of in-house IT organisations; IT role becoming the strategic centre of the company, IT teams turning to value creation function, and IT staff facing higher expectations from user groups named as 'knowledgeable user community' (Kettinger and Hackbarth, 2000) or 'customers and partners' (Reich and Nelson, 2003).

The infrastructure of E-business enterprises is regarded as more standardised architecture throughout the IT organization to smooth the flow of data (Purvis and McCray, 1999), but such efforts can pose new challenges to the existing infrastructures leading to the demands for new technical knowledge and skills like data modelling; as one interviewee said, "we're starting to get better with data modelling but that's a skill we need to get better about" (Reich and Nelson, 2003, 34). The cornerstone behind E-business is the reliance on the alignment of business and IT and such alignment can help to enhance the 'value equation' (Kearns and Lederer, 2000) for the firms. But one interviewee was rather dissatisfied and said, "we're spending so much money trying to knit all this stuff together, it's unbelievable!" (Reich and Nelson, 2003, 34). When the investment in web-enabled, mobile-friendly infrastructures involves a large sum, those investments need to be justified by "extend[ing] the IT value chain, with business cases and benefits realization being key parts of projects" (Reich and Nelson, 2003, 39). As Kettinger and Hackbarth (2000, 92) stated, the more

extensive and innovative the business process changes, the more critical is to conduct a "business audit of their IT infrastructure" because these capabilities influence the speed and nature of the business process change as desired in the company (Broadbent et. al., 1999).

The above indicates that "information technology skills need to move even closer towards the strategic centre of the company, requiring increased business knowledge, improved ability to negotiate, and improved ability to create value" (Reich and Nelson, 2003; Trauth et. al., 2007, 114). With the increasing adoption of e-commerce in different industries, it is found that the competency requirements of information technology professionals are also altered (Cash et. al., 2004; Niederman, 2005) in terms of technical, business, relationship and conceptual skills which are all necessary to ensure information technologies work effectively (Trauth et. al., 2007). For business process integration, IT staff is required to understand the business practices of different departments and the external business partners whose systems may need to be connected to or partly integrated; this process would demand the IT staff possess good soft skills, in addition to strong technical skills. It is the job of IT staff to conduct "a thorough review of current or potential customer and supplier process", and to examine opportunities and threats for effective application of e-business technologies (Kettinger and Hackbarth, 2000, 79).

Apart from the standard practice of cost-and-benefit analysis as required in all business models, e-business has brought up the new dimensions of security risks, legal, data fraud or theft and cyber-attacks, into the overall implementation considerations and analysis (Reich and Nelson, 2003). Reich and Nelson (2003, 32) point out that "the launching of e-business initiatives that cross the corporate boundary has moved security to the forefront of issues. Security becomes not just a technical issue, but also a strategic and potentially legal one (Birman, 2000)". Just as one interviewee expressed concerns about the different government regulations imposed on their international offices where their team needs to handle local compliance issues like telecommunications accordingly. The Internet can expose firms to different types of cyber risks, showing that massive incidents of data fraud or theft are predominantly driven by economic motives and whose actors commit crimes

using information networks (Bilan et al., 2019). According to the global risks report published by World Economic Forum (WEF, 2019, 8), 'data fraud or theft' and 'cyber-attacks' were both ranked in the top 5 global risks in two consecutive years in 2018 and 2019.

### 2.3.3 Technology threats, and IT knowledge deficiencies and skills

Technology-enabled sectors are not only facing pressures to improve their existing technological infrastructures but also to develop innovative ways to support their business goals. For example, web-enabled infrastructures need to advance further to enable wireless access and mobile access because "the invention, emergence and popularization of ICT has been proved as beneficial for the society both economically and socially" (Bhujabal et al., 2021, 42650). Referring to the International Telecommunications Union (ITU, 2018) report, "currently 51.2% of the world population are using the Internet", showing that there is strong demand for broadband services, though such infrastructures are not available in some areas in the developing countries. "ICT infrastructure continues to improve, especially in the developed countries, as companies implement 5G networks" (UNCTAD, 2021, 87). With the increasing demands for IT professionals across different industry sectors, both in quantity and in quality, Lee et al. (1995, 334) foresee that "the critical human resource needs of our profession are moving targets". The effects of rapid technology changes lead to the general view on IT knowledge and skills are easily obsolete and that can be explained using the 'technology S-curve theory' which has "empirically shown that the advantage of improved technology rapidly decreases when machines (and algorithms) become more powerful" (Szabo and Szabo, 1988, 14), leading to the current debates around the threats of digital technologies, automation and the rise in the unemployment rate and income inequalities. "When the deployment of digital technologies enables productivity growth that exceeds the combination of demand growth and market share growth", it is found that some categories of existing jobs will become redundant (Roos and Shroff, 2017, 181).

Based on his empirical study and theoretical model, Bessen (2019, 615) argues that the "elasticity of demand" with respect to labour productivity affects industry employment and

such elasticity “determines the sign of the effect”; according to the historical data and Bessen’s model, it is expected to have “substantial heterogeneity across industries in their response to new productivity-improving technologies”. Regarding the impact of automation and the decline in aggregate employment, it is assessed to involve the factors of individual industry responses, the spillover effects on downstream producers and the general equilibrium effects on labour demand (Autor and Salomons, 2018), implying that “new productivity-improving technologies will likely bring a disruptive reallocation” (Bessen, 2019, 615). In 2021, UNCTAD report findings do not hide the facts, stating that in a more modest view on jobs and employment, the impacts of automation are estimated to be 8 to 14 per cent across occupations (UNCTAD, 2021, xviii). However, the report also points out that “the distinction between occupations and tasks is critical since even occupations at high risk of automation can perform tasks that are hard to automate” (UNCTAD, 2021, 40).

Radermacher and Walia (2013, 525) conducted a systematic literature review to examine which IT knowledge and skills the graduating students are most frequently not able to meet the expectations of employers, practitioners, or educators. Knowledge deficiencies, the collective term, is defined as “any skill, ability, or knowledge of concept which a recently graduated student lacks based on the expectations of industry or academia”. The study showed that there were 16 identified knowledge deficiencies listed by the ‘number of occurrences’ in Table 2.1. These knowledge deficiencies are extracted from the identified publications, not served a ranking purpose but are counted by the frequency shown in those papers mentioned. Programming is the only knowledge deficiency found to meet employers’ satisfaction as graduating students’ programming abilities (Lu et. al., 1999), but more programming skills are needed. Noll and Wilkins (2002) suggest placing more focus on web-based languages and CASE tools, but Miller et. al. (2010) emphasise independence as the importance of programming language. Code testing (Haddad, 2002) and debugging code (Begel and Simon, 2008b) are regarded as senior-level student skills but both are seen as deficiencies by both industry and academia. Moreover, project management and database were regarded as two deficiencies most graduating students will wait till graduation and then acquire these skills largely at work (Lethbridge, 1998; Misic and Russo, 1999). Computer ethics is the most problematic as graduating students did not know how

to distinguish between ethical and unethical behaviour (Woodward et. al., 2009). The most discussed were the deficiencies in communications, oral and written, including the great concerns about their ability to communicate with customers and their ability to listen (Tesch et. al., 2008), and sometimes, struggling to communicate even when they needed assistance or struggling with a problem (Begel and Simon, 2008a). Given the changes in knowledge deficiencies over time, deficiency in teamwork has become most frequently identified within the past 5 years but other knowledge deficiencies like presentation skills have decreased over time.

| **Knowledge deficiency** | **Occurrences** |
|---|---|
| Written communications | 10 |
| Oral communications | 10 |
| Project management | 9 |
| Software tools | 9 |
| Testing | 9 |
| Teamwork | 7 |
| Problem solving & critical thinking | 7 |
| Programming | 7 |
| Requirements | 7 |
| Personal skills | 6 |
| Ethics | 5 |
| Leadership | 5 |
| Design | 5 |
| Databases | 5 |
| Development & Improvement Processes | 5 |

*Table 2.1: Most identified knowledge deficiencies (extracted from Radermacher, A. and Walia, G., 2013, p.527, Gap between industry expectation and the abilities of graduates)*

### 2.3.4 IT curriculum design and professional certifications

IT curriculum design and structure have evolved over time, but the central theme is career orientation for graduates. IT knowledge and skills are generally perceived to be easily obsolete and Lee et. al. (1995, 333) hold a similar view that a “generic curriculum to meet the educational needs of all future IS professionals is obsolete”, meaning that cannot fulfil

the needs for all IS jobs (Noll and Wilkins, 2002). It is suggested that IS degree programmes should be career-driven with career path tracks or distinctive concentrations, that is, "curriculum design must be driven by a clear vision of the career path for the graduates" (Lee et. al., 1995, 333). The central idea is to "target the diverse job market" (Noll and Wilkins, 2002, 152), with the curricula meeting the career path objectives and the development of distinctive concentrations following the user domains or job nature. There is a set of common core skills in business knowledge and soft skills that are required by all concentrations, where the required and elective subjects are also made available in both core and concentrations, that is, university IT students are more flexible in selecting the courses they are interested in.

Contextually, Srinivasan et al. (1999) and Riihijärvi and Iivari (2008, 11) propose to involve IT practitioners in curriculum design and teaching as their involvement can help to assure both 'currency and relevance' in the topics they teach while the latter further specifies the importance of 'practical relevance' contributed by IT practitioners in designing the degree programmes. It is a two-stage process (George and Marett, 2019, 222) that the design of the obligatory studies is informed by "the education expectation expressed by practitioners" whilst the design of elective and optional studies is informed by "the skill requirements of practitioners", complementing the core curriculum of more focus on the key IT knowledge areas and topics. They also assert that IT academics is very dynamic "because the area we study is dynamic". It is not substantially to conclude that all the changes in technology and business needs are the only reasons contributing to all of the curriculum changes in the past 50 years; rather, "the social and economic factors" are seen as "uncontrollable" and often "unforeseen" in nature, have been highly influential in the past and are expected to lead the way on, such as the trend of big data leading to increasing demand for data scientists. However, "there is a fear of data and identity thefts, as hackers have engaged in large and well-publicised data breaches", driving the need for "better data stewardship" and "expanding cybersecurity efforts" (George and Marett, 2019, 228-229), paving the career path for more cyber security professionals.

Certifications are viewed as “skills with a narrow focus” but are not unimportant by themselves. Market conditions for “highly specific skills” are extremely volatile, and it is worrying that IT professionals may “risk” their careers in making “a niche with a specific technology” (Bailey and Stefaniak, 2001, 98). Compared to the work of Reich and Nelson (2003, 42), most CIOs recognise the “need to have project management standards, a common set of practices upon which they manage projects”. One interviewee said that there were 136 people certified in project management qualification in the team, stressing that “our preference is just not to hire a project manager that doesn’t have certification from the project management institute. That doesn’t make them excellent either, but at least it tells me that they understand the concepts that we’re going to be challenging them on”. It is apparent that CIO’s decision for project management certification as a pre-requisite is signalling their management decision to “use people with company-specific knowledge to run their projects and give their people a reason to stay”.

### 2.3.5 Knowledge structures and expertise development in higher education

The essence of knowledge (Anderson 1984) represents the nature of knowledge, affecting the ways of teaching and learning in higher education, especially for expertise development. Tacit knowledge is regarded as the “black box of intuition” (Kinchin et al., 2008, 321) whilst Dreyfus and Dreyfus (1986) and Eraut (1994) agree that tacit knowledge and intuition are critical features of professional expertise. If this opaque phenomenon is not uncovered, the students’ tacit presumption in learning can easily “miss the target by miles” whereas the teachers’ tacit presumption “can operate like conceptual submarine that learners never manage to detect or track” (Perkins, 2006, 40). It resonates with the work of Novak and Symington (1982) who identify that “the problem of moving from linear [text] structure to a hierarchical [psychological] structure and back again is in some ways the fundamental educational problem” (Kinchin et al., 2008, 321) for two reasons.

First, “the notion that expertise is associated with a qualitative transition from a conceptually rich and rational knowledge base to one comprised of largely experiential and

non-analytical instances" (Schmidt et al., 1990, 619). Second, experts often find it difficult to describe the actions they exhibit, and this phenomenon is interpreted by Hoffman and Lintern (2006) simply as a "lacked the tools and vocabulary to uncover and explain their practice" on the part of professionals. Based on the 'skill model' developed by Dreyfus and Dreyfus (1986), a practitioner can develop a skill of proficiency through five levels, namely, novice, advanced beginner, competent, proficient, and expert. When progressing from proficient to expert level, the practitioner is required to apply analytical skills in decision-making and possess an intuitive understanding of particular situations. For the experts, performance is "largely automatic, and non-reflective" (Kinchin et al., 2008, 317), and they reassess the initial action only when they need to handle the task particularly difficult or critical because the skill possessed by the experts become part of him, thereby, "when things are proceeding normally, experts don't solve problems, and don't make decisions; they do what normally works" (Dreyfus and Dreyfus, 1986, 30).

After reviewing the concept of professional expertise (Dreyfus and Dreyfus, 1986) and the practitioner progression model (Eraut, 1994), Kinchin et al. (2008, 316), it is discovered that the experts do not rely on rules or guidelines at work and "the rules are in fact forgotten" because they can exercise the "intuitive grasp of situations based on a deep tacit understanding". Apparently, the links between expert knowledge and developing practice need to be made explicit, and Kinchin et al. (2008) develop the concept of 'knowledge structures' to distinguish between expert knowledge and expertise, by showing the relationships between chains of practice and the networks of understanding that they depend on. The criticality of the knowledge structure concept adds transparency to the presumably tacit process and contributes to the understanding of the link between invisible expert knowledge and visible chains of practice.

Expert knowledge is defined as "an integrated/holistic framework of understanding", and expertise as "the application of expert knowledge through the selection of appropriate chains of practice" (Kinchin et al., 2008, 321); by accepting this notion, it can help to explain why teachers can still hold the expert knowledge structures though they lose the expertise

(know-how) for not practising anymore (Dreyfus and Dreyfus 1986). When expertise is described as an individual's ability to navigate between underlying networks of understanding and chains of contextual practice, it is analogous to the 'professional artistry' perceived by Manley et al. (2005) and it can give the explanations to Dreyfus and Dreyfus (1986) who do not want to simply accept the efficacy of tacit theories for the development of educational practice as well as the core of expert decision-making to be the intuition in a black box. Goal-oriented learners can strategically be successful in identifying the essential information from what is made available while "selectively ignoring the rest"; but if students adopt this strategic learning attitude in studying, they are usually criticised as having "a blinkered view of higher education" and hence, it "may reflect disciplinary differences" (Kinchin et al., 2008, 319). But if the networks of understanding for students become the goal of higher education, it may be contested because chains of practice seemingly have more immediate utilities than networks of understanding.

Kinchin et al. (2008, 319), have the view that "expert knowledge structures assumed to be holistic" (Bradley et al., 2006) and "clinical reasoning skills shown to be linear in structure" (de Cossart and Fish, 2005). When applying it in education, the definition of expertise, related to chains of practice and networks of understanding, can work across the spectrum of academic disciplines, while the context of clinical teaching represents "the separation of chains of practice and underlying networks of understanding". Within a clinical teaching environment, it is found that "possession of highly competent skills within a given chain of practice is not sufficient" for educating professionals in making informed choices in future because of "isolated chains of practice" or 'broken stories' described by Stronach et al. (2002). That is why it is strongly suggested that the students are "encouraged to make links from his/her chain of practice to a developing network of understanding" (Kinchin et al., 2008, 322). According to Manley and Garbett (2000), it is found that when the expert is seen as holding the 'right answer' by using arbitrary criteria (Kinchin et al., 2008), the students perceive the 'right answer' as a moving target for them to identify (Cabot and Kinchin, 2007; Hay and Kinchin, 2007). Hence, successful lecturers are those who can demonstrate the link between linear and hierarchical structures (Novak and Symington, 1982), or between chains of practice and networks of understanding. The "hallmark of

expertise" refers to the "interactions between these complementary structures and the ease of transformation (from one to the other)" and thus, the development of an authentic pedagogy in higher education should recognise the complementary nature of linear and networked knowledge structures and their contextual significance, focusing on the transformation of these knowledge structures (Kinchin et al., 2008, 324).

## 2.4 Curriculum design, teaching pedagogy, and graduate employability

### 2.4.1 Forms of graduate capitals and the practical implications

The discussions around how graduates can succeed in the labour market and what universities can do to enhance graduates' employability continue to create pressures in curriculum design and development, especially in those programmes that employers expect to produce work-ready graduates. Tomlinson (2017, 339) conceptualises graduate employability in the form of "graduate capital", described in a variety of interactive forms of capital in human, social, cultural, identity and psychological dimensions. These forms of graduate capital, "cumulative and recursive in nature" (Tomlinson, 2017, 348), are the key potential resources in empowering graduates to find jobs as well as to make transitions from the university to the job market. Graduate capital posited as graduate-centred can be "acquired through formal and informal experiences" by the students.

Human capital (Tomlinson, 2017, 341) refers to the knowledge and skills that graduates acquire, as a foundation of their labour market outcomes and this concept is following the economist Gary Becker (1993) who refers to it as the 'marginal' productive value attached to higher level qualifications in the labour market. The strength of human capital is the reliance on education preparing the graduates with specified knowledge applicable to their future employment, implying that "formal education provides a key foundation". According

to Pool and Sewell (2007), graduates need to learn how to associate the link between technical knowledge and subject specialism, as well as whatever generic skills they have acquired, demonstrating how these may translate into future performance. The acquisitions of 'career-building skills' (Bridgstock, 2009) by graduates include CV development, job search and wider awareness of job opportunities (Tomlinson, 2017).

Social capital refers to "the sum of social relationships and networks that can help mobilise graduates' existing human capital and bring them closer to the labour market and its opportunity structures" (Tomlinson, 2017, 342), suggesting that the role of universities can be extended to offer chances for graduates to develop the "bridging ties" (Putnam, 1999) with the external social actors to access the information relevant to the future employment. The concept of strong and weak ties introduced by Granovetter (1985) can be used for showing the 'relational bonds' surrounding the graduates who can benefit from brokering trust, level of information and inside knowledge. Therefore, it is valuable for them to extend the weak ties beyond the formal university space because "the strength of weak ties in form of a relatively thin spread of social connections and contacts", like employer contacts, can create diverse and knowledgeable sources for the graduates and the impact is influential (Tomlinson, 2017, 342). Hence, universities can help to arrange some forms of "bonding ties" (Putnam, 1999) for graduates through extra-curricular activities for example.

The concept of cultural capital (Tomlinson, 2017, 344), originated from discussions of the transference of individually valued cultural knowledge for the validation in the educational context (Bourdieu, 1986) or symbolic capital (Lindberg, 2013), which refers to the formal credentials and social standing as a form of cultural synergy and alignment for graduates to enter the labour market. Graduates can find ways to develop social standing through or beyond academic education; following Lindberg's (2013) study of symbolic capital in elite occupational contexts, such as prizes won, conference attendance and other wider achievements can add value to the graduates' profile during the job seeking. Besides, "the manifestation of individuals' desired embodied behaviours and dispositions" can form part of "embodied capital" within a given field, representing the interpersonal and behavioural

expectations of a specific organisational field. Once integrated "via accent, body language, humour", the individual can develop the overall "personality package" to demonstrate their potential confidence and self-perceptions of value (Tomlinson, 2017, 344). So, it is practical for the graduates to build up an informal network like internships, or some formal recruitment training to "harness embodied dispositions and behavioural competencies which can better fit employers' recruitment practices" (Tomlinson, 2017, 345).

Identity capital refers to "the level of personal investment" that can be extended to the graduates' abilities to "draw on experiences and articulate a personal narrative which aligns to the employment domains" (Tomlinson, 2017, 345). According to Cote (2005, 225), identity capital shows how individuals "invest in a certain identity (or identities) and engage in a series of exchanges with others in a variety of contexts (only some of which are economic)". It also depends on the graduate's capacity to develop emerging identities of values, social engagement, intellect, and performance to form his or her own graduate identity; and then to be warranted and negotiated through discourse and action (Hinchliffe and Jolly, 2011). Following Jackson's (2016) concept of "pre-professional identity", the graduates' early professional development and formation can be developed through the wider "landscapes of practice" facilitated by the universities through the provision of "career services, extra-curricular engagement and other forms of experiential learning". The role of curricula and learning is potentially helping the graduates in developing self-perceptions and goals that may form part of their wider career development. Graduate development no longer is confined to "walled disciplinary communities" because the informal dimension of the university experience can help the graduates to develop work-related identity through universities' diverse experiential offerings. Reproducing the description of skills is not enough, higher education needs to constitute practices "appropriate to future work-related roles and practices" (Tomlinson, 2017, 346-347). Besides, the curriculum vitae (CV), "salient mode of identity projection" or "autobiographical practice" (Morgan and Miller, 1993) is a key tool for graduates to encapsulate a formal presentation of themselves through a narrative description of their lived experiences and the accounts of their employment to highlight "one's relative employment value". The accumulation of work-related achievements and experiences can

be converted into the “markers of potential organisational value” that become attractive to employers. It is very popular for graduates to use extra-curricular activities as a vehicle for enriching their profile, making them more competitive when compared to other graduates with “identikit educational profiles” (Roulin and Bangerter, 2013).

The resources of psychological capital can enhance the graduates’ career adaptability (Savickas and Porfeli, 2012) to respond proactively and “withstand what is likely to be inevitable pressure and set-backs over the course of a career”. The development for graduates can be ranged from the “overall self-perceived employability and job search behaviours, through to productive coping strategies” (Tomlinson, 2017, 347) and hence, self-efficacy is the key, and this capital requires the graduates to develop a self-perceived ability to accomplish career goals and the capacity to withstand adverse conditions. It is important for the practitioners to help “frame a graduate’s career goals less around single jobs and job markets and more around a range of pathways”, and to “manage expectations around an education-work transition” that might increasingly be understood as a “reality shock” (Kramer, 1974). Tomlinson (2017, 347) also advises that graduates need to learn about expectation management and develop “mindsets around flexibility and career malleability”, better preparing themselves before entering the job market.

### 2.4.2 The Understanding, Skills, Self-Efficacies, and Metacognition (USEM) model of employability through the curriculum

The literature on employability topics discusses three major perspectives: educational policies, employers’ expectations and graduate knowledge, skills, and attributes. In terms of the multi-dimensional concept of employability, Little (2001) suggests distinguishing between the factors relevant to obtaining a job and the factors relevant to the preparation for work while Morley (2001) posits that employability is not just about students making deposits in a bank of skills (Lees, 2002). Knight and Yorke (2002, 261) define graduate

employability as “near-tautologous, elaborated as the possession of the understandings, skills, and personal attributes necessary to perform adequately in a graduate-level job”; and the examples of the computer industry and social work can show the importance in differentiating what kinds of professional expertise needed to be employable because the nature of discipline demands for its own specific set of knowledge and skills required to perform the disciplinary work. Reich (1991) introduces the education of symbolic analysts in four fundamental skills, abstraction, system thinking, experimentation and collaboration skills but is criticised as “giving students a fistful of ‘transferable’ skills” by Knight and Yorke (2002, 263) who are more attracted to capability, defined as “necessary part of specialist expertise” (Stephenson, 1998, 2) and also practical intelligence (Sternberg and Grigorenko, 2000) which is “malleable, not fixed” (Yorke and Knight, 2004, 28). The inclusion of personal qualities in understanding employability and the commitment to academic values, Knight and Yorke (2002) introduce the USEM model of employability through the curriculum by integrating the concept of capability and the insights derived from the interpretations of the literature on cognitive and social psychology.

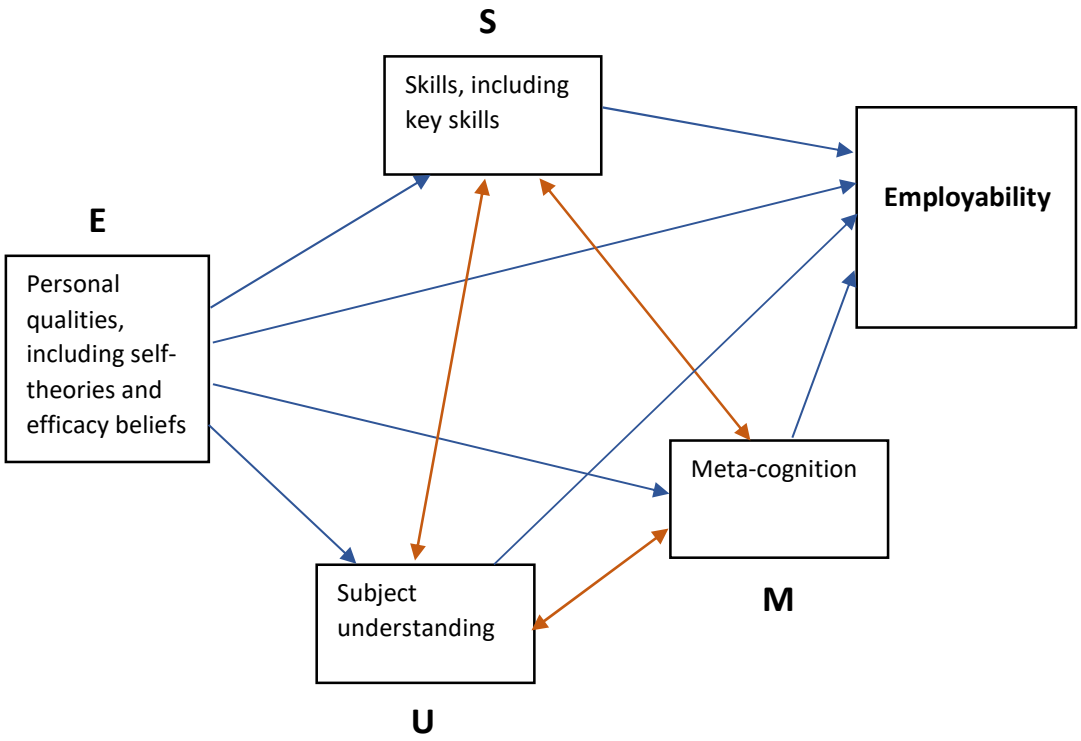


Figure 2.1 The Understanding, Skills, Self-Efficacies, and Metacognition (USEM) model of employability through the curriculum *(extracted from Knight and Yorke, 2002, p.265, Employability through the curriculum)*

The USEM model of employability through the curriculum, see Figure 2.1 *(extracted from Knight and Yorke, 2002, p.265)*, is a network of interconnected variables, namely, subject understanding (U), and skills, both discipline-based and generic (S), at the expense of the efficacy beliefs, and self-theories in general (E) and metacognition, including reflection (M). This model is distinctive in two aspects: addressing the weakness of traditional curricular design and enhancing the inner potentials of the learners. "Understanding, skills, and metacognition can be mutually supportive and developmental" during the learning process through the learners' self-awareness and self-reflection while "the channel between the subject and skills is two-way and the inclusion of personal qualities is a useful corrective to skills-dominated accounts of employability" (Knight and Yorke, 2002, 266).

When Knight (2002) comes to explore how the state of expertise understanding is developed in a knowledge domain, it is impressed that De Corte (2000, 253) gives an insight into addressing the theory-practice gap which can be minimised when learners can manage the "mastery of four categories of aptitudes", including domain-specific knowledge base; heuristic strategies for problem analysis and transformation; metacognitive knowledge and self-regulating skills; and positive beliefs, attitudes and emotions related to the subject (Yorke and Knight, 2004, 26). It is suggested that the learning of self-theories and personal qualities in the curriculum can shape qualities, like the capacity to cope with errors and problem-working strategies, of the students for their employability in the future. Dweck (1999) describes self-theories, as the belief systems and learners' attributes like intelligence are mutable, depicting the notion of self-theories in a spectrum spanning from strongly fixed to strongly malleable, and endorsing the power of "malleable" self-beliefs in influencing the way on how a person tackles problems and difficult tasks. "Self-directedness is likely to be needed for success" (Knight and Yorke, 2002, 268) and malleability is preferred for fostering greater versatility (Yorke and Knight, 2004). However, it does not mean that students with fixed self-beliefs cannot be successful but once faced with some difficulties, they would quickly make a judgement in advance on whether they can achieve it or not, making them less persistent in taking on challenges or risky tasks and avoiding failure. According to Dweck, self-theories are understood to be "strongly embedded" and these

attributes can be changed but “the change will not occur without positive intervention” (Knight and Yorke, 2002, 267). Therefore, “self-theorizing is an important mediator of student learning” (Yorke and Knight, 2004, 26).

Metacognition refers to the student’s capacity to reflect on, in and for action (Cowan, 1999); having it embedded in the curriculum, students can be developed into mindful and self-regulating persons and in the workplace, they are “reflective practitioner[s]” (Knight and Yorke, 2003, 7). As Bevins et al. (2012, 10) suggested, it is worthwhile for technology and engineering educators to focus some instructional time and activities to enhance the student’s abilities to apply innovation to their thinking, which is “a trait employers seek in workers, a requirement for economic growth, and a trait that can be cultivated through technology and engineering education”.

### 2.4.3 Work-integrated learning (WIL)

Work-integrated learning (WIL) is the curriculum design intended to integrate theory with workplace practices (Patrick et al., 2008) in which students spend time on professional work, or other “practice settings relevant to their degrees of study and to their occupational futures” through specially designed tasks and activities engaged by students who can apply and learn disciplinary knowledge and skills in a real-world context (Smith, 2012, 247). Work-integrated learning curricula and WIL approaches cover the general terms of placements, internships, supervised practice, and simulations, but are not working experience or work-based learning. The rationale behind WIL “goes beyond” (Smith, 2012, 248) the provision of the physical environment of a workplace as a site for students to experience work or to learn professional practice as WIL approaches aim for the “close integration” of disciplinary learning in university and professional or workplace practice and applications (Smith and Worsfold, 2015, 22). Work-integrated learning is a relatively new jargon, but the WIL agenda becomes more engaged in universities because of the increasing pressures coming from government policies focusing on productivity gain (Yorke, 2006), the employer demands (Harvey, 2005) for more employable and work-ready graduates (Orrell, 2004), and

many students who see education as an investment (Abeysekera, 2006) and prefer to complete the programme quicker for starting a job sooner (Smith and Worsfold, 2015). The goal of the WIL curriculum is to integrate disciplinary or canonical knowledge and skills with professional practice or those tasks done in the workplace (Billett, 2001). Smith (2012, 259) emphasises that WIL curricula are comprised of the "essential pedagogically relevant characteristics", "especially the authenticity of the workplace experience and the incorporation of integrative learning as a learning outcome".

Authenticity is at the heart of all "workplace-situated learning" (Smith, 2012, 250) where the authentic environments and contexts will expose the students to real work settings and situations and they can "observe, interact and respond to that particular context" whereas WIL curriculum must feature "authentic activities, with complexities" that "match those in real practice". In addition, authenticity in WIL does not only equate to 'physical authenticity' but also refers to 'cognitive authenticity' (Herrington & Herrington, 2006), where students can engage in those authentic learning tasks and activities within a particular disciplinary framework (Stein et al., 2001). As Smith and Worsfold (2015, 37-38) highlighted, authentic tasks usually are not crucial in nature, allowing the students to learn by mistakes while motivating them to achieve real results for a real client. It is very valuable to have such a learning approach in WIL as it "may help the individual to develop self-efficacy or confidence both as a student (where pertinent learning occurs) and as a practitioner (where useful outcomes or products are generated for the client)". Observing the correlation between measures of authenticity and other variable factors in the study, Smith and Worsfold (2015, 39-40) consider it to be the priming effort and the notion of 'sensitisation to engagement', saying that when students' learning experience at university is highly aligned with the workplace, it can prime them to behave differently at the workplace. Just like a pharmacy student's learning task of doing medication labelling in a pharmacy, it is usually seen as a menial task; but if the "student rates the labelling experience as authentic given the enhanced awareness of the importance of accurate labelling for avoiding potentially lethal intoxication", the student knows the consequential nature of this task and thus acts as a profession. In sum, work-integrated learning is

thought to provide education that can respond to present and future needs (Alderman and Milne, 2005).

## 2.4.4 Educational authenticity

### 2.4.4.1 Authentic experience

In an educational imperative, authenticity (Splitter, 2009, 147) is the property of academic curricula and pedagogy, which "calls for a clear correspondence with problems and practices in "the real world"" in the learning process; whereas it is utterly reminded that "this kind of correspondence must be mediated by - or seen as subordinate to - the activities of judgement formation and meaning (sense)-making". At the heart of good teaching pedagogy, both Newmann et. al. (2001) and Splitter (2009, 147) agree that it is the "capacity" to let students "make meaning and form judgements based on good reasons". Within that capacity, it is "each person's sense of themselves as "one among others" in a community" whereby people can make meaning and form judgements whilst that sense is refined and cultivated by direct way of dialogical communications among the members in the community. Following Taylor's (1991) conception about human persons of reason-making and inner dialogically, dialogue is the ground of the learner's authenticity and one can make sense of the self and the "one among others" as a member of the same dialogical community. The self is "constructed inter-subjectively" (Splitter, 2009, 135); and through dialogical engagement, learners can work out who they are and what they stand for, among the others (Splitter, 2009, 148).

In the field of education, authentic experience is the centre of authentic pedagogy and curriculum, and such experience is constructed through dialogues and interactions between teachers and their students whose teachers can help them to "acquire and master the cognitive, meta-cognitive, effective and social tools which underlie meaning and judgement" (Splitter, 2009, 147). According to Dewey (1938), lived experience is at the heart of the

content and the process in education, and it is reasonably considered by Splitter (2009, 144) who perceives that there are some kinds of correspondence or network of relationships underlying an authentic educational activity, and illustrates that an authentic experience is meaningful and connected, given that the meaning is both "constructed, not given, and transitional, not fixed". Ideally, if students' lived experience of the real world is "on a single continuum" (Petraglia, 1998, 27) from the classroom to that beyond it, it is expected that "the need for learning in school is to prepare one for the real world" (Petraglia, 1998, 31). This is an important semantic notion requiring the students to actively engage and perceives in the learning process; and through instruction, acquire the desired real-world correspondence. To be successful, the students need "to develop key cognitive, meta-cognitive and interpersonal skills and dispositions" so as to make sense and meanings out of that correspondence.

#### 2.4.4.2 Construction of knowledge and social constructivism

Splitter (2009, 135) posits that the core of education is to nurture the learners in thinking, meaning and understanding, rather than learning, truth and knowledge; by stating that learning experiences in education do not require validation from the "real" world. Therefore, he is against the way of analysing authentic engagement simply in terms of the relationship between school work and "real" work because "the presence of "real world" connections does not guarantee that teaching and learning will be truly authentic". Newmann et. al. (1995, 4) observe that students can "process, interpret and negotiate the meaning of new information" when they are doing exercises collaboratively with other students; and during this learning process, students are active participants in making sense of their experience (meaning-making). Splitter (2009, 139) agrees with Newmann's constructive view while at the same time, proposes his idea of social constructivism, from which "not only knowledge, but truth, reality, facts, texts, even ourselves, are social constructs, and that learning (knowing, meaning-making) does not depend upon any kind of fixed correspondence with the "real world" out there" because there exists something unknown to people or even cannot figure in any account of knowledge in the world. Considering the epistemological perspective in teaching and learning, when knowledge

claims, as warrantably asserted or justifiably believed outcomes of the inquiries, are not strengthened by adding a conception of truth in the belief or assertion, "such addition would either be redundant" or "meaningless" (Splitter, 2009, 145). In nearly all cases, for learners as authentic persons engaged in the process of constructing the knowledge for a discipline, their deliberations and findings are linked to the deliberations and findings of relevant "experts" or the "knowledge considered authoritative by others" as indicated by Newmann et al. (1995, 5).

Newmann and his team (1995) are further criticised (Splitter, 2009) when they contend that within the discipline, "students' construction of knowledge must be based on a foundation of prior knowledge" when engaging with "real" problems, tasks and challenges, (Newmann and Associates, 1996a, 24), that is, that knowledge produced by others. Once again, Splitter (2009, 139-140) expresses two concerns in teaching when some teachers practice constructivism to ensure the students' findings matched with the experts in the field, for that can bring up the risk of pouring 'insert' knowledge on top of "activated" ignorance to the students, as well as, create the risk to "subvert the constructive process", inducing the students to perceive being pushing for the answers that the teachers already knew.

#### 2.4.4.3 Disciplinary inquiry and Authentic intellectual work (AIW)

For authentic pedagogy in constructivist curriculum, in practice, students are required to "master and apply the very disciplinary tools" that successful or expert practitioners use, including the "structured collaborative inquiry with their peers"; as well as to understand the findings produced by these experts, though "not necessarily accept it as true or as the only truth". This approach is challenged by Splitter (2009) who is doubtful whether the students can become truly thinkers in a such learning environment where, possibly the students are conditioned to accept and learn, making the learning engaged genuinely in question. An alternative approach (Splitter, 2009, 140-141), is for students to internalise both the skills and the dispositions appropriate to "inquiry-based learning" for "they can examine, test, deliberate over, and think hard about both the information made available to

them and the responses and viewpoints of their peers who are engaged in the same process alongside them". At least, those students can accept what they learned as "the (tentative) outcome of their own inquiry" as scientific knowledge in its own right. Promoting students as reflective inquirers within the same disciplinary framework, they become engaged learners as authentic participants in that discipline, having a genuine position in the ongoing construction of the discipline. The reason for student work becoming more authentic and similar to the work outside is the authentic process that can promote genuine discipline-based knowledge construction and interactive inquiry, grounded in the disciplines and other activities, making the work bound to be meaningful and fulfilling to the learners, without the need to going via the "real world". Nevertheless, Splitter (2009, 142) reminds us that ''inquiry-based teaching is not context-free'' and it is the job of the teachers to provide the appropriate contexts in the classes.

According to Newmann et al. (1996b, 283), the disciplinary inquiry is viewed as cognition work featuring authentic academic achievement, consisting of three main characteristics: based on the prior knowledge accumulated in a field, one can attain authentic accomplishments; the "striving for in-depth understanding rather than superficial awareness" by creating "relationships among pieces of knowledge that can illuminate a given problem or issue"; and "expressing conclusions through elaborated communication" in terms of verbal, visual, symbolic, narratives, explanations, etc. Following the line of teaching and cognition research, the centrality is on how teachers challenge intellectually the students in applying the core disciplinary theories and knowledge while guiding their learning effectively through the curriculum design. For effective teaching, teachers need to "pose challenging questions and press students to justify their answers with evidence" and also, to ''support cognitive autonomy'' by encouraging them to generate solutions to problems that can be applied meaningfully outside the classroom setting (Newmann, 1991; Saye et al., 2018, 866).

Newmann and his colleagues, as the core study team on authentic intellectual work (AIW), have influenced some international researchers to consider AIW components in their study

between authentic pedagogy and student learning. Saye et al. (2018, 870) launched the research project to study individual teachers' practices by adopting the model of AIW indicators for classroom instruction, covering higher-order thinking, deep knowledge, substantive conversation, and connectedness to the real world. A deeper understanding of AIW (Saye et al., 2018, 878-879) is obtained by seeing the "scores for connectedness and substantive conversation to be notably lower than scores for the other AIW standards" whereas it is consistent with the disaggregated AIW scores from previous research studies. It shows that there is "the persisting difficulty of developing assignments that ask students to address real-world problems" (King et al., 2001, 7) and so does the difficulty in addressing the quality of classroom discussions that demands complex skills and intense effort in the planning and implementing of the substantive discussions (Parker and Hess, 2001).

However, Splitter (2009) argues that the criteria of relevance and meaningfulness should be equally accounted for the value beyond the classroom on student activities and assessment tasks connecting to the world. It is valuable to have students' learning on authentic tasks, but that value should not be restricted to the single purpose of assessing competence as promoted by Newmann et al. (1996b) and Gulikers et al. (2008). The criterion of relevance is not sufficient to be authentic, rather is the meaningfulness of the experience which "constitutes a broad array of connections of which relevance, as normally construed, is only one". When the discussion between students and their teacher is rich in meaning, through "higher order thinking and disciplined inquiry in the subject content", the discussion and the inquiry are authentic as they stood, implying that "the additional requirement of relevance to a "real world" issue would have been redundant". As the nature and depth of the problems can trigger the mode of inquiry and influence the structure of the lessons, it is observed that "subject matter and pedagogy are, or should be, interdependent". Based on the rationale of a rich and open-ended task, that can facilitate real thinking and students may still find it meaningful in spending time on the task, though it is not attached to any assessment or relevance to the world (Splitter, 2009, 142).

#### 2.4.4.4 Educational understanding of authenticity and its implications in education

As a property of academic curriculum and pedagogy, educational understanding of authenticity can be viewed as very closely related to the common understanding. The authenticity of ordinary material identity is described in an absolute term like an authentic coin; but when something is described as authentic, it is something to be "worthy of acceptance or belief because of conformity to fact and reality" (Petraglia, 1998, 15). According to Splitter (2009, 136-138), "relationships of conformity are relationships of similarity" and it is "a matter of degree", not kind, in terms of "greater or lesser authenticity", not authenticity per se. It is important to understand that perceptions of similarity are "highly subjective" (Gulikers et al., 2008, 402) and "contextually relative", and the "sameness of type is a relation of similarity". Therefore, the relation between classroom work and those activities that take place beyond the classroom can be assessed by the kind or type of conformity. The work of Newmann et al. (1995) posits the object of authenticity as an object or an entity external to one's consciousness; whereas some scholars offer an opposite view that Gulikers et al. (2008, 402) see "authenticity is not an 'objective' quality" in the project work of assessing authenticity on professional practices which is "dependent on perceptions" (Gulikers et al., 2004, 69). Splitter (2009, 136) views persons and entities both are "constitutive of and dependent upon persons, such as experiences, thoughts, actions, and lives". Based on moral grounds, persons are "in being subjects (of awareness)" and thus, not objects at all. Following the philosophy of authenticity, it can be declared that with respect to the self, what is inner is true and genuine and what is outer is a mere shadow and something derived. Splitter (2009) accepts the concept of authenticity, being described as "privileging the inner over the outer" (Guignon, 2004, 81).

For authenticity, it is necessary for a curriculum, problem, pedagogic method, or mode of assessment to correspond to both what is in the world beyond the classroom and to what ought to be; it is the sense of normative ideal in making value judgements in the claims of authenticity. For authentic learning, learners should be persuaded and not just told, and the desired correspondence is between what we want them to learn and their understanding of the world, not the world per se. As Petraglia (1998) said, it is very

demanding to have the transformation from presenting the students with new and improved 'reality kits' or 'pre-packaged' pieces (Splitter, 2009) to persuading the learners. Again, this transforming process involves value judgement as this kind of educational experience can demand the students to make sense of what they learned by connecting them to theories, principles, and experiences that matter to them (Splitter, 2009, 143). Inquiry and deliberation are dialogical processes involving reasoning. When all the inquiries are probable fallibilistic, it implies the possibility that some knowledge, previously as the result of inquiry and claimed as truth by some exemplary students and scholars, might be mistaken; that is the reason Splitter (2009, 145) follows Dewey and Peirce to admit that "truth is ideal, but only in a temporal or transitory sense". Assuming that "inquiry lies at the heart of all good teaching and learning", it is reasonable to accept that "teachers and students operate within a fallibilistic framework". Following this understanding, given that the centrality of constructivism is built into "a dual sense of commitment to which is claimed as knowledge, and to the process of inquiry that ensures a warrant or justification so to claim, then constructivism is safeguarded against accusations of relativism". In other words, this commitment is good for motivating students and their teacher "to tread cautiously and watchfully in the realm of claims to know", as well as, encouraging both parties to act collaboratively, by way of inquiry into what they believe and why, as those relevant experts in the field.

## 2.4.5 Authentic learning environment and authentic assessment

### 2.4.5.1 Instructional technology learning environment

Splitter (2009, 135) articulates the classroom environment to become a "classroom community of inquiry", having the "dual function of cultivating disciplined inquiry and facilitating the kind of personal development"; but that is not equivalent to the authentic learning environment for practising the workplace practices. In the classroom, working in practice for competence development, the students are assigned learning tasks whose

authenticity in resembling the work practices is relative to a situation, place, or profession (Gulikers et al., 2006).

The theory of situated cognition or situated learning (Lave and Wenger, 1991) can help to promote a model of instruction with implications for classroom practice (Brown et al., 1989), having the capacity to promote authentic learning as Herrington and Oliver (2000) observe that the instructional technology community is the constructivist computer-based learning that can promote the model of situated learning in conventional classrooms as a model for teaching in the practical classroom situations. Wineburg (1989) acclaims that "the abstract representation of knowledge was at least as effective as the situated learning approach and much more readily implemented in the classroom" (Herrington and Oliver, 2000, 24). But this approach is criticised as not cognitive apprenticeship because the model of instruction is based on how closely the learning environment has resembled. Tripp (1993, 75) stresses that "computer-based simulations are not sufficient and reiterated that true expertise is learned by being exposed to experts"; and Hummel (1993, 15) strongly emphasises that "[electronic] courseware becomes the learning environment and not the authentic situation". Nevertheless, the findings derived from a study of the multimedia program in mathematics education (Herrington and Oliver, 2000, 41) confirm that "authentic assessment can be used successfully in multimedia, albeit not encapsulated with the software itself, but as part of the learning environment". McLellan (1994, 8) also acknowledges the learning in context requirement in the situated learning model and states that "context can be the actual work setting, a highly realistic or 'virtual' surrogate of the actual work environment, or an anchoring context such as a video or multimedia program".

The students' perspective (Herrington and Oliver, 2000, 41-42) is that they appreciate the blurring of the two in the multimedia program, where "theory and practice were combined" in the authentic context, with no need to be challenged in the engaging process of "application" and "generation" (Henderson et al., 1994), implying that "the situated learning framework appeared to pre-empt the need for these interventionist strategies". To conclude, situated learning can be an effective instructional paradigm to guide the learning

of an appropriately complex task and "cognitive apprenticeship" is considered a useful instructional paradigm (Collins et al., 1991, 45) where the reflective report produced by the students can become the authentic product. On the contrary, Khaled et al. (2015) argue that teachers' view on that of the profession may lead to the development of hands-on simulations too complex for young and inexperienced students, possibly creating the problems like information processing overload (Merrienboer and Sweller, 2010).

#### 2.4.5.2 Authentic assessments on students' learning for professional practice

Authenticity is the quality criteria in competence-based assessment, comprised of the tasks reflecting the competence to be assessed, the content of the assessment involving authentic tasks to represent real-life problems, and the thinking processes following how the experts solve problems in the knowledge domain (Gielen et al., 2003). To align with the context of assessment goals, Gulikers et al. (2004, 69) define authentic assessment as "an assessment requiring students to use the same competencies, or combinations of knowledge, skills, and attitudes, that they need to apply in the criterion situation in professional life". The educational goal of authentic assessments is to stimulate the students to have deep learning in those work-related activities and to develop more professionally relevant skills or competencies (Boud 1995; Gulikers et al., 2006, 2008). Following this orientation, authenticity is assessed in terms of its "resemblance to students' (future) professional practice" (Gulikers et al., 2004), making authentic assessments become the tools to show students the link between learning and working in practice and direct their learning towards professional skills development. This practice is highly concentrated in vocational-based curricula, used for achieving the correspondence between learning and working. According to Boud (1995, 36), learning can be influenced by assessment in three ways, by the intrinsic or objective qualities of the assessment, by the teacher's interpretation of the to-be-assessed material, and by the student's interpretation of the task on hand and the context of the assessment.

For assessing authenticity, if authenticity is interpreted by the degree of resemblance between the assessment and students' professional practice, it will make authenticity an objective construct but "authenticity is not an objective quality" (Gulikers et al., 2008, 402). "Something is only authentic with respect to something else, for example a situation, place or profession" (Gulikers et al., 2006). When a person considers an assessment as authentic or not, he or she creates a "reference point in mind against which the authenticity is measured" (Gulikers et al., 2008, 403). Moreover, a person's perception of authenticity can be changed and affected by the amount and kind of practical experience, schooling, or age (Lizzio and Wilson, 2004; Petraglia, 1998). Gulikers et al. (2008, 403), therefore, conclude that in reality, "authenticity is in the eye of the beholder". In schools, it is observed there are differences between teacher and student perceptions of a learning environment or assessment (Boud, 1995; Gulikers et al., 2008). Teachers often use an assessment to send a 'message' to their students about the expected requirements in the learning, but students' perception of this message is not necessarily synchronising with their teacher's intention. Coping with the learning, students create their own 'hidden curriculum' to interpret the assessment practices based on their perceptions (Boud, 1995).

There are some issues with authentic assessment between teachers and students, affecting authentic educational practice. Firstly, the gap in assessment authenticity is observed between teachers' beliefs and their actual assessment practices (Orrell, 2003) as there is "no one-on-one relationship" between the teachers' beliefs of implementing and what they actually implement. Many educational practices are criticised as the "existing assessments that are 'dressed up' with some realistic elements" (Cummings and Maxwell, 1999) as those teachers are "not yet internalised or accepted the underlying beliefs about these kind of assessments" (Gulikers et al., 2008, 409) whereas the impact can hamper the learning of the students (Cooper, 1994) who are those experiencing the actual practices only. Therefore, Maclellan (2001) argues that the "greatest disjunction" between beliefs about good assessment practice and actual practice can be associated with authentic assessment (Gulikers et al., 2008, 408).

The second issue is related to the authenticity of professional practices as teachers have a more detailed frame of reference for interpreting authentic assessments than students do (Gulikers, 2006). Based on their own educational and practical experience, teachers develop the assessment practices in alignment with how and what they think of the authenticity of the professional field (Lizzio and Wilson, 2004) without the need to take students' ideas into account; that is called "pre-authentication" (Petraglia, 1998, 53), referring to "the attempt to make learning materials and environments correspond to the real world prior to the learner's interaction with them". The problem is that the learners or students may have different perceptions of authenticity in the real world, but their perceptions of the assessment practices determine their way of learning. According to Gulikers et al. (2008, 409), the discrepancy between student and teacher perceptions may come from both sides, for "students do not have an accurate or complete picture of what professional practice entails" while many teachers do not work in the field of the subjects they are educating, or their beliefs of the professional field are unrealistic or outdated. Students' perceptions about the real world of work create another problem after they graduate as they experience a 'reality shock' (Pena, 1997), showing that what they experience in the graduate job is different from what they expected while studying. Similarly, the findings from Pena (1997) and Gulikers et al. (2008, 410) suggest that "students remain in a 'school-based frame of reference' for interpreting their assessments that is changed after leaving school and entering the labour market". Since teachers and students can have misconceptions in perceiving authentic assessments, it is worthwhile to develop authentic assessments collaboratively on competence-based curricula.

## 2.4.6 Experiential learning, learning space, network space, and networking

### 2.4.6.1 Experiential learning

Based on a constructivist theory of learning conceptualisation, knowledge is the learning outcome generated in the learning process where the learner goes through two kinds of experience, the grasping experience in taking in information, and the transforming

experience in understanding and actioning. Following experiential learning theory, social knowledge is created and recreated in the personal knowledge of the learner, and that can become a new form of contextual knowledge in a socio-historical context. The experiential learning theory (ELT) developed by Kolb and Kolb (2013) is based on learning-oriented propositions with some inherited from the famous foundational scholars of experiential learning. Learning is best conceived as a process, not in terms of outcomes, meaning that the process and the goal of education are the same things. When all learning is seen as re-learning, the key to success relies on the learner's ability to come up with the proper interpretations and comparisons during the re-learning process. The learner needs to learn how to balance the opposing modes when facing conflicts, differences, and disagreements with the external world. When the learner decides for taking on a new experience, the learning can be influenced by the actual occasions he or she is currently experiencing, which in turn, are determined by the characteristics of the learner and the learning space where the learning transactions are taking place, in higher education, both classroom environment and the beyond. Therefore, learning is a holistic process for a whole person's development and for one's adaptation to the world.

#### 2.4.6.2 Learning space

The concept of learning space refers to multi-dimensional learning in terms of cultural, social, institutional, and psychological levels, extending the learning process from the traditional physical classroom environment (Kolb and Kolb, 2013). This is built on Lewin's field theory on life space where the person and the environment are interdependent in the learning process, in addition to the activity theory of social cognition (Vygotsky, 1978) and situated learning theory (Lave and Wenger, 1991). So, social knowledge contributes to the understanding of the learners who are encouraged to participate in the wider community of practice. Upon the knowledge creation theory (Nonaka and Konno, 1988), learning in a shared space promotes care, trust, and commitment among learners and their interactions with others. The learning space concept is gaining importance; Brown and Long (2006, 9-10) highlight three emerging trends in their design. With reference to the learning principles, the design of learning space requires alignment with the understanding of how people

learn, enabling the configuration of constructivist learning spaces to promote active learning and deliver value for learning. Second, human-centred design can put focus primarily on the learners, demonstrating "why is the design" accommodated the learning activities intended for them. The third one is the design that can promote the learning spaces as "learning-driven" rather than "teaching-driven" in the future.

#### 2.4.6.3 Network space

According to Huggins et. al. (2012, 204, 207), network space is defined by "the nature of the relationships, interactions and ties" across a range of "interpersonal networks" occupied by "inter-organisational network actors". The distinction between social capital and network capital rests on the individual level versus enterprise level, including regional and global levels. Under the conceptual network space, social capital is focused on the individual members' social interrelations while network capital is "in the form of more calculative and strategic networks designed specifically to facilitate knowledge flow and accrue advantage for firms" (Gulati, 2007; Huggins, 2010). Functionally, the value of "social structure" is the resources in the network that actors "can use to achieve their interests" (Coleman, 1998, S101) and thus, inter-organisational networks are regarded as the strategic resources for firms to facilitate effective knowledge exchange and innovation in the long run. In summary, social capital is capital assets and network capital is "relational assets", serving as a complementary concept to social capital in the creation of network space (Huggins et. al., 2012, 224). Social capital's culture of obligation, norms, and trustworthiness (Coleman, 1998; Huggins et. al., 2012, 207) is posited as secondary to the fulfilment of social motives for approval and prestige, aiming for attaining personal interests and advantages, "Locke (1999) argues that there is a potential loss of objectivity in linking business and social relationships" as the ways people communicate are becoming more selective and subjective. However, Coleman (1988, S100, S117) states that "the value of social capital can be both economic and noneconomic" and he does not reject the economic value of social capital and describes those people as "rational actors".

#### 2.4.6.4 Networking

Networking is an individual behaviour that can create many forms of valuable social capital including advocacy, introductions, and mentoring, through these activities to enjoy the "information benefits" derived in forms of "access, timing, and referrals" (Nahapiet and Ghoshal, 1998, 252). When 'know-whom' is valued almost as much as 'know how', networking becomes a key imperative of contemporary capitalism (Grabher and Ibert, 2006) because the participants make new contacts and enhance the scale of their "personal knowledge networks" which are "perceived as homogeneous, cohesive, and local personal ties" and that can be seen "to compensate the shortcomings of the formal organisation" (Grabher and Ibert, 2006, 251) through an informal network (Cross and Prusak, 2002). Hence, networking is viewed as a goal-directed behaviour to promote a system of "interconnected and cooperating individuals" (Luthans et al., 1998, 120) that can improve the structural dimension of social capital and gain access to valuable information and resources (Adler and Kwon, 2002). If "relationships are nurtured" through sharing resources and supporting each other, "it boosts trust and identity formation" (Batistic and Tymon, 2017, 376); and through a history of interactions, the relational embeddedness in personal relationships is developed and strengthened (Granovetter, 1992) because of the presence of personal and emotional attachments. When there is a personal bond created, it promotes the quality of networking as strong ties (Granovetter, 1973). Lin (2001) proposes that strong social networks can elevate the credential of job seekers because these networks can bring them the resources, and potentially positive recruitment referrals through "putting in a good word" which can be decisive in the recruitment selection situations (Stiff and Vugt, 2008). Social relationships are seen to provide access to career management resources in enhancing employability (Burt, 1992; Granovetter, 1973) and a good example is the arrangement of instrumental and targeted networking through the use of "calculative ties" (Huggins et al., 2012, 204).

Based on the observation of Bourdieu (1986, 249), the existence of connections is "the product of an endless effort at institution", not a natural given or a social given. Baker (2000) identifies distinct attributes and measures of social capital through the use of

sociometric techniques and this approach can make it possible for people to develop their social capital profile. To develop a person's career, including "practitioners" (Nahapiet and Ghoshal, 1998, 262), it is advised that deepening and developing new relationships can be of comparable benefit as "people can accumulate social capital just as they can accumulate knowledge or wealth" (Tymon and Stumpf, 2003, 18).

## 2.4.7 Knowledge retention

### 2.4.7.1 Intellectual capital and absorptive capacity

In an economic sense, knowledge is the most powerful engine of production (Marshall, 1965). Nahapiet and Ghoshal (1998, 243-246) refer to intellectual capital as "the 'knowledge and knowing capability' of a social collectivity, such as an organisation, intellectual community, or professional practices. The rationale underpinning this definition is two-folded. Firstly, it recognises Polanyi (2009) to consider knowledge as an object and knowing as an action or enactment, actively shaping experience performed in the pursuit of knowledge. Secondly, it reflects "the significance of socially and contextually embedded forms of knowledge and knowing as a source of value". Fundamentally, knowledge and meaning are always embedded in a social context, where the shared cognition, "through the existence of shared language and vocabulary", and "through the sharing of collective narratives", can help to facilitate the creation of intellectual capital (Nahapiet and Ghoshal, 1998, 253).

According to Nonaka and Takeuchi (1995), knowledge can be advanced through the development of new concepts and narrative forms; and shared language and codes can help to enhance combination capability through social exchange, provided that "different parties must have some overlap in knowledge" during the exchange process (Nahapiet and Ghoshal, 1998, 253). Regarding the shared narratives in the creation and transfer of new interpretations of events, Clark (1972) proposes to use myths, stories, and metaphors to

articulate the rich sets of meanings while Bruner (1990) suggests two forms of cognition modes for knowledge creation, the information or paradigmatic mode and the narrative mode. Specifically, metaphors can cut across different contexts by combining imaginative and literal observations with cognitions (Bateson, 1972) and the work of Orr (1990) shows the power of narratives in the exchange process of practice and tacit experience between technicians, through storytelling, they can discover the problems and develop the improved practices accordingly. Relating to Nahapiet and Ghoshal (1998, 248-249), the creation of intellectual capital can be conducted through a combination process and exchange activities as a pre-requisite for resource combination while the "combination capability" is contributed by 'absorptive capacity'. Examples of intellectual capital, in form of intellectual properties, are technologies, copyrights, patents, and trade secrets (Tymon and Stumpf, 2003).

Absorptive capacity (Cohen and Levinthal, 1990, 128-129) as innovative capability is the presence of prior related knowledge as the pre-condition, together with the "ability to evaluate and utilize outside knowledge"; and that can simply refer to basic skills or a shared language, or even the knowledge of some scientific or technological developments in a given field. It is observed that absorptive capacity is supported by the studies in cognitive and behavioural sciences at the individual level; and prior knowledge can enhance the learning in the general knowledge, in subsequent learning tasks as well as in problem-solving skills. According to the research on memory development, the accumulation of prior knowledge increases both "the ability to put new knowledge into memory" and "the ability to recall and use it", allowing "more objects, patterns and concepts that are stored in memory, the more readily is new information about these constructs acquired" that the individual can use them in new settings (Bower and Hilgard, 1981, 424). Associative learning is interpreted as those "recorded into memory by establishing linkages with pre-existing concepts" that the creation of new knowledge is influenced by the breadth and varieties of categories in the prior knowledge acquired by the individuals (Bower and Hilgard, 1981). However, Estes (1970, 16) argues that even without prior experience with a learning task, an individual knows how to learn better, and the accumulation of prior experience may simply imply the need for relatively less learning in attaining a given level of performance. In terms

of problem-solving methods and heuristics, Pirolli and Anderson (1985) found that almost all students using "analogy-to-example" programs and their understanding of how these examples worked determined their success in developing new programs. Cohen and Levinthal (1990, 130) argue that learning capabilities and problem-solving skills have a similar mode of development and thus, the effect of prior relevant knowledge and skills can help to enhance creativity, "permitting the sorts of associations and linkages that may have never been considered before".

Based on the learning sets identified in Harlow's (1959) work, the behavioural phenomenon of "insight" typically refers to the rapid solution of a problem (Ellis, 1965, 35). Considering the psychology literature, both creative capacity and absorptive capacity can be regarded as the same. Firstly, when the material is processed more deeply in association with those learned previously, the later retrieval of the item will be better (Lindsay and Norman, 1977); and secondly, the foundation of the learning-set theory is based on the rationale that learning in solving problems is accumulated by many practice trials on related problems, though Harlow (1959) discovers that if a practice is discontinued before the learning in solving a particular type of problem is reliably acquired, little transfer of knowledge will occur to the next series of problems. Learning is cumulative, and thus the richness of the pre-existing knowledge structure can affect the power of assimilation, implying that an individual's expertise will change only incrementally; but knowledge diversity is a more robust basis in a learning environment, meaning that the innovative process of an individual is enhanced in making better novel associations and linkages. Therefore, Cohen and Levinthal (1990, 131) point out that organisational absorptive capacity is "not" simply "the sum of the absorptive capacities of its employees" but tends to "develop cumulatively".

#### 2.4.7.2 Notions of encapsulation

Through exploring mathematics discipline and object constructions, Tall et al. (2000, 239) discover that the encapsulation method can be used for turning a process into an object or an entity, and this way of thinking can allow a rich concept image to convert to a

manipulable entity, “in part, by using mental processes and relationships to *do* mathematics and in part, to use a name or symbol to mentally manipulate, and to think about mathematics”. This concept is largely contributed by Piaget's notions of abstraction, from which empirical abstraction defines the perceived objects, reflective abstraction constructs the platonic objects, and higher-level reflective abstraction enables the pivot between process and concept.

Leveraging this notion, the academic value of the encapsulation method can be perceived for examining the transformation and retention efforts during the learning process and this concept is borrowed in this study. The subtle meaning (learners’ understanding in my study) of the perceived objects (can be a task or a step when doing the lab exercises or can be a solution in tackling a problem in a case study) in the learning environment (in context) can be sought through the verbal descriptions and definitions (like experience sharing). The process on the real-world objects (like a practical solution, or industry practices in my study) can be performed and symbolised in the same way. The properties of the axiomatic objects (learning tasks) can allow specifying criteria and those properties can be deduced by formal proof. It is worth examining how encapsulation can be articulated.

Tall et al. (2000, 235) study Piaget’s proposed idea of turning actions and operations into thematised objects of thought or assimilation through abstraction, admitting that “pseudo-empirical abstraction focuses on *actions* and their subsequent symbolization and conception as encapsulated objects”. Dubinsky et al (1988, 45) consider Piaget’s notion of a permanent object and offer a single, unified theory of encapsulating cognitive processes as “cognitive objects”, in which “encapsulating the process of performing transformations in space which do not destroy the physical object”; and the individuals possess the ability to repeat the actions. Tall et al (2000, 225) interpret that when the individual can describe or reflect upon all the steps in the transformation without necessarily performing them, “the action becomes a process”. When going to the next step, after noticing the totality of the process, the individual realises that transformations can act on it, and then can construct such transformations, “a process becomes an object”. The key to success is whether the learner

can possess the ability to view the self-contained whole entity as a permanent object in its own right and then convert the already condensed process from an operational to a structural mode of thinking (Sfard, 1992) into an object-like entity in his or her own mind (Tall et al., 2000).

The saliences of conversion in states of human thinking, imagination, and comprehension are central to the meaning and understanding of the world by the learner (Sfard, 1994, 45) that meaning is the characteristics of signs and concepts and "it is a kind of externally determined "cargo" carried by symbols and sentences". Sfard supports Johnson's (1987) objectivist view in defining meaning, understanding and knowledge. Meanings are "disembodied" and received by a human mind rather than shaped by it. Understanding is considered as "grasping the meaning", the process mediating between an individual mind and the universally experienced, absolute, ahistorical realm of facts and ideas. Objectivism views understanding as "somehow secondary to, and dependent on, predetermined meanings" (Sfard, 1994, 45). When it comes to the process of locating the understanding related to the inner sensations, Sfard (1994) admits that there are no better means of inquiry into the learner's meta-cognitive skills.

#### 2.4.7.3 Transferability

According to the works of Mason et al. (2009) and Wilton (2011), there is limited efficacy of formal skills-centred provision to promote graduates' employment outcomes. The key issue is the "contextual barriers", making the employability skills acquired in universities not "simply be transferred given that so many of the actual skills graduates deploy are derived from, situated in, and further generated through, the actual work context in which they are utilised" (Tomlinson, 2017, 340). Both hands-on laboratory practices and case-based exercises are considered the teaching methods used for strengthening the integration between theory and application, which can in turn support knowledge retention.

During the laboratory sessions, students can practice the laboratory exercises designed to demonstrate concepts previously presented in the lectures and these hands-on learning activities can enable the students to acquire declarative knowledge by performing practical tasks. The weakness is this incidental learning unlikely to have permanent or long-term memory until there are follow-up repetitions and practices (Shell et al., 2010; McFee et al., 2018). For case-based exercises, they are designed in case-based learning or problem-based learning, organised around authentic problems and projects. Both designs, though, are problem-centred approaches with problem-based scenarios (Bevins et al., 2012), and new knowledge is acquired differently. Case-based learning exercises require the learners to apply both what they learned and their prior experiences in solving the current problems; thus, forward reasoning is expected in learning. Problem-based learning exercises involve the open-ended exploration of the problems, requiring backward reasoning, and are considered more difficult because the design rationale for open-ended problems is "no one best solution" (Bevins et al., 2012, 11). Hence, the case-based learning approach, used for supplementing a more traditional curriculum, is relatively easier because the basic concepts covered in the case studies are usually taught in classes before discussing the case (McFee et al., 2018). Bransford et al. (2000) cite that problem-based learning is highly applicable to medical schools for crafting excellent educational experiences and best preparing for the medical students' competencies (Barrows, 1985). For technology and engineering programmes, it can support the students to "develop their innovative powers to solve technical problems" whilst for localised problem-based scenarios, "whose solutions will make a difference to the growth of the students" (Bevins et al., 2012, 11). Case-based learning, on the other hand, is deemed to be guided learning, making the traditional classroom learning of business school and law school and the like, more relevant to the subsequent workplace.

Three major factors can hinder the flexible transfer of knowledge. First, in the context of original learning as people may fail to transfer the learning from one context to another context. Second, is the stickiness of the learning in context at the time the knowledge is acquired (Eich, 1985) because learning transfer across contexts is very difficult, especially when a subject is taught only in a single context rather than in multiple contexts (Bjork et

al., 1989). However, if the learners can learn the subject in multiple contexts, supported by some examples, they are more likely able to abstract the relevant features of concepts and develop a flexible representation of knowledge (Gick and Holyoak, 1983). Third, is related to overly contextualised learning, with case-based and problem-based in particular, undertaken through instructional programmes that the information presented in a context in attempting to solve complex, realistic problems (The Cognition and Technology Group at Vanderbilt, 1997; Barrows, 1985). It is because overly contextualised learning content makes a flexible transfer to new situations very difficult. In response to the above obstacles in knowledge transfer, Bransford et al. (2000) propose three teaching guidelines for teachers. First, teachers need to prepare additional but similar teaching cases, in addition to the first but specific teaching case as this approach can help the learners to abstract general principles from a list of similar case-based examples. Second, learners need to learn both "what-is" in a specific context and "what-if" by solving the problem. Third, learners need to learn how to generalise the case and that can be achieved by learning how to create a solution that can apply to a whole set of related problems.

## 2.5 Conclusion

In the 21st century, the role of higher education is very much varied according to the stage of economic development in respective nations. Human capital is the pre-requisite for economic growth, implying the importance of educational attainment of the labour force (Benhabib and Spiegel, 1994), and competencies and capabilities acquired by the workforce (Tymon and Stumpf, 2003). According to Coleman (1988), social capital can influence the development of human capital while network capital (Huggins, 2010) is embedded resources in knowledge networks (Maggioni and Uberti, 2009), supporting individuals to take more effective action (Drucker, 1989). Universities are regarded as the largest knowledge-based institutions by policymakers whose policies can influence the supply of graduates and the requirements of occupational skills through government funding allocations. Together with the popularity in the political world of university ranking league tables, higher education is increasingly engaged in the triple 'economic-social-political' role

in the 21st century and thus, universities are described as knowledge factories (Aronowitz, 2000). The massification in higher education systems has been viewed as a worldwide phenomenon, leading to the problems of credential inflation (Tomlinson, 2008), overcrowded graduate labour market (Anderson and Tomlinson, 2021), and possibly the imbalance supply and demand in the labour market whilst increasing the pressure on individuals' human capital. Therefore, it is recommended that the graduates can build up more "behavioural competences" (Tomlinson, 2008, 51) to strengthen their personality package (Tomlinson, 2017) to distinguish themselves from other job seekers. When knowledge is perceived to be obsolete easily by both employers and educators, the employers hope that a university education can help the graduates to develop more key competencies; meanwhile, they look for competent candidates in the recruitment process and even turn the graduates to become 'social magic' (Ingram and Allen, 2019) if unable to find the suitable candidates.

The employability agenda can be interpreted as the process model (Forrier et. al., 2015) or the personal resource model (Peeters et. al., 2019). The process model refers to the movement capital (Trevor, 2001) in the labour market while the conceptual employability capital is developed in a matrix of 'employability distinction' and 'capital distinction' by the work of Peeters' team who finds that social capital is loaded on all dimensions of employability, implying that social capital is the essential resources in all stages of employability: job-related, career-related, and development-related. Both primary and secondary IT sectors (e.g., Trauth et. al., 2007) demand IT professionals whereas the technological advances further necessitate new sets of knowledge and skills in the existing job roles and further create new job groups but fewer jobs for low-skilled labour. The top two most identified knowledge deficiencies of IT graduating students are oral communications and written communications (Radermacher and Walia, 2013).

Tomlinson (2017, 339) proposes the conceptual forms of graduate capital as the resources needed for graduate employability, including the human, social, cultural, identity and psychological dimensions, all of which are regarded as the key potential resources in

empowering graduates to find jobs as well as to make transitions from the university to the job market. In the aspect of IT curriculum structure and design, career path or distinctive concentration is commonly adopted whilst the involvement of IT practitioners in curriculum design and teaching is also proposed. The USEM model of employability (Knight and Yorke, 2002) is formulated by embedding the subject understanding, skills, efficacy beliefs, and metacognition in the curriculum design, through which to understand the relationship between curriculum design and teaching and the graduates' employability. In terms of integrating academic theories with the workplace or professional practices, the work-integrated learning approach is considered the curriculum design for learning disciplinary knowledge and skills in a real-world context. In assessing the authenticity of university learning for professional practices, it is observed there are differences between the constructivism approach and social constructivism approach as the latter stresses the need for meaningfulness on top of the relevance, but authentic learning can be seen as not need to go via the real world (Splitter, 2009). Beyond the classroom, experiential learning can help the students to acquire social knowledge, through the shared space during networking activities, meaning that extra-curriculum activities can play a key role in supporting the student's learning in the field.

When graduate employability can be viewed as inclusive of getting a job and doing a job, it is imperative to find out what university students learn and how they learn as graduate students. It is considered that the teaching pedagogy of the teachers and their curriculum design can provide some of the answers; that is why both practice-led teachers and their students are identified as the research participants. Hence, the next chapter will discuss the research methodology adopted in this study.

# CHAPTER 3 RESEARCH METHODOLOGY

## 3.0 Introduction

This chapter describes the journey in planning, learning, revisiting, and decision-making process that is experienced by a novice mixed methods researcher when designing the methodological approach in this research study. It is understood that "research problems are not neutral" and hence, the selection of methodology in research design "depends upon what you are trying to find out" (Silverman, 2022, 18) and is essentially "driven by the purposes of the research" (Cohen et al., 2018, 9) and guided by the "research question(s)" (Newby, 2014, 135), allowing the selection that is made "on the basis of 'appropriateness to task'" (Pring, 2015, 59). The philosophical considerations in academic research include "the nature of reality (ontology)", how the researcher knows what she/he knows (epistemology), "the role of values in the research (axiology), the language of research (rhetoric), and the methods used in the process (methodology)" (Creswell, 2007, 16). The philosophical assumptions underlying quantitative and qualitative research methods can reflect different worldviews, with the former method "seen to be appropriate to the physical world" whereas the latter addressing "that which is distinctive of the personal and social, namely, the 'meanings' through which personal and social reality is understood" (Pring, 2015, 60). Since the methodological approach in mixing research methods started to emerge, the philosophical assumptions underpinning the respective quantitative and qualitative research methods are further being pushed away from each other by the respective researchers to defend their distinctive position.

The pragmatism worldview is adopted in this study to explore the relationship between practice-led teaching pedagogy and graduate employability, involving the process of teaching and learning as well as the perspectives of both teachers and students. The rationale for undertaking the mixed methods approach through the application of both qualitative and quantitative research methods can actively look for "completeness" (Clark et al., 2021, 558) in the study; that is, "a more complete answer to the research question"

because it is believed that “the gaps left by methods associated with one research strategy can be filled by methods associated with the other strategy”. Having said that, it is completely different from those scenarios criticised by Giddings (2006, 200) as “post-positivist flavor” and “fitted in” at the paradigm level; and also, those by Silverman (2022, 231) as the possible “illusory search for the ‘full picture’” if simply aggregating data “to arrive at an overall ‘truth’”. With a mixed methods approach, the “robust link” (Newby, 2014, 136) between research question(s) and research method(s) represents that “the method will generate data appropriate to the question” and thus, the research question is “unlikely” to be “just a sentence”, but rather “a short paragraph outlining the complexity of the issue to be explored”, as well as “the dimensions of the question” to be addressed. Following this practice, the section under 1.3 Research aims and questions, provides the descriptions of the main research question and the sub-questions in addition to the research objectives of this study.

The research purposes and questions in this study are directly related to the group of practice-led teachers with professional industry experience in the IT field and also their taught students in the IT degree programmes. So, purposive sampling is deployed in the mixed methods design for data collection, which is based on “pre-determined criteria or acknowledged expertise” (Newby 2014, 257) in selecting the research participants as it can “allow the researcher to learn as much as possible about the phenomena of interest” (Clark, 2021, 378), enabling “the full scope of issues to be explored” (Cohen et al., 2018, 289).

As advised by Cohen et al. (2018, 42), “there must be a defensible reason for mixing data types” in data analysis. To state, my ‘intent’ in the design for combining the different data types towards the common discussion topics in data analysis and interpretations is to achieve “a better fix” through “triangulating evidence” (Newby, 2014, 134) in answering the research questions, that are made up of the perspectives from both teachers and students on teaching and learning as well as their dialogic communications between teachers and students on each of the student project presentations. Teaching and learning is a two-way mutual process, and the students are the receivers; hence, the justification can be achieved

through the collection of qualitative data by interviewing the practice-led teachers in terms of their motivations, teaching pedagogy and expectations. Those qualitative descriptions expressed by the teachers will be validated by the quantifiable student survey responses on those areas related to their learning experience and graduate job prospects corresponding to their teacher's teaching pedagogy, as well as through observing the dialogic discourse and interactions in a question-and-answer session after each student project presentation. In this study, the research "methods should be complementary, producing different aspects of the reality under investigation and then put together" (Gorard and Taylor, 2004, 46). With this approach adopted, the study can "work at a higher level to provide rich detail and to improve understanding" during the process of data analysis and interpretation (Newby, 2014, 134).

Serving as the code of ethics in academic research, the ethical considerations will be discussed in section 3.6. For good research practice, the ethics of validity and reliability will be examined in section 3.7 to show the quality of the research work, including how the method of triangulation is deployed to improve the credibility and validity of this mixed methods research. Lastly, the limitation of this study will be reviewed further in section 3.8 of this chapter.

## 3.1 Philosophical underpinnings and worldview paradigm

Following academic practices, researchers ought to provide an explicit philosophical rationale for their methodological choices (Biddle and Schafft, 2015) because "good research requires making these assumptions, paradigms, and frameworks explicit in the writing of a study" (Creswell, 2007, 15). As stated by Punch and Oancea (2014, 16), "methods of inquiry are based on assumptions – assumptions about the nature of the reality being studied, assumptions about what constitutes knowledge of that reality, and assumptions about what therefore are appropriate ways (or methods) of building knowledge of that reality". Before discussing the research design process, I set out the

philosophical assumptions and the paradigmatic considerations for my methodological approach in this study.

The schools of thought representing qualitative and quantitative research methods respectively are adopting different and opposing paradigms, leading to the subsequent 'Paradigm Wars' and the 'Incompatibility Thesis' in the early 1980s (Lincoln and Guba, 1985; Bergman, 2008) when mixed methods research approach started to take some shape. Such extreme contrast is positioned as "incommensurable" (Coe et al., 2021, 7), meaning that "a philosophical commitment to a particular way of seeing the world necessarily implies the adoption of certain approaches and the rejection of others". But Pring (2015, 61) criticises that this sharp quantitative-qualitative divide epistemologically and ontologically is a "false dualism". Cohen et al., (2018, 9) support Pring's viewpoint and further agree with him to take "cautions against adopting a priori either a quantitative or qualitative view of the world as this massively oversimplifies the real world, which is complex and complicated". Therefore, a pragmatic approach in combining the research methods may seem to provide more sensible results and make good ideas in better shape; and more importantly, "these ideas could become the foundations for a new epistemology even if we are not there yet" (Newby, 2014, 133).

From my perspective in teaching and learning, both teachers and students are on equal grounds as both sides can have their own perceptions, learning and expectations; through a mixed methods approach, it can corroborate the data in the findings as well as triangulate the interpretations in the analysis. According to one of Mason's (2006) strategies in mixing different research methods, when different research approaches are required for answering different questions in one study, each forms a part of the study; that is, "the individual elements can be assembled to create a holistic understanding of an issue" since combining the methods can "reflect dimensions and nuances in the research issue" (Newby, 2014, 135). Planning for a research project, Punch and Oancea (2014, 19) introduce a "paradigm-driven approach" and "question-driven approach", representing the 'top-down approach' and 'bottom-up' approach respectively. In this research study, I am planning to explore the

teaching pedagogies adopted by the practice-led teaching staff, and through the investigation, to understand how they can influence the learning experience and the employability of their taught students. Based on the above reflections, the 'bottom-up' approach in mixed methods is considered in the study.

**Ontological Considerations**

Ontology refers to the assumptions about the form and the nature of reality and its characteristics, and what is there that can be known about it (Creswell, 2007; Punch and Oancea 2014). In this research project, by "embracing the idea of multiple realities" (Creswell, 2007, 16) and so do the individuals being studied and the readers of the study, I will study the perspectives both from the teachers and the students because I believe both sides carry their own meanings – their own contextual interpretation – about the reality which can be true when standing at their side at a particular point of time. The real world is a complex system, not a set of variables; according to Brierley (2017), the position of realist philosophical stance focuses on the alignment between realist ontology and constructivist epistemology because reality is independent of our perceptions, theories and constructions, no need for verification and falsification. For practice-led teachers, they can interpret their way of teaching in supporting their students to understand something related to what needs to be accomplished in the workplace while their students can express their doubts about the usefulness of this kind of learning. Once the information is gathered from both sides, their perspectives and their interactions – 'teacher-student interface' – in classes, a more complete picture can be formed as the reality. Therefore, "realities are apprehend-able in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature" (Guba and Lincoln, 1994; Cobern and Loving, 2007) and thus, my ontological consideration "assumes to be a socially constructed dynamic reality through a framework which is value-laden, flexible, descriptive, holistic, and context sensitive" (Yilmaz, 2013).

**Epistemological Considerations**

Epistemology refers to the nature of knowledge and knowing; what is the relationship between the researcher (or the knower) and that being researched (what can be known) (Guba and Lincoln, 1998; Creswell, 2007; Punch and Oancea, 2014). Realities are complex, dynamic, and ever-changing. Knowledge can be constructed through people's learning, understanding and discovery and these knowledge claims need to be justified by the researchers throughout the whole study. The notion of fallibilism is becoming increasingly a responsible epistemic position, as it "admits to the uncertainty of knowledge but does not end up with the relativist conclusion that all beliefs are equally valid" (Holma and Hyytinen, 2015, 342). When groups of people get together, they can create different sets of collective wisdom, which can be in the forms of 'tangible', 'intangible', 'implicit', 'explicit', multi-layered, and multi-faceted, all of that can be shared with other people. In this study, both the researcher and participants are making contributions to the process of knowledge discovery and creation and then shared it with the readers. With the above epistemological assumptions, I conducted my study in the field where some research participants are working and some are studying, including universities, classrooms, and their work offices because I want to get as closer as possible to the participants being studied, for the sake of minimising the 'distance' or 'objective separateness' (Guba and Lincoln, 1988, 94) between myself and those being researched (Creswell, 2007, 18).

**Philosophical worldview assumptions**

A paradigm or worldview is "a basic set of beliefs that guide action" (Guba, 1990, 17) and these beliefs can "shape the practice of research" advanced by the researchers. Creswell (2007) describes four worldviews, they are post-positivism, constructivism, advocacy or participatory, and pragmatism. Post-positivism requires "an emphasis on empirical data collection, cause-and-effect oriented, and deterministic based on a priori theories" and my study is not following this approach. The basic tenet of advocacy/participatory worldview, focusing on "the marginalised groups" and looking for actions to help these individuals, is not related to my study, too. For social constructivism, the goal of the researchers is "to reply as much as possible on the participants' views of the situation" and "these subjective meanings are negotiated socially and historically". My study has some similarities with this worldview, such as the participants' view on teaching and learning which can have socially

negotiated meanings; but my research is not working towards developing a theory or pattern of meanings (Creswell, 2007, 20-22). Pragmatism as a philosophical stance advocates the "use of multiple data sources and interpretations in research" and acknowledges that "the values of the researcher play a large role" in the interpretations of results. (Christ, 2013, 116).

Pragmatism is the emergent worldview, with a "focus on the outcomes of research – the actions, situations, and consequences of inquiry" (Creswell, 2007). The notion of "what works" (Patton, 1990) or "what works as the truth" (Christ, 2013) becomes the ongoing driving force during the whole process of conducting the research study. "Pragmatism does not reject the relevance of concepts of the philosophy of knowledge" (Brierley, 2017, 16) but it also does not accept the privileging of ontology over epistemology or vice versa. In other words, both the methodological approach and philosophical approach can be organised to offer a mix of quantitative and qualitative methods to answer research questions (Onwuegbuzie and Johnson, 2006), implying that the researcher needs to work out practical research, and it is how my study plan is designed for. To sum up, let me take the quote from Onwuegbuzie and Johnson (2006), "pragmatism includes a healthy dose of pluralism by which we mean that it is not logically contradictory to claim that quantitative and qualitative research are both useful, even if, at times, they appear to be contradictory; perhaps what is seen as contradictory are different perspectives that are complementary and enable one to more fully to see his or her world" (Onwuegbuzie and Johnson 2006, 54; Brierley, 2017).

## 3.2 Mixed methods approach

This study adopts the mixed methods research approach, allowing me as a mixed researcher to address the interests, values, and standpoints of multiple stakeholders, including the teachers, the students, and the fellow classmates in the research process of the study. It is believed that this approach can provide "the fullest and best answers" to "many research

questions" as the perspectives of multiple stakeholders can be recognised through the notion of "multiple stakeholder legitimation" (Tashakkori et al., 2020, 19) or "sociopolitical legitimation" (Johnson and Christensen, 2020, 622). Methodology refers to "the way we go about discovering knowledge in a systematic way" (Killam, 2013, 9) and the process by researchers to create their knowledge claims. In this research project, how the practice-led teaching embedded with the professional experience of the teachers informing the educational experience of their students to be examined through interviewing, is the centrality in this study whilst the student surveys and the class observations are used for providing the students' perspective and the perspective on teaching-learning interactions respectively, formulating the study to become multi-perspective research. The mixed methods are comprised of semi-structured interviews with teachers, student surveys, and class observations to achieve the credibility of this study.

The use of a semi-structured format in the qualitative interview is advantageous for me as the researcher to become "more malleable, with much more room for the interviewee to shape the focus and direction of the interview" (Clark et al., 2021, 425), enabling "the course of the respondents' responses to dictate the direction of the interview" (Cohen et al., 2018, 535) when the viewpoints and insights of the interviewees are of paramount importance in the study. Even though I have prepared 'an interview schedule' to keep an interview on track, a semi-structured style can allow me to have "spontaneous discussion" with the interviewees, i.e., the practice-led teachers, in a variety of ways; such as "ask new questions" (Clark et al., 2021, 425) that follow up their replies, to "clarify people's understanding", to "ask follow-up questions to explore a viewpoint" (Newby, 2014, 356), as well as to "operate probes to inquire further into issues" that are coming up during the interview (Cohen et al., 2018, 535). More importantly, it can "open up other explanations and answers to questions that were not foreseen when the research questions were determined" (Newby, 2014, 356).

As a result, the above design format is the best application of the qualitative approach to make their sharing central to the research theme but flexible enough to extend the scope of

discussions within each of the high-level interview questions, see Appendix 3.7: Log sheet of the discussion flow, in the semi-structured research interviews. Practice-led teachers in the study are the whistle-blowers of this research, whose professional knowledge incorporated with industry experience to inform the student's educational experience, is the main theme to be explored. The student survey is used for collecting feedback from the role of receivers, and class observations can provide real-time snapshots of the field interactions between the teachers, the students, and possibly the fellow classmates. The collection of these two data sets can help to show the cues about the learning experience of their taught students about the course and in the class. The question set in the student survey is designed on a 5-point Likert-type scale. For some questions, they are set in pairs, with the second question prepared in the open-ended format as the follow-up to the first question to let the student respondents give some elaborations on the previous question being rated. For instance, in the pair set of question 4 listed in Appendix 3.4, the first question (4a) is asking the students to rate the effectiveness of course assignments and projects in helping them to practice what they learned in the course whilst the second question (4b) in the pair, is to encourage them to give examples: "The areas that you had practised were (please give examples)". In the student survey, the purpose of having 3 open-ended questions asking for some examples in the areas of most difficult topics, most practical skills, and IT professional qualifications, can act as the function of cross-referencing to the interviews conducted with the practice-led teachers, such as numbers 11, 5 and 4 of the interview questions as listed in Appendix 3.3.

Observations can be deployed in a natural setting to observe "people's actions, behaviour and attitude" in "real time in the research environment" (Newby, 2014, 288). Class observations are used "to interpret actions and interactions of participants" from which can assess and understand "the instructional quality" in the classrooms (Coe et al., 2021, 221). In terms of "unstructured approaches to observation", the researchers need to have an "open mind" when observing the "events and behaviours" that may "become relevant" to the research topics (Clark et al., 2021, 258). The application of this study is to explore the patterns of teaching and learning in particular samples of practice-led teachers through studying the discourse in terms of dialogic interactions between the teachers and the

students in the feedback loop process right after each project presentation delivered in front of the class in the last lesson of the course, see the examples in Tables 4.14(a), 4.14(b), 4.14(c) and 4.14(d). It is the 'moments of truth' that can reflect partly the outcome of teaching and learning in the course while both sides can get to know it together. Both parties are holding 'their own assets' on hand and it is the authentic engagement as the teacher and the students are proactively 'discussing' with each other that particular piece of project work presented by the students after completing the course. In other words, the group projects, or individual projects in one of the courses, can be regarded as the intellectual work asset held by the student groups or the individual students, who designed and developed the project based on what they learned in the course plus their own reflections and self-learning through further research work done for the project. Contextually, each of the student groups or individuals is supposed to be more knowledgeable about the project being presented than the practice-led teacher.

In this sense, the completed student project work is the tool, once mastered by the students that can substantiate the learner's standing in front of the teacher, used for showing their learning and articulating their understanding, and ultimately, to defend their project work. For practice-led teachers, they listen to what the individuals or the student groups presented, to understand what they have done, and to assess how much and how well they have learned based on the presentations delivered by the students. The process becomes the student-led or 'learner-driven' process where the feedback of the teacher is, on the continuum, the last stage in the teaching process for the course performed through a real-time assessment of the student learning. The teachers, leveraging their professional experience to inquire about the materials presented, see Table 4.13(a), exercise their judgement on the student's effort, and their learning and understanding, see Table 4.13(b). Through the questions raised and the answers given in a looping process, the interactive process of discourses is observed for each of the practice-led teachers.

When these three sets of data are combined for analysis, it becomes a very powerful mix, generating a credible understanding of complex real-world contexts in this study. During

the analysis, student surveys and class observations “can help by validating, interpreting, clarifying, and illustrating qualitative findings” (Miles et al., 2014, 43) collected from the semi-structured interviews. Through the theoretical framework and conceptualised notions, the research findings can be strengthened. As a researcher, my methodology involves the “procedures” in doing research, which is “characterised as inductive, emergence, and shaped by the researcher’s experience in collecting and analysing the data” (Creswell, 2007, 19). Lincoln and Guba (2000, 164) proclaim that “methodology is inevitably interwoven with and emerges from the nature of particular disciplines” whereby my study sits on the educational discipline in the contextual nature of information technology. In other words, methodology reflects my beliefs about “the knowledge and values inherent in the paradigm within which the study is conducted and implies a concern and commitment to construct a particular type of knowledge” (Klenke, 2008, 18). In this capacity, to my best understanding, the knowledge is related to the threads of professional experience, practice-led teaching pedagogy and graduates’ employability.

My commitment to this mixed methods approach reflects my pragmatic orientation, in which I seek to reconcile different ontological and epistemological traditions in order to build a comprehensive picture of the phenomenon being studied. It is the case that some knowledge forms can be incompatible, however in this study quantitative data is only ever supplemental to the substantive qualitative study. In this sense, the study is technically mixed methods, and I locate my work in a pragmatic paradigm, however, the study is fundamentally one shaped by a constructivist orientation and hence my argument is that the data sources, and the knowledge they reflect, are compatible.

## 3.3 Identification and recruitment of research participants

### 3.3.1 Purposive sampling

This study requires understanding both perspectives of teachers and students to reflect the dynamics and interactions of teaching and learning. Hence, through a "direct reference to the research questions" (Clark et al., 2021, 378), the purposive sampling method is chosen to achieve 'representativeness' (Teddlie and Yu, 2007) in the study of the phenomenon related to practice-led teaching and learning. Its merits can facilitate the researcher "to maximize the scope of the information obtained" (Lincoln and Guba, 1985, 274) and also, "to answer the research questions in a way that is as meaningful and informative as possible" (Clark et al., 2021, 378). Since this study is designed to obtain insights and understanding from a group of participants who possess some "understanding, insight or experience of what is being researched", the selection of research participants needs to be "criterion-based" in terms of their "acknowledged expertise" in the field (Newby, 2014, 257, 255), "their typicality or possession of the particular characteristic(s) being sought", or having "in-depth knowledge about particular issues" (Cohen et al., 2018, 218, 219). With respect to the sampling on learning perspective, it is logical to involve the students taught by the teachers joining the research interviews. Concisely, those teachers covered in the sampling need to possess some professional industry experience in the IT field and thus, their taught students are invited for filling in the online student questionnaire. The following sections will elaborate on the selection and recruitment of the research participants in this study.

### 3.3.2 Selection of practice-led teaching staff in universities

The practice-led teaching staff is defined as "knowledgeable people" (Cohen et al., 2018, 219) having industry "experience and intimate knowledge" (Newby, 2014, 256) in the IT field because, before joining the teaching profession in universities, they have possessed the working experience in IT industry or technology-enabled sector. These practice-led teaching staff conducting teaching in IT-related degree programmes and their taught students are the core subjects in the study, too. First of all, I needed to locate where they are working, that is, in which academic departments and the universities. Searching the university websites of the eight government-funded universities in Hong Kong, the IT-related degree programmes

offered by the academic departments have different naming conventions in different universities, namely, Computing, Computing & Decision Sciences, Computer Science & Engineering, Computer Science, Information Engineering, Information Systems, Mathematics & Information Technology. There are a total of 10 academic departments as two of the universities have more than one department to offer IT-related degree programmes.

It is generally understood that it would be extremely difficult in succeeding if I invited the heads of the above academic departments from different universities to nominate those teaching staff whose backgrounds can fulfil the selection criteria for participation in my research study. Even though some might be willing to support this study, it would take a long time to go through the internal approval process that they might not want to do so. Hence, I decided to go for a more direct way by looking at the university websites of all ten academic departments and conducting a search for potential participants in the academic staff directory. Firstly, I reviewed the section of honorary professors in the staff directory on the respective university departmental websites because these professors should be qualified to be my study participants because they are joining the university either already retired or still have a full-time job in the industry. I found that there are 12 staff relevant in the search, see Table 3.1, but some of them do not mention their teaching role or their industry experience as they are mainly involved in the in-house lab research. And it happened to have only 2 of the teaching staff agreed to join my research study.

| | Honorary/Adjunct professors | | |
|---|---|---|---|
| **Department Names** | **A** | **B** | **C** |
| Computer Science | 1 | | |
| Computer Science & Engineering | | 1 | |
| Computing | 1 | | 3 |
| Computing & Decision Sciences | | 1 | |
| Information Engineering | | 1 | 1 |
| Information Systems | 3 | | |
| **Total:** | **5** | **3** | **4** |
| | | | |
| A: Industry Experience only (25 to 37 years) | | | |
| B: Industry Experience (9 to 20 years) before PhD attainment | | | |
| C: PhD attainment before Industry Experience & HE Teaching (11-27 years mixed) | | | |

*Table 3.1: The potential list of participants on Honorary/Adjunct professors*

I then moved on to study other sections of the academic teaching staff list, including the emeritus professors. It was very tough for me since the number of academic staff working for each of the departments ranged from 30 to 50. To be bias-free, I needed to study the staff profile of all the academic staff in each department one by one before the selection. Based on the academic staff profile published on their respective departmental website, there are 18 academic staff who are relevant to my research study. Through the formal email invitation, there are a total of 4 academic staff showing interest to join the study while one of them was referred by one of the agreed academic staff. The referrer replied to my email and invited me to attend an academic-industry event launched in the university conference hall where we met and surprisingly, he introduced another delegate to me and told me that he may be a suitable candidate for the study. After his introduction, I had the chance to talk to the delegate who then gave me his name card. After the event, I looked at the university's departmental website and found his name, but no personal profile is shown. I sent him the formal invitation through email, and he replied to my email to join the interview. Finally, I obtained their consent through the email reply from the 6 practice-led teaching staff who then become the research participants in my research study. Each of them signed the hard copy of the Participant Consent Form (see Appendix 3.3) before the research interview started onsite.

According to their public profile presented on the academic department website, the initial profiling of the practice-led teachers is depicted in Table 3.2. They are coming from 6 different academic departments and all of them have indicated that they join this research study as their personal involvement, not representing their respective academic department or university. Due to the exposure of their public profile, this research study cannot mention their academic department and university in order to comply with the terms of ethical consideration as stated in sub-section 3.6.3 for confidentiality and anonymity.

| Name | PhD (Y/N) | Nature of taught degree course(s) | Job nature | Industry experience |
|---|---|---|---|---|
| Practice-led Teacher A | Y | Technical | Applications | IT and academic sectors |
| Practice-led Teacher B | Y | Technical, professional practices | Infrastructure | IT and technology sectors |
| Practice-led Teacher C | Y | Technical consultancy | Cybersecurity | IT field |
| Practice-led Teacher D | N | IT Consultancy | Consultancy | IT field |
| Practice-led Teacher E | N | IT professional practices | Head of IT | Banking and finance sector |
| Practice-led Teacher F | N | Not applicable | Technology business | IT field |

*Table 3.2: The profile of the 6 practice-led teachers*

### 3.3.3 Recruitment of students taught by the practice-led teaching staff

The perspective collected from the students taught by the practice-led teachers can help to understand the educational experience of the students about the teaching of professional knowledge and skills during the process of teaching and learning in the study. Therefore, it is necessary for their taught students to be recruited for filling in the student survey.

When I sent the email invitation (see Appendix 3.5) to the potential interviewees, the practice-led teachers, I stated clearly in the letter of email that it was the research invitation, including one research interview with the teacher and one online student survey by enclosing these two research instruments, one set of interview questions and one set of the student questionnaire. When the six practice-led teachers replied to my email, they only mentioned that they were available for the research interview and proposed their preferred time slot and date. Therefore, I tried to do the follow-up on the student survey after the interview with each of the practice-led teachers. Four of them said that it was going to be very difficult to conduct it in their department. One teacher sent an email to introduce me to the programme director and let me approach the director seeking approval; however, I did not receive a reply from the programme director. One of the

practice-led teachers was my previous course instructor and the department head has known me before. So, I visited the office of the department head and he said that it was a too lengthy process in getting it approved and thus recommended me to approach the teacher directly to see whether the teacher is willing to do it for me as an individual course. Per his advice, I talked to my previous instructor, who was willing to support me and agreed to email the online student survey to the students whereby the student survey was positioned as the academic research project conducted by the alumni's doctoral study. Thus, the student surveys in this study could be arranged in the classes of one practice-led teacher only, who told me to forward the online survey form to her because the invitation to the students needed to go via the teacher only.

## 3.4 Methods of data collection

The methodological approach adopted in this study is the pragmatic worldview, and therefore, I deploy both qualitative and quantitative research methods as a mixed methods approach in my study plan and the respective justifications will be provided accordingly. The fieldwork schedule included semi-structured research interviews, student surveys and class observations, see Appendix 3.6.

### 3.4.1 Semi-structured research interviews

The central study is how the practice-led teachers inform their professional knowledge and experience on the educational experience of the university students studying IT degree programmes. They possess years of IT industry experience ranging from 18 to 35 years, some are acquired before the teaching profession while some are still working in the industry, having teaching duty in the university too. The long years of industry experience possessed by the research interviewees are observed to have extended the discussion, taking the interview much longer with wider topics being discussed.

The key focus is to explore what is the practice-led teaching approach and how they teach the students to support the students' learning and the graduates' employability. Therefore, the design of the interview question set (Appendix 3.3) is the high-level blueprint of their teaching approach in loosely-related questions, which are consisted of four dimensions, their motivation and perceived contribution to teaching, their view on the importance of industry learning in university education and its relationship with graduate employability, any gaps or challenges between teaching and learning, and their recommendations. The corresponding format of the set of questions is semi-structured, enabling the flexibility for the teachers to express their views and opinions freely in each of the questions or topics, and give examples as they like. The research interview is scheduled to be 45 to 60 minutes which is stated in the participant information sheet (Appendix 3.1) and it happened 5 out of the 6 research interviews exceed the scheduled duration, with some almost doubling the time, see Appendix 3.7, which were lasted for 35mins, 121mins, 141mins, 102mins, 101mins and 78mins respectively. The participant's consent form (Appendix 3.2) is also attached with the information sheet in the email invitation to the potential research participants. I brought along the hard copy of the participant consent form with me in each interview, and I invited them to sign it before starting the interview. As they read the consent form enclosed in the previous email invitation, they all signed it in front of me. The set of interview questions is depicted in Appendix 3.3. For each of the research interviews, I sought the interviewee's consensus before each was audio-recorded and then, later transcribed for analysis.

### 3.4.2 Student surveys

The design of the student survey was originally referenced to the course experience questionnaire sets (Ramsden, 1991; Wilson et al., 1997) and the extended CEQ version (Griffin et al., 2003). I have conducted a very detailed analysis of how they come up with the CEQ measurement scales adopted in those three sets of questions. The first version of CEQ proposes 5 measurement scales: good teaching, clear goals and standards, appropriate

workload, appropriate assessment, and emphasis on independence (Ramsden, 1991, 134) while the second version contains 6 scales, having the scale of generic skills being added (Wilson et al., 1997, 34). Griffin et al. (2003, 260-261) point out the need for addressing "a more holistic range of factors in the contemporary undergraduate experience" as some student learning can be experienced outside the classroom. The design in the previous version of the CEQ version is commented for the inability to address the current trend as it was "based on a theory of learning that emphasises the primary forces in the undergraduate experience as located within the classroom setting". Hence, the extended CEQ version in 2003 constructs a new set of 6 sub-scales, including the student support scale, learning resources scale, course organisation scale, learning community scale, graduate qualities scale and intellectual motivation scale (Griffin et al.,2003, 263) and the total number of questions is increased from 37 to 81 questions in the survey. In my study, the student survey is used for collecting the data specific to the IT courses taught by the practice-led teachers, not for the course assessment of the whole degree programme. The long set of student questionnaires is too much to be relevant and to be adopted in my project. However, the rationale in defining the sub-scales gives me very good insights and that 'teaches' me how to prepare my own set of questions in the survey.

Designing the student survey, I have divided it into 6 sub-sections, see Appendix 3.4. The first three sub-sections are set for course design, student learning experience and student learning outcomes, with survey questions related to the areas of course design, appropriate workload and assessment, learning resources, teaching approach, professional skills and graduate qualities. The fourth is open-ended questions seeking student feedback on the most difficult topics in the course and the most practical skillset learned. The fifth is divided into two parts, related to the rating on a list of course items and activities in terms of the usefulness in the course learning as well as the perceived helpfulness in a future graduate job. The first part of the questions is prepared for the IT degree course-level while the second part is set for the IT degree programme-level. The last sub-section is linked to the topic of IT professional certifications. As the student survey is invited by the practice-led teachers directly, it is prepared in the format of an online student survey and the mechanism for collecting the responses is done through Google Forms online platform. I

created the online student survey form and the survey's weblink and then emailed it to the practice-led teachers who can just attach the weblink to the email and send it to their students as an invitation for online survey participation. To me, I can log in to my personal Google account to view the survey responses and download the survey data for analysis.

### 3.4.3 Class observations

After the research interviews, the participants and I get familiar with each other, and they have some trust in me. So, I followed up with them and asked whether class observations can be conducted in their classes. Their first reaction from them was to ask what I wanted to do during the class observations, and I said I wanted to know how the students interacted with the teacher during the classes. Most of them replied that the students are very quiet in lectures and thus they suggested me to do class observations during the student project presentations in the last lesson of the course because it is going to have a question-and-answer session after each student presentation. And I appreciated their suggestion. All the class observations were confirmed by emails which gave me the dates, the time, and the locations. The observation schedule was listed in section C in Appendix 3.6. The observational technique of "participant observation" was employed to observe their dialogues, providing "a more in-depth understanding of the processes" and the "context" during the question-and-answer sessions after student project presentations (Guest et al., 2012, 210-211). The observations conducted in the classes from the first practice-led teacher were recorded through field notes taken. All the subsequent class observations were having some notes taken and assisted with audio-taped for analysis, as that would be useful for me to refer back to those parts related to some technical terms. Besides, two industry seminar talks were covered for class observations as one of the practice-led teachers does not involve in teaching but was responsible for organising the extra-curricular activities for the department.

### 3.4.4 Pilot study on the prepared research instruments

This research study was small-scale because there were only 6 practice-led teachers who joined the research interviews whilst their taught students were regarded as the potential research participants in the form of an online student survey. Hence, the pilot study covered both the interview questions and the student questionnaire. Piloting the interview questions can give me the chance to "clarify people's understanding" (Newby, 2014, 356) of the set of questions as well as to "adjust emphases to address issues that emerge" (Clark et al., 2021, 425) but relevant to the research theme. For the student survey, the pilot test can check for appropriateness in terms of "the clarity of the questionnaire items, instructions and layout" and also, "to eliminate ambiguities or difficulties in [the] wording" (Cohen et al., 2018, 496).

#### 3.4.4.1 Semi-structured interview questions

All the research interviews were arranged according to their suggested date and time, and they were conducted on separate days. The interview question set (Appendix 3.3) was enclosed in the email invitation, which was mentioned to welcome any comments from the research participants, but no teacher raised any concerns about the questions. Therefore, I leveraged the first research interview as the pilot to find out whether any adjustment was needed on those research questions. The first research interview was conducted very smoothly but there was one question that the interviewee felt was difficult to answer because he asked me, what was the question asking for – Question 6: "In what ways do you monitor the learning progress of your students in acquiring the professional skills and understanding in your course(s)?". After I elaborated on the question, he indicated that there was no monitoring specific to the learning of professional skills, and he further explained that provided that the students passed the course, they showed their understanding. Based on this pilot testing, I learned to prepare myself to 'make clarification' (Newby, 2014) on this question to the interviewees, if needed, in the remaining research interviews followed.

#### 3.4.4.2 Online student questionnaire

As stated under sub-section 3.3.2, there was only one practice-led teacher agreed to invite the students to participate in the student survey; and the first set of student questionnaires was set on the course-level (under the section of IT Course Design of Appendix 3.4), which was developed into an online format of student survey in the Google Forms. I forwarded the Google form link to the teacher for review, and it was accepted. Per the teacher's request, the student survey needed to be conducted via the invitation directly by the teacher and so, this process was left to the teacher. After reviewing the written responses to those open-ended questions by the students, it showed 'clarity' on the question set (Cohen et al., 2018) because the respondents understood the nature of the questions for no response inconsistent with the open-ended questions was found. The second round of student surveys was arranged in the next semester but there was a new section for the IT degree programme-level added, including three sub-sections exploring the usefulness of the course items in the study and the helpfulness for graduate jobs, and IT professional certifications. However, the same first set of student questionnaires in the IT Course Design section remained unchanged. The full question set for course-level and programme-level is listed in Appendix 3.4.

## 3.5 Data analysis

In this study, the research idea is to explore and examine the relationship between practice-led teaching, students' learning, and graduates' employability through the combination of qualitative and quantitative approaches in one study. This mixed methods approach can be pursued "to obtain knowledge about the issue of the study which is broader than the single approach provided" or "to mutually validate the findings of both approaches" (Flick, 2018a, 27). In section 1.3 of Chapter one, the main research question of this study contains three sub-questions which have set out the three key topics on the profiling of practice-led teachers, IT curriculum design and graduates' employability, and practice-led teaching

pedagogy and students' acquisition of disciplinary knowledge and skills, that is, "the question itself creates the topic" (Guest et al., 2012, 67) while a topic is defined as "an area, domain or category of the dataset" (Braun and Clarke, 2022, 296).

There are three sets of data collected from the fieldwork. The first and third sets are qualitative data collected through interviews and class observations, respectively. The second set is the survey result, mostly statistical data but also including some written responses on the open-ended questions serving to seek elaboration from the students. The interview data set is the centre of the study representing the teaching perspective, whereby both survey data and class observation data are smaller sets of data, which are used for providing other perspectives on some of the key topics – students' practical learning and the dialogic interactions in teaching and learning – being explored in the interview data set. As strongly advised by Silverman (2022, 229), it is imperative to exercise "method combination" rather than "method integration" so as to distance the positivistic approach during data aggregation, particularly when a constructivist view of reality is adopted in mixed methods. So, this study follows Silverman's suggestion.

### 3.5.1 Research interview transcripts

As the interviews' question set is in a semi-structured format, some derived sub-topics came up from most of the questions during the interviews because they were very interactively conducted, just like sharing sessions by the teachers, ending up with the inter-related data being scattered in more than one question. Therefore, it makes the process of data analysis very challenging. Over 50,000 words were transcribed from 6 audio-recorded interviews. Having the clear direction of exploring the practice-led teaching pedagogies with specificity to the professional knowledge and industry experience to inform the students' learning, I adopt the "inductive" strategy through an "exploratory" approach to study the qualitative data that is "content-driven" and "better fitted" to question-oriented research study as well as non-probabilistic samples of research participants (Guest et al., 2012, 7-8), that is, suitable for purposive sampling in this study.

As a result, the structural coding method is employed to locate the "segment of data" to answer to the "topic of inquiry" in correspondence to the "specific research question". The application of structural coding is "content-based" (MacQueen et al, 2008, 124) or question-based coding approach, which is appropriate for "semi-structured data-gathering protocols" to "gather topics lists or indexes of major categories or themes", particularly useful for interview transcripts and open-ended survey responses (Saldana, 2016, 98). It "acts as a labelling and indexing device, allowing researchers to quickly access data likely to be relevant to a particular analysis from a large data set" (Namey et al., 2008, 141).

**Question-based indexing**

First, I extracted the whole chain of discussion topics following the flow of each interview, maintaining the original list of questions (interview schedule) in sequence and then, adding those content-topics (highlighted in blown-colour) brought up in each interview question. This process can summarise all the content-topics from each of the transcripts to form the content-index of the actual flow of discussions for all the interviews. It is understood that some of the content-topics can be repeated in other questions as some topics, like course design, are relevant in more than one interview question. So, the log sheet was created to document the discussion flow and it would be finalised when the following 2nd step was completed, see Appendix 3.7. That can help me to have a very high level of awareness about the actual scope of the content expressed in each of the field interviews. This step is very similar to the approach of "text segmentation" recommended by Guest et al. (2012, 50) who consider it a tool used for applied thematic analysis. Thus, the chains of questions in terms of content-topics were placed in a Microsoft Excel spreadsheet so as to provide me with an overview of the discussion contents covered in all the interviews. In other words, this log sheet becomes the index, acting as the repository list of content-topics. Since the interview data are thick and rich descriptions, keeping the original flow of discussions in the index can facilitate the content search by effectively locating the expressions and ideas of the interviewees under similar topics but mention in different interview questions.

**Content-based structural coding**

Adopting the exploratory approach in the research study, "the researcher carefully reads and rereads the data, looking for key words, trends, themes, or ideas in the data that will help outline the analysis, before any analysis takes place" (Guest et al., 2012, 7-8). Therefore, the second step required me to go through the transcripts one by one very slowly, reading and re-reading, and this practice is called 'data familiarisation' (Braun and Clarke, 2006). Once the overall picture in each of the interview transcripts was sought, I started the data exploration process by initially highlighting key phrases on the transcripts, see Appendix 3.8 as an example, and then populated them onto the log sheet previously created (Appendix 3.7), that is, each topic in the index to have a few words to describe the text segment in the transcripts or using the interviewees' original expressions. As Guest et al. (2012, 65) said, "you'll know it when you see it" in the coding process. The whole process was very lengthy whereas the effort was critical. The factual picture of each interviewing is formed, such as their motivation, their views, their actions and so on. I can say and I can feel about the data from which each interviewee is shown as a practitioner-teacher role. Through this step, the preliminary understanding of what was expressed by each interviewee on each interview question can be obtained, i.e., the vertical view on each interview transcript, in terms of their experience, their motivations and perceptions as well as their teaching approach towards the main research topic in this study, see Appendix 3.9.

**Drafting of sub-themes in graphic format for each interview question**

The previous two steps were focused on the high-level touch of the interview data set and directed by the sequence and descriptions of the data. This third step was the process for the data identification process. Following the direction of each interview question, I replicated and modified the concept developed by Guest et al. (2012, 67) from "the question itself creates the topic" to become 'the interview question itself creates the sub-themes'; based on the interviewees' responses to each interview questions, I drafted the sub-themes on A3 papers to construct the relationships between different sub-themes in graphic form, see Appendix 3.10. In this process, I could reflect on how the key ideas of the

interviewees were shown in the set of interview data which were connected to the high-level responses in answering the interview question by all the interviewees.

**Multi-tasking categorisation of sub-themes and data comparison**

Fourth, it came to the data categorisation process that I re-read the interview transcripts again to summarise the key points under the same topic or sub-themes but across all the 6 transcripts, see Appendix 3.11. This step was critical for me to do comparisons on their responses to find out the similarities and differences among different interviewees on the same topic. Since then, the drafting could be started by incorporating three dimensions, data collected for each interview question, the same question across all 6 transcripts, as well as the data relevant to the same sub-theme but scattered in other questions. Following the analytic approach to textual data analysis, it is suggested by Hennink et al. (2020, 209) that the process of data coding is based on those themes identified in the study, and then "using description to convey depth and context, and comparison to identify core patterns in data". Since codes can be identified as "issues, topics or concepts that are present in data", my coding approach is to "code self-contained segments of text" (Hennink et al., 2020, 218, 228) whose meanings can be preserved even after being removed from the main body of the transcripts. When thick descriptions are employed in the account of the phenomena of interest, that can help to "capture the emic perspective of study participants more directly" (Hennink et al., 2020, 220) and thus, the interviewees' original words are quoted if deemed as appropriate in the findings.

In terms of practicality, cross-referencing the graphic presentation which showed the relationships between the sub-themes (Appendix 3.10) and the cross-sectional comparison among all the 6 transcripts on similar topics (Appendix 3.11), I started the write-up on the sub-themes based on the highlighted interview transcripts (Appendix 3.8), supported by the keyword search in the Microsoft Excel as prepared in the previous steps (Appendix 3.7).

**Revision of the sub-themes for alignment and double-checking with the transcripts for completeness**

The fifth step was used for ensuring the alignment of those efforts made in the previous steps in terms of data identification (the third) and categorisation (the fourth). This step was very crucial for me to compensate for any shortcomings in the second step conducted in populating the key phrases or words in the log sheet. Some co-related data could be scattered in more than one question while the keyword search in Microsoft Excel was not 100% sufficient enough to locate all the scattered data. Hence, the fifth step was treated as the reversing process by leveraging field data to confirm, revise or update the sub-themes which were finally adopted in the write-up of the findings. The purpose of this last step was to ensure that all the 'key sub-themes' were identified and included in the findings. The word meaning of "key" was referring to the identification of the 'relevant sub-themes' done by cross-checking them among all the 6 transcripts and served as the outcomes generated as the consolidated view of all the interviewees. The word meaning of "relevant" was to represent the relevancy of the sub-themes with respect to the research questions and sub-questions. It was an incremental process in formulating the whole set of key sub-themes relevant to the research study, based on the interview data set collected from the practice-led teachers.

### 3.5.2 Student survey responses

The data analysis for student surveys leveraged the method of descriptive statistics to "do what they say: they describe, so that researchers can then analyse and interpret what these descriptions mean" (Cohen et al., 2018, 753) and also to describe "their characteristics" (Clark et al., 2021, 318), which were done by Microsoft Excel spreadsheet (e.g., Figure 4.1) whose functions can perform tabulation and calculation for Likert-type scale in this study. Moreover, the graphic presentation, see Figure 4.2(b), made of "visual techniques" (Cohen et al., 2018, 754) for data display, was also created by the function in Microsoft Excel. There were two versions of the student survey adopted in the study and both were using the same analytical approach based on the individual course taught by the practice-led teacher. The

first version was developed at the course-level, covering the areas of course design, learning experience, and learning outcome. In the second version, two more sections were added, with part one related to the course items and activities to be analysed in terms of usefulness in course learning as well as helpfulness in graduate jobs whilst another part was about IT professional certifications.

Other than the quantitative data, the survey data set contained some qualitative data which involved two sources. One source was collected through the open-ended questions, which were set in pairs with the corresponding question on a Likert-type scale, seeking some examples to give elaboration on the previous question answered. Another source was coming from the open-ended questions set for collecting the students' perspectives on some key themes also asked by the interview questions with the teachers, such as professional experience and the course's practicality. Hence, question-based structural coding was deployed to analyse these data, see sub-section 4.2.5 and 4.2.6 as examples. Combining the views from both teachers and students in the data analysis could help to provide a more complete picture of teaching and learning on those common themes set in the questions. After reviewing the whole set of survey data, no "missing data" was found in the student responses to all survey questions including those open-ended questions, implying that this issue did not affect the "correct-ness of analysis" in the survey results (Cohen et al., 2018, 753).

### 3.5.3 Class observation discourse

The class observations were arranged in the classes where the students presented their individual or group projects, leading the discourse analysis to focus on the "narrative text[s]" to describe "the social reality (or discourse) around a phenomenon". Hence, the data analysis can be used for examining the "conversational structure" (Hennink et al., 2020, 210), that is, analysing the dialogic interactions between the teacher, students, and fellow classmates during the feedback session after the student project presentation. Observational data analysis could be performed by "thematic analysis and patterning"

(Cohen et al., 2018, 555) which was used for summarising the participants' behaviours observed in the classes, including the approach the teachers asked the questions as well as the ways the students answering teacher's questions in this study. Since "language structures reality" (Clark et al., 2021, 484), this part of the analysis was aiming for understanding the practice-led teaching techniques which were described in the interview data set as well as the practical learning by their students as reflected in the student survey.

For practical consideration, class observation data analysis was necessary to offer the perspective on teacher-and-student interactions, which served for triangulating with teachers' perceptions and students' perspectives in terms of practice-led teaching and learning. It was then expected to come up with the analysis of whether these two perspectives were aligned or contrasted through real-time observations in the classroom environment. During the project presentations, the contextual understanding could be articulated through the project work done by the students who applied what they learned in the course and paid effort to their study whilst the practice-led teachers could observe and assess the actual understanding of the students at the end of the course, see Table 4.14(a) to 4.14(d).

### 3.5.4 Project management is identified as the common theme across the research instruments

Project management is the common topic across the three research instruments, that is, research interviews, student surveys and class observations. The role of IT projects is positioned as central to the IT discipline as every formal project needs to be managed by an IT project manager. In the research findings, there was a separate sub-section to provide an integrated view of project management, through the analysis of the three research instruments which were further supplemented by the online research for the IT professional body related to the certification on project management, see sub-section 4.5.2.

## 3.6 Ethical considerations

This section provides the evidence, based on the ethical guidelines recommended by the academic research bodies and scholars, about the appropriate actions that I have taken when conducting the field research for this study. As defined by the University of Nottingham (2021, 12), research data is defined as "the data collected, observed, or created by further analysis to produce original research results", including "personal data and/or commercially sensitive data". During the research process, the primacy of respect is preserved for the practice-led teachers and their taught students as the research 'participants' (BSA, 2017; BERA, 2018; BPS, 2021a; UoN, 2021) or the 'human subjects' (AoIR, 2020; QTD Working Group, 2019), with the latter description increasingly adopted in internet-mediated research. In this study, online research was deployed to perform the preliminary screening of candidates, but the data collection processes involved the primary fieldwork of face-to-face interviews with the teachers, online student surveys and class observations; therefore, the description of research participants or respondents is preferred.

As mentioned in sub-section 3.3.1, all the teachers have indicated to join this study in person, meaning that their academic department and the institution need to be protected without being identifiable. Through the university's website, I accessed the academic staff directory and obtained their personal profile before inviting them to join the study, implying that their public profile is searchable by everyone, leading to the issues of 'ethical sensitivity' (Anabo et al., 2019) and 'data sensitivity' (BERA, 2018; AoIR, 2020) in the research data, which are of particular importance for me to take precautionary steps in preparing the data set for analysis as well as to disseminate the research findings. Per the ethical guideline of the British Educational Research Association (2018, S-45), "all reasonable precautions" should be taken "to avoid identification" through "association or inference".

### 3.6.1 Access to research participants

This study involves two groups of participants, practice-led teachers, and their students. I performed the online research by visiting all the university websites to locate the academic departments offering degree programmes related to information technology or the related subject areas. Once the relevant academic departments were located, I went to the academic staff directory to review the teaching staff's personal profiles to see who the potential research participants for this study could be. Some of them have their profile description hyperlinked to their personal website while hosted in the departmental portal and thus, this detailed information is also included for analysis. That means the initial identification of potential research candidates was conducted through 'unobtrusive use' of the "found Internet data" (Hine, 2011, 2) whereas the academic staff was "the data's creator or source" (Anabo et al., 2019, 138) are unaware of being studied. Following research ethics for integrity (BERA, 2018), when I sent the formal email invitation (Appendix 3.5) to all potential participants, I mentioned that I obtained their personal profiles through their university's website before inviting them to join the study.

After each of the research interviews was completed, I followed up on the online student survey with them and only one teacher agreed to invite the students, requiring the invitation to be sent directly via the teacher. That is, I obtained 'verbal consent' from the teacher through a face-to-face meeting. After preparing the online student survey on the Google Forms platform, I set up the weblink access and then forwarded it to the teacher for review; as no further comments were received, that was then up to the teacher's pursual for students' invitation. This practice follows the ethical guideline on academic 'autonomy' or 'freedom' (BERA, 2018; AoIR, 2020).

In addition, I tried to propose having class observation activities to understand how they interacted with their students in teaching; they showed support to me but asked for my intention in doing so. After my further elaboration, they initiated to let me attend the lesson(s) scheduled for student project presentations at the end of the course. As the

research interviewing process has helped the research participants and me, the researcher to create “mutual respect and trust” (BPS, 2021a, 4; BERA, 2018; BSA, 2017) during the research interview, when I followed up with them on whether I could have some class observation activities, they were eager to voluntarily offer the form of class observation activity specific to the needs of my research project.

### 3.6.2 Informed consent and ongoing consent

#### Informed consent

“Consent is not valid unless it is given from an informed perspective” (BPS, 2021a, 12). Per the BERA (2018, S-8) guideline, the researcher is expected to make sure that “participants’ voluntary informed consent to be involved in a study will be obtained at the start of the study” because the “primary way of protecting the (deontological) norms of *autonomy and equality*” (AoIR, 2020, 8) is the “freely given informed consent” (BSA, 2017, S-18). Following this practice, even though I have received their positive email replies to join the interview with the available date and time and the location provided, I could only treat those emails as their ‘intention to consent’. Therefore, when we met up and sat down for the research interview, I handed the hard copy of the participant consent form, which had been sent over through email, for each of them to sign on it before the research interview formally commenced. By then, I have obtained both the intention to consent and the written informed consent for conducting the research interviews.

#### Ongoing consent

“Ethics is an ongoing process” (AoIR, 2020, 2) which may be involved through the “ongoing negotiation of the project” (QTD Working Group, 2019, 11) with the research participants taking part. In ethical practice, obtaining consent may be regarded “not as a once-and-for-all prior event”, but as an ongoing process (BSA, 2017, S-19; BPS, 2021a). Per se, it is “the right of all participants to withdraw from the research for any or no reason, and at any time, and participants should be informed of this right”; thus, the researchers are advised to

"provide their own contact details to participants" (BERA, 2018, S-31). In my study, the participant information sheet enclosed in the letter of email invitation states that even if the participant decides to take part, he or she is "still free to withdraw during the interview or any time up until", see Appendix 3.1; and my contact detail has been provided in the email invitation. Furthermore, both the contact details of my academic supervisors and my own contact information are written on the participant information sheet and the consent form. Regarding the other two research instruments – online student survey and class observations – in this study, they were arranged after the ongoing consent granted by the practice-led teachers at the end of each research interview.

### 3.6.3 Confidentiality and anonymity

Addressing both the privacy concerns and the protection of research participants' identity, "the confidential and anonymous treatment of participants' data is considered the norm for the conduct of research" (BERA, 2018, S-40) while "an individual participant's personal information obtained as a result of research" (UoN, 2021, 14) is also considered to be confidential. For the issues of confidentiality and anonymity that are intricately associated, data anonymisation (BPS, 2019b) or data de-identification (AoIR, 2020) is commonly adopted for supporting confidentiality. However, some "de-identified data sets may potentially become re-identified" when combined with other "patterns of information" (BPS, 2021b, 11) like personal characteristics, or when some are "possessing a combination of attributes that make them readily identifiable" (BSA, 2017, S-31).

To mitigate the possible risks of compromising the anonymity of research participants through "re-identifiability" (BPS, 2021b, 18), particularly caused by some traceable or available online data such as the academic staff profile, all the possible identifiable elements need to be removed from the write-up. Therefore, the name of practice-led teachers in this study is "pseudonymised" (UoN, 2021, 15) and replaced by PLT-A, PLT-B, PLT-C and so on, with their gender undisclosed, too. In terms of writing practice, I need to use a possessive pronoun in this piece of academic writing; therefore, for simplicity, I have used 'his or him'

throughout the whole piece write-up as most of them are male teachers. The names of degree programmes, academic departments and universities are also not mentioned in the study. It is because once the academic department is identified by the readers, the identity of practice-led teachers who participated in the research interview can be revealed or re-identified easily. The above settings for 'data-masking' as ethical practice are, therefore, adopted to ensure privacy, confidentiality, and anonymity in the study.

### 3.6.4 Data storage and access

Keeping the research data storage and access in a secure manner is regarded as part of the protocols in ethical practice (AoIR, 2020; BSA, 2017), covering the deployment of "password protection or data encryption" (BERA, 2018, S-50), the secure platforms and access through a secure network (BPS, 2021b), and the creation of "password-protected files" (QTD Working Group, 2019, 13). Based on the guidelines of the British Psychological Society (2021a, 19), "all records of consent, including audio-recordings, should be stored in the same secure conditions as research data". In this project, the hard copy of the signed consent forms was scanned into PDF files before being physically stored securely. The research data documents of signed consent forms in an electronic file, audio recordings and transcripts are all password-protected. Moreover, the access to the online platform to review and download the data collected from the student surveys is also protected by a secured password and the folder can only be accessed by the researcher. So, the ethical guideline for researchers to "ensure that data are kept securely" (BERA, 2018, S-50), has been followed accordingly.

## 3.7 Research quality

The quality of a piece of academic research is essentially reflected in the research process and procedure (Creswell and Plano-Clark, 2018; Silverman, 2022) as that can exhibit how the ethics of validity and reliability, "the corner-stones of any research" (Newby, 2014, 130), can

be fulfilled. These two principles can be applied to qualitative, quantitative, and mixed methods research, though the 'meanings', the 'criteria' and the 'interpretations' of validity and reliability are varied in different research methods. "Research should not paradigm-bound" (Cohen et al., 2018, 246), but once the paradigm chosen to reflect the underlying philosophical considerations and assumptions in the inquiry, the researcher needs to show "fidelity to the approach" and the researcher's work needs to be "fit for purpose" (Cohen et al., 2018, 245, 246), that is, to abide by the required standards of validity and reliability in the methodological approach identified. Regarding the method of triangulation, it is served for improving the credibility and validity of the research study and its application is more broadly elaborated to support the research goals in a variety of ways, like "validity strategy" (Creswell and Plano-Clark, 2018, 217), evidence base verification (Mason, 2006), seeking convergence of findings (Mark and Shotland, 1987) and so on. The following sub-sections will discuss in detail how this study can demonstrate the research quality.

### 3.7.1 Validity and Credibility

The ethics of validity is "an important key to effective research", posited as "the touchstone of all types of educational research" (Cohen et al., 2018, 245) because both qualitative and quantitative approaches value it in "checking on the quality of the data, the results, and the author's interpretation of the data results" (Creswell and Plano-Clark, 2018, 216). However, it is suggested that researchers should look for achieving "an acceptable level of validity" (Cohen et al., 2018, 246) as it is unrealistic to attain 100 per cent of validity in research work (Cohen et al., 2018; Miles et al., 2020). The scope of validity covers research instruments, research design, inferences, and conclusions; in other words, the instruments are sound when they measure what it claims to measure while the interpretations of data and the knowledge claims are also warranted by the evidence used.

For qualitative research, validity refers to truth, that is, "the extent to which an account accurately represents the phenomena to which it refers" (Hammersley, 2016, 62) whilst other scholars prefer to use 'understanding' (Miles et al., 2020) to replace the term of

validity. At the beginning of this writing, I have explicitly stated my research positioning (see section 1.5) in the role of a researcher; according to Cohen et al. (2018, 247), I am the "key instrument of research" in conducting the semi-structured interviews with the practice-led teachers in the study. My academic qualifications, industry knowledge and experience in the context of the IT field can better support me to accommodate "the context-boundedness and 'thick description'" in performing the data analysis and interpretations as I become "part of the researched world" in this study, which is focused on IT degree programmes and IT field. When the role of researchers is included as part of the world to be researched, Cohen et al. (2018, 247) agree that "we cannot be completely objective about that", and this viewpoint is also echoed by Newby (2014, 131) who contends to "be partial in relation to, and allow our values to influence" in the research, we involved, "but we should strive to be impartial in the way we use evidence to reach conclusions". Consequently, the "credibility" of the researcher's "interpretations" in this study is acceptable (Silverman, 2022, 433).

Similarly, the quantitative approach of student surveys in collecting the students' feedback on IT courses would require me to fulfil the criterion of internal validity, which involves "the content validity of the measures used" (Cohen et al., 2018, 247). As argued by Carmines and Zeller (1979, 27), content validity, "by necessity, is an imprecise standard against which to evaluate the validity of empirical measurements"; rather, demanding the research instrument to sufficiently cover the domain or categories to be researched. In the study, the purpose of the student surveys is to collect the students' learning perspective in the courses taught by the practice-led teachers, which can be achieved through the design of survey questions covering two levels – one is the course level on course design, student learning experience and student learning outcomes while the other one is the programme-level relating to the rating on a list of course items and activities in terms of the usefulness in the course learning and the perceived helpfulness in a future graduate job. So, the whole survey design is directly related to the study on practice-led teaching pedagogy in the research, used for triangulating the data collected from the research interviews and class observations. Further detail on the triangulation approach will be elaborated in section 3.7.3. As defined by Teddlie and Tashakkori (2009, 27), "inference transferability"

incorporates the standards of 'external validity' and 'transferability' as required in mixed methods design. In terms of research quality, the specification of context-bound and the sampling design in this study does have its limitation which will be reviewed in section 3.8.

### 3.7.2 Reliability

Reliability refers to the degree of "consistency" (Guba, 1981, 81) in the study design and research procedures (Miles et al., 2020; Silverman, 2022) developed by the researchers. Compared to quantitative research, in general, the role of reliability plays less in the qualitative approach as the researcher "emphasizes the value of his or her subjective interpretations" (Creswell and Plano-Clark, 2018, 218). However, one of the requirements set for reliability quoted by Miles et al. (2020, 305) is that "the findings show meaningful parallelism across data sources" which applies to both qualitative and quantitative data collected in the study. Since reliability is viewed as a necessary "precondition of validity" (Guba, 1981, 81; Cohen et al., 2017, 245), qualitative researchers also look for ways to conduct their research consistently to get credible results in the work whereas Guba (1981) and Lincoln and Guba (1985) prefer to use 'dependability' as the parallel term.

In qualitative research, as commented by Silverman (2022, 449), providing "detailed data presentations which make minimal inferences" is the approach more desirable than "researchers' presentation of their own (high-inference) summaries of their data" because low-inference descriptions (Seale, 1999) or thick descriptions are seen as more reliable, allowing the readers and other researchers to come up the understanding by themselves without relying much on "the researcher's depiction of what was going on". The merit of thick descriptions can provide them with a repository for "making judgements about the possible transferability of findings to other settings" (Clark et al., 2021, 366). According to Miles et al., (2020, 305), the reliability of a study can be enhanced if "the features of the study design are congruent" with the research questions, and "the researcher's role and status" can be "explicitly described". In the study, the three research sub-questions are set to look for the field data corresponding with the main research question while my

researcher's positioning has been stated in section 1.5. In terms of presenting the findings, direct quotes from the practice-led teachers and their taught students have been displayed in most of the sections. In addition, the dialogues between teacher and students after the student project presentations are also exhibited in detail in Table 4.14 (a)-(d).

As defined by Creswell and Plano-Clark (2018, 217), "quantitative reliability means that scores received from participants are consistent and stable over time"; and in this study, I have selected student surveys as the research instrument to collect the student feedback on both course-level and programme-level which can be seen as a consistent approach in response to their practice-led teachers' perspective on teaching while the quantitative data presentations are using descriptive statistics. Since the student surveys were performed for the courses taught by one practice-led teacher only, the requirement for stability over time in the scores cannot be met in this study, and this issue will be discussed in section 3.8.

### 3.7.3 Triangulation

Triangulation is the common approach to allow the findings generated from one method to validate the findings derived through other methods. Alternatively, it refers to leveraging more than one method or one source of data to study the same research problem or phenomenon, seeking "to validate a claim, a process or an outcome through at least two independent sources" (Newby, 2014, 130). In assessing the appropriateness of the analytic strategy in the mixed methods approach, Rossman and Wilson (1985) come up with the term 'corroboration', which carries the same purpose of triangulation (Caracelli and Greene, 1993, 199), meaning that "analyses of the different data types are conducted independently and then compared for convergence at the level of conclusions and interpretations". During the process of "cross-referencing" one method or data source with another, if the researcher "finds correspondence" in different sources, that can help to deepen "the researcher's field of vision" (Clark et al., 2021, 364) and give him or her greater confidence and assurance in those results drawn from the findings, "even the methods contrast with each other" (Cohen et al., 2018, 265).

For the conduct of qualitative research, the process of triangulation is largely respected for bridging the issues of validity and reliability, to avoid the researchers from taking people's words simply at face value because "people's words are some of the richest data" which can carry deeper meanings in the research study. Even though the research participants are not intended to tell lies, sometimes, "they may seek to represent themselves in a better light" (Newby, 2014, 155). In this sense, triangulation can receive merits for producing knowledge on different levels, thereby going "beyond the knowledge made possible by one approach" and thus promoting better quality in research (Flick, 2008, 41). Moving forward, when the method of triangulation is considered for operating within and across research strategies, it is the mixed methods approach; as observed by Moran-Ellis et al. (2006), there is a growing trend of applying triangulation strategy in the "process of cross-checking findings deriving from both quantitative and qualitative research" (Clark et al., 2021, 364).

The high-level themes of this study are related to university teaching and learning which involve the perspectives of teachers and students. So, "triangulation of perspectives" (Flick, 2018b, 454) is identified in its own right in the study design. Following the contextual teaching and learning environment in universities, the generic ratio is set for one teacher to teach a class of students as a unit. To understand the teaching pedagogy of practice-led teachers, the semi-structured qualitative interview is considered whereas, for the collection of student feedback related to the course teaching, the research instrument of student survey is deployed to count the number of student responses, supplemented by some open-ended questions for collecting their written explanations for their rating on 5-point Likert-type scale. For the study of teacher-and-student interactions, class observation is viewed as the appropriate method for data collection which can allow me, the researcher, to experience the process of practice-led teaching and student learning at the sites of the learning environment.

Cohen et al. (2018, 266) point out that the triangulation method is desirable "when a more holistic view of educational outcomes is sought, or where a complex phenomenon requires

elucidation". Aligning with the study requirements on both perspectives of teachers and their taught students whilst the research question is complex involving people, the learning environment and the future workplace, methodological triangulation (Denzin, 1970) is adopted in this mixed methods study design. This consideration is supported by Cohen et al. (2018, 265), who points out that in the field of social science, triangulation can be endeavoured "to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and, in doing so, by making use of both quantitative and qualitative data". Having methodological triangulation in place necessitates the approach of data triangulation (Denzin, 1970) across the qualitative and quantitative strands when the mixed methods approach is considered as a vehicle for improving the quality of inferences drawn from both of the methods (Teddlie and Tashakkori, 2009) or as value-added techniques to extend the range of insights beyond the information provided by either quantitative or qualitative analysis (Creswell and Plano-Clark, 2018, 218).

## 3.8 Limitation of this study

The design of this research study has adopted purposive sampling and a mixed methods approach, leading to some limitations that need to be addressed in this section.

Purposive sampling is a non-probabilistic approach that it relies on the researcher's "ability to argue a case to convince others" (Newby, 2014, 266). The goal of purposive sampling is "to sample cases or participants in a strategic way" (Clark et al., 2021, 378) and the selection in this study is based on 'the aims of the research', which is involved describing a particular context, making sense of the interpretations related to the people in that context and promoting insightful and deep understanding for that context (Coe et al., 2021). Therefore, the selection criteria are those practice-led teachers who possess some prior industry working experience in the IT field. When I reviewed the public profile of the teachers through the university's portal, there was not much information mentioned about the

number of years of industry working experience they possess. But the number of years of working experience is normally treated as a variable in demographic profiling and this factor of variance can affect a teacher's practice-led teaching pedagogy. In the study, happened that all the practice-led teachers who joined the research interviews, are IT veterans possessing very extensive professional experience in IT practices in the field, making the research findings rather unique. As described above, the sampling of semi-structured interviewees is selected purposively according to the research aims but not by "the kinds of claims we want to be able to make"; however, both are the two conditions set for assessing the sampling methods in terms of "transfer across participants" (Coe et al., 2021, 54). As for this study, purposive sampling is chosen to align with the aims of the research study, and the specificity and profile of the participants in the research interviews may limit its transferability to other groups of teaching staff, such as those having less than 10 years or 5 years of industry working experience in the same context of IT degree courses.

Regarding the student questionnaire, all the students who participated in the surveys were taught by one practice-led teacher only, leading to the survey results being unable to represent the overall student perspective about the teaching efforts contributed by all practice-led teachers in the study. Consequently, the survey results cannot be positioned for confirming or rejecting the perspective concluded from the group of practice-led teachers in this study. As briefly mentioned in section 3.7.2, this quality issue is related to 'quantitative reliability' (Creswell and Plano-Clark, 2018) as the survey findings cannot prove its stability over time due to one single source (i.e., taught by one practice-led teacher) of student classes participated. However, there are some open-ended questions included in the student survey for collecting written explanations from the student respondents on some important topics like most difficult topics learned and most practical skills learned. This part of mixed methods within the survey design is the method of combination (Silverman, 2022) to pursue 'knowing more' on some key discussion topics, and this approach of 'following a thread' (Moran-Ellis et al., 2004) can help to improve the depth or quality of the student survey results.

Whilst for class observations were suggested by the practice-led teachers because it is a good time for them to provide feedback to the students after each project presentation in the last lesson of the taught course and those sessions could be interactively conducted. Though the scope of observations is limited to the student project presentations, it covered all the students in one class and the class observations were conducted for 5 out of 6 practice-led teachers, with the observation activities for the 6$^{th}$ teacher related to two guest speakers' seminars, implying that the whole data set of class observations can achieve 'representativeness' (Teddlie and Yu, 2007) in the findings and data interpretations, carrying its weight in the conclusions made. Concisely, this set of class observation data is valuable and relevant for understanding the direct interactions between teachers and their taught students.

In this mixed methods research study, the development of the research instruments was prepared in parallel, and so does the process of data collection. During the stages of data analysis and interpretation, the perspectives of practice-led teachers and their taught students derived from the three data sets were combined and triangulated to form the full picture of the phenomenon being researched whilst the tasks of comparison and contrasting were conducted at the same time. As defined by Teddlie and Tashakkori (2009, 27), "inference transferability is the degree to which the conclusions from an MM study may be applied to other settings, people, time periods, contexts, and so on". The interpretations and conclusions inducted in this study have some potential to transfer to another similar context of degree courses of practical and applied orientations but some of the unique characteristics of the research participants may impose some limitations, since the claims for its application to "transfer across contexts" demanding for "an adequate, representative range of participants" (Coe et al., 2021, 54; Miles et al., 2020). To conclude, deploying the triangular techniques in mixing the qualitative and quantitative approaches in this study to explore the phenomenon or issue of interest, it becomes "less concerned with the accuracy of measurement than it is with the correctness of the insight and the legitimacy of the interpretation" (Newby, 2014, 134).

# CHAPTER 4 FINDINGS

## 4.0 Introduction

This chapter discusses the field research findings collected through the approach of mixed methods, including the semi-structured research interview with the practice-led teachers, the online student surveys, and the class observations on student project presentations in the class as well as two industry seminar talks. IT project management is an essential topic for the primary and secondary IT sectors as every company needs to have a good project manager to manage IT projects. Hence, there is a separate sub-section to offer an integrated view of project management after the data is collected from different research tools. The analysis of different sets of data is conducted separately but the results are linked and combined for interpretations. The outcomes for the linking between qualitative and quantitative research approaches are found to be no contradictory results and even can demonstrate complementary results (Caracelli and Greene, 1993), providing a fuller picture of practical teaching and learning (Flick, 2018a). Besides, the linking of the student survey results with the practice-led teachers' interview results can evidence the values of industry experience and the importance of teachers' experience sharing in student learning, but unable to confirm its helpfulness in graduates' jobs as 43% of the student respondents answered "May be" in the survey though no student chose the answer of "No".

There were 6 practice-led teachers participated in the semi-structured interview, coming from six academic departments from four different universities. All of them graduated from technical-oriented degree programmes, possess a technical background and are/were working in the IT field before joining the teaching profession in the university. As mentioned in the methodology chapter, only teacher PLT-D agreed to invite the students to join the online student surveys, having a project management course conducted in two semesters and a risk management course in one semester. In the two rounds, a total of 47 survey respondents participated, with 19 and 28 respectively. The first version of the

student survey consisted of three sections: course design, learning experience and learning outcome while the second version had three sub-sections added: the level of usefulness in 15 course items and activities for course study, the helpfulness in terms of future graduate jobs, and IT professional certification. For the fieldwork of class observations, there were 16 individual student projects and 20 group projects observed. The analysis was focused on the dialogical conversations between practice-led teachers, project presenters and fellow classmates. Two industry seminar talks were also observed but the analysis was focused only on those non-technical questions and answers.

## 4.1 Practice-led teaching profiling, motivations, and perceptions

### 4.1.1 Practice-led teachers' profile as capital distinctions in teaching

The study of the six practice-led teachers and their interactions with the students is central in this research study; thus, the socio-demographic (Kuckartz, 2014; Saldana, 2016) profile of these teachers is first to be examined. According to the academic staff section published on the departmental websites of the respective universities, I can source the public profile about their academic background, their past and current job history in brief, their membership in the professional bodies as well as their representative role in some of the industry bodies. During the research interview, each of the teachers also shared with me their professional experience in the first interview question. Based on these two sources of information, I consolidate the information collected and create a summary of their professional profile in Table 4.1. There is a note for teacher PLT-F, whose public profile is not made available, and his profile is created according to what he said in the research interview.

| | Practice-led Teacher A | Practice-led Teacher B | Practice-led Teacher C | Practice-led Teacher D | Practice-led Teacher E | Practice-led Teacher F |
|---|---|---|---|---|---|---|
| **PhD qualification** | Yes | Yes | Yes | No | No | No |
| **Academic researcher** | Yes (current) | Yes (current) | Yes (current) | No | No | No |
| **Academic teaching** | Yes | Yes | Yes | Yes | Yes | Industry liaison |
| | | | | | | |
| **Industry experience** | | | | | | |
| **IT vendors** | Yes (previous) | Yes (previous) | Yes (previous) | Yes (previous) | No | No |
| **IT service provider** | No | No | Yes (current) | No | No | Yes (previous) |
| **IT trainer** | No | No | Yes (current) | Yes (previous) | No | No |
| **Commercial organisations** | Yes (current) | Yes (previous) | No | No | Yes (retired) | Yes (current) |
| **Job nature** | Technical | Technical lab researcher | Technical | Technical | Regional CIO | Business head |
| **Work focus area** | **IT applications** | **IT infrastructure** | **IT security services** | **IT project delivery** | **IT management** | **IT business** |
| | | | | | | |
| **Professional membership** | | | | | | |
| **Industry representative in public bodies** | No | No | No | No | Yes | Unknown |
| **Advisory board member in public bodies** | No | No | No | No | Yes | Unknown |
| **Committee member in professional bodies** | Yes | Yes | Yes | Yes | Yes | Unknown |
| **Professional membership** | Yes | Yes | Yes | Yes | Yes | Unknown |
| | | | | | | |
| **The courses taught by them, for example:** | **Programming** | **Engineering Practices** | **Cybersecurity Practices** | **Project Management** | **Professional IT Practices** | **n/a** |
| | **Artificial Intelligence** | | | **Risk Management** | **Management Practices** | |

*Table 4.1: Professional profile of the 6 practice-led teachers*

There are three of the teachers, PLT-A, PLT-B and PLT-C, hold the PhD qualification and continue to make academic research contributions in their current role in academia, with PLT-A and PLT-B supervising the PhD students while PLT-C said that he is preparing to do it shortly. The academic qualifications of all the six teachers are related to the technology discipline and are/were working for giant global technology companies or technology-enabled sectors after graduation. That means, their tertiary education and graduate jobs are in the same field; and they are demonstrating the lived experience of the real world "on a

single continuum" (Dewey, 1938, 27). Three of them studied in a university outside their home country while the remaining studied locally, and hence, the "academic mobility" (Altbach et. al., 2009, 3) of the research interviewees in this study is 50 per cent. Teachers, PLT-C and PLT-D, have many years of training experience as IT technical trainers, with the former focusing on the corporate level such as government departments while the latter on individuals' training in public classes. For teacher PLT-E, the career profile started with a graduate job as a trainee programmer in a global financial institution, though in between, he had ever changed jobs to work for another top-tier financial institution overseas, he was invited to re-join the company he first worked for and later, promoted to the top of the career ladder as the regional Chief Information Officer, overseeing several thousands of IT staff and the software development centre in the region until the retirement.

Based on their public profile, except for PLT-F, they all have memberships in professional bodies, such as BCS, HKCS, IEEE, ISACA, and PMI, as well as taking up the role of the committee member in some of the professional institutions. These professional bodies indicate the conventions for practices or social practices which are embedded in the institutions as a form of social capital (Sambasivan and Smyth, 2010). Before retirement, teacher PLT-E was representing the organisation to become chairman of the technology committee of the international regulating body for financial institutions; regarding the position held as an advisory board member in some of the statutory public bodies, he is still holding the current position in some of them. These are 'knowledge networks' (Nahapiet and Ghoshal, 1998), "based on a logic of business and professional expectations" as network capital (Huggins, 2010, 348). For teacher PLT-A, his public profile mentions that he won several local and regional awards in artificial intelligence (AI), including academic research and IT professional excellence, showing that he possesses good social standing as a form of symbolic capital (Lindberg, 2013) or cultural capital (Tomlinson, 2017).

In terms of industry working experience, they possess experience working in the field ranging from 18 to 35 years in full-time mode and have been working in the university ranging from 10 to 25 years. They all have a technical background since they graduated

from the technology discipline. Interestingly, it is learned that their focus area in work is/was on different aspects of the IT field. In terms of speciality in IT or the team setting within an organisation, the nature of work for teacher PLT-A is related to IT applications (software team), teacher PLT-B to IT infrastructure (hardware & network team), teacher PLT-C to IT security services (consulting team), teacher PLT-D to IT project delivery (IT services delivery team), teacher PLT-E to IT management (C-level executive), and teacher PLT-F to IT business executive (business head).

### 4.1.2 Teaching motivations as caring, obligations, and commitment in social capital

Most practice-led teachers are passionate about helping young people while teaching jobs can provide the best opportunity for them to care about them, and to get in touch with them. They were rather attentive to the needs of the young graduates in their previous commercial jobs and said to understand the young graduates, not feeling the distance from the university students, like PLT-D who previously taught the conversion courses to those university students who graduated from non-IT subjects but wanted to move to IT industry through the intensive conversion course. PLT-A feels the joy from teaching young minds while PLT-E clearly shows his motivation to teach the students to understand the alignment between business and IT and to apply what they learned for practical use to "make a big difference to the student's proficiency". The teachers also show their love for the academic field, particularly for PLT-B who said, "I like academia" and they see teaching as "a very rewarding profession". The personal motive of PLT-D is about learning, explaining that "for teaching, I had to know every single function and feature in the database because the students might ask me". Some teachers sense the urgency in the field, showing obligations (Coleman, 1988) to the industry sector they have been working for. So, they hope that the course taught by them can support the students to obtain accreditation from the professional institution. PLT-C feels worried about not doing anything to encourage the students to enter IT security's technical field; "five years later, this field may have vanished locally". For PLT-E, based on his previous experience in an advisory role to some

universities, they are lost when asking the students whether they know the industry; hence, he shows dedication to filling in this academic knowledge gap by joining the teaching profession after retirement.

All the six practice-led teachers understand the value of possessing IT industry experience in their teaching job whilst each of them views their contribution in a specific way towards the student's learning and their graduates' jobs, and even one teacher supports the academic peers. Two-thirds of the teachers thought to offer effective teaching pedagogy and better student support for graduates' jobs. For the remaining two teachers, one is not sure about the effectiveness of his teaching but is certain in articulating the practicality of the students' research projects while the other one does not involve in teaching but helps to line up the relevant industry resources for the department and other professors. For instance, they can make a balance between academic and commercial experiences for student learning and prepare the students to better adapt to the working environment in their graduation jobs, making them better IT professionals. But for PLT-B, he is not sure, if leveraging his previous industry experience and his ways of sharing and explanations in classes, is sufficient enough to make a difference in teaching, but he agrees that if the academic staff possesses industry experience, they can make lots of differences in the research work because they tend to supervise the students doing more practical research projects. One of his supervised final year projects made an extraordinary achievement as the graduate student set up his own start-up company to develop the software product whose idea was based on his final year project.

### 4.1.3 Role of industry learning in university education and graduates' employability

#### 4.1.3.1 Purposes and values of industry learning in IT discipline

From the viewpoint of the practice-led teachers, industry learning as part of university education consists of knowledge and skills, work code of practice, expectations of employers and clients, industry sense and the latest updates about industry changes, which are listed in the following:

- practical skills,
- practical knowledge,
- business knowledge,
- professional knowledge,
- professional code of conduct in workplace,
- what they need to perform in the job,
- the requirements of the employers,
- the expectations of the clients,
- industry sense,
- the requirements of the industry,
- what the industry is doing,
- how the technology to enhance the business,
- the impacts of changes in the industry, including advancement and threats,
- the kind of knowledge the people are acquiring in the market.

Out of the six practice-led teachers, only teacher PLT-B disagrees to cover industry learning in the university education because he refuses to make university education become vocational training and that is not required or useful for the students. He only recognises the value of "practical knowledge" and "professional type of things" for the students to learn in the university but that should be handled in a special course, separated from the core theme and the core units of the programme. The course he developed served to commence ***an industry sense*** on the students before they go to the industry, but further clarifying that "I hesitate to make any minimum professional training to students from [the] university". Referencing the concept of knowledge structures for expertise development (Kinchin et al., 2008), teacher PLT-B holds the distinctive view for the students to learn the networks of understanding and the chains of practice.

The other five practice-led teachers have similar views on the value of industry learning in university education to resonate with the market impacts on graduates, reflecting their

orientation to the market model (Clark, 1983) in teaching. This orientation is hugely supported by the inter-dependence between job-seeking and industry experience which is described in section 4.1.3.2. Teacher PLT-A articulates the value of practical skills from the industry as ***an integral part of student learning*** and further posits "industry experience to be crucial to the student learning; unlike other subjects, for example, history, the art, there is no industry much learning". Teacher PLT-D views industry learning in university as the pre-learning for ***adaptation*** in the workplace like the professional code of conduct, including the self-awareness of those mistakes that are easily made in practical assignments and projects. For teacher PLT-E, graduates' ***competitiveness*** is the key to success in their career because technical excellence is not something that will give the students a very high rank at work as there are millions of technical experts in India, but they know nothing about the local business. He stresses the essence of knowing what the industry is going on and how technology can enhance the business as part of the curriculum. For teacher PLT-F, his comments were mostly his self-reflections derived from the negative observations on those global or giant companies that vanished from the market one by one through time, including those he previously worked for. As technological advancement can create drastic changes in the industry and threaten the bottom line of many IT firms, he emphasises that learning for ***survival*** is the key as we cannot impart all the knowledge to the students facing these industry changes, but they need to face these difficulties once start working after graduation. Practically, teacher PLT-C posits the industry learning as the actual ***market needs***, therefore, it is necessary for the students to know the market requirements, and the expected level of knowledge and skills being stated in the job specifications.

#### 4.1.3.2 Consensus over students' readiness for graduate job and inter-dependence between industry experience and job seeking

All the practice-led teachers agreed that nearly all the students are looking for a job upon graduation, and only a small number of graduates will plan for the academic route towards a research degree. For instance, "all the students found [a] job at the back instantly" (PLT-A); "for computer science, we are expecting more students to find jobs in the industry than to do research after graduation" (PLT-C); and "there's not a lot of positions for computer

scientists. So, in most cases, people learned about the technology, and they go out to try to find a job" (PLT-E). As most of the graduates go for a job, the teachers hope that IT degree programmes should at least teach the students something relevant to their future careers. However, both teachers PLT-A and PLT-C point out the dilemma between job seeking and student experience, describing it as the dead-looping and their interdependence. Teacher PLT-A said, "finding [a] job is caught current two situations where you can find a job unless you have experience, but you don't get experience unless you have a job"; and this perspective is echoed by PLT-C, saying that "if you did not work in this field before, how can you have the related experience? If you do not have the related experience, how can you start to work in this field?". Therefore, it is signalled by teachers PLT-E and PLT-F that there are some possible adverse effects on graduates' employability if teaching in the universities does not cover some relevance to the industry context, implying that as such, "the students would be at a disadvantage when they are looking for a job" (PLT-E).

#### 4.1.3.3 Their perceived students' self-efficacies on graduates' employability

Three of the practice-led teachers, through lab practices and experiential programme activities, observe the students' attitudes and behaviours and specifically describe a set of good personal qualities more advantageous for the graduates in job seeking and planning for their career development, see table 4.2. It is observed that if students are more mature, more curious, and sociable, taking self-initiation to learn new things, and self-motivated to acquire professional skills and plan for their career ahead, all these positive beliefs and attitudes can enable them to become "highly attractive" job candidates. It is shown that some students treat the alumni speakers as their role models and start to imagine their graduate job during the mentorship's networking activities. As expected, if the graduates have good personal qualities and good learning motives, they can keep up the momentum to learn the specific knowledge and skills at work and become fast learners to catch up with the industry pace in their job. Teacher PLT-C said, "I don't need to hire staff with [the] excellent academic result, but I need the candidates to have good attitudes"; for IT security jobs, "even though the graduates are very outstanding, they are still learning mode in the first two years to learn the technical skills". On the contrary, there are some poor

behaviours and attitudes affecting student learning negatively, such as those less mature students who are "selectively listening" to the exam-related contents or "less participation in classes". It is interpreted that how they behaved in classes can be extended to how they will behave in the future workplace.

| | **PLT-A** | **PLT- D** | **PLT- C** |
|---|---|---|---|
| **Part 1: Learning in the university** | | | |
| Student learning activities | | Observations through<br>1. Co-curricular course[(C)]<br>2. Experiential programme activities[(d)] | |
| **Part 2: Personal qualities of the students** | | | |
| Personality | | • "More curious in knowing"<br>• "More sociable" | "Have the curiosity in learning new things" |
| Level of maturity | Self-understanding[(a)] | More mature | More mature |
| Advanced planning | **Career objective in mind**<br>• Plan to advance themselves and get promoted | | |
| Motivation | "Love to acquire professional skills, because it's their career" | | Good motivation to learn[(e)] |
| Behaviour | | "Definitely taking more initiative" | "Take self-initiation to find out the answers" |
| Attitude | | | "Who can grow faster, with professional development after graduation, are those with good attitudes" |
| **Part 3: Preparation for work** | | | |
| Advantages: | "Highly attractive in terms of employability" | | |
| **Part 4: Aspiration for career development** | | | |
| Self-aspiration | Technically strong for career progression[(b)] | • "To be IT project manager in the future" [(C)]<br>• "To admire him [alumni speaker] and want to be 'him' in the future" [(d)] | Planning for professional development |

*Table 4.2: Personal qualities, creating competitive edge towards the USEM model of employability*

(a) "For lots of students coming to the university, they are more practical, they understand that they will be working in the industry. They are highly motivated already in terms of IT skills." (PLT-A)

(b) "You really need to be strong technically in order to progress in your career." (PLT-A)

(c) "For instance, we offer a course on project management. Many students said that they show interest to do project management for IT projects, to be IT project manager in the future." (PLT-D)

(d) "Some students are more mature. How can I observe them? ……. After they attended these activities, they have already got some ideas about the industry. Take the sharing of one alumni speaker as an example, he has worked in the industry for 5 years and now is an IT project manager. When the students heard about his sharing, they started to admire him and want to be "him" in the future." (PLT-D)

(e) "Be active outside classrooms, such as writing some programming, doing some computer settings, doing business or even doing repairs on IT equipment. All these can help to show the motivations of the students." (PLT-C)

## 4.1.4 Pedagogical approach on students' understanding and practising

### 4.1.4.1 First principle's teaching approach versus Vocational training approach

Regarding the role of university education, it looks like to be a contradictory view between teachers PLT-B and PLT-C. The perspective on foundational knowledge from teachers of PLT-D and PLT-F is very close to the first principle's teaching approach advocated by PLT-B which defends the positioning of core university education from the vocational training approach. He trusts that it is paramount important for the university to teach the students "the more fundamental knowledge, the more basic principles and how to think", to develop the students to have more general knowledge about certain disciplines but not very specific [product] knowledge. This approach can promote the "learning how to think" on the general knowledge initially before the students learn the specific applications or at the product level at a later stage. When the university teaches the students to think more broadly and to think more fundamentally, through the reflection process to acquire knowledge, the students can learn more general knowledge from the first principle's approach.

It is echoed in the positioning of foundational knowledge in education and the perspectives of teachers PLT-D and PLT-F, with the latter regarding the foundational knowledge as the goal of education – "when you know one thing well, you can understand all related to that one thing". As teacher PLT-B said, the acquisition of fundamental knowledge can help the students to understand more specific things more easily in their graduate job. Conversely, if the university education focuses too much to teach very specific things, he worries about the students who may be, "miss[ing] the point", and "not appreciate how to", and they learn how to do one thing but probably "don't know the principle how to do other things". It is very similar to the issues of isolated chains of practice (Kinchin et al., 2008) or 'broken stories' (Stronach et al., 2002) being described. Hence, he cites the example of learning programming languages and the rationale behind the teaching is to emphasise what are the differences between different languages, what's the trade-off when using one language over the other in terms of easier to program, faster to program, more efficient in running the applications and so forth. His belief in university education is to teach students "more on those issues, rather than make you proficient in using a particular language because using that is a skill, you can learn it – it's just a skill"; and he concludes that "the university is not the end, especially for IT industry", because the graduates are required to continue the learning at work.

Teacher PLT-C is apparently to support the industry training approach in university teaching. Strictly speaking, as a practitioner of IT security (Srinivasan et al., 1999; Riihijärvi and Iivari, 2008; George and Marett, 2019), he was invited twice by the university to design and teach new courses related to IT security and computer forensics on professional diploma level, which offered the opportunity for the students to get accreditation from the professional bodies. Having a good understanding of the fast pace of changes in the field, he perceives that university education can, theoretically, provide a foundation for the students to know how to do their job, and emphasises that IT security courses cannot overlook the need for practising. By citing the similarity between football training school and IT vocational training school, he poses the challenging idea: If the students show interest in IT security and choose the course to study, why not train them as the field does during undergraduate study? If we

can make it, the graduates do not need to go for further training after joining the firm. He said, “why not we introduce this kind of training in the undergraduate course so that university education can make it for them?”. However, he is mindful that the university also needs to make a balance between different factors affecting university education for careful consideration.

#### 4.1.4.2 Skill proficiency versus Work proficiency

For the topic of students’ proficiency, teacher PLT-B rejects the student requirement for skill proficiency while proficiency at work is required by teacher PLT-E. It seemed to be contradictory at the first sight, but they are referring to different types of proficiency. For teacher PLT-E, through his teaching approach and the experience sharing of the industry practices in classes, he hopes that the students can become more knowledgeable in applying the theories for practical use and can understand how the business is running. “When they graduate and come out to work, I think that will make a big difference to the student’s proficiency”. In terms of the course content that is embedded with his own experience in the industry, he expects that his students, by absorbing the lecture materials, “can take some of those and that become part of their competency”, implying that they can apply the similar principles in their graduate job. Whilst teacher PLT-B, he does not agree with the student requirement for proficiency in skills because the centrality of university education is to teach the students how to think, such as learning the differences in deploying different programming languages, the trade-offs, and the considerations, rather than making them proficient in using a particular language as it’s just a skill.

## 4.2 IT disciplinary knowledge and skills, and the implications for teaching and learning

### *Part A: Teachers’ perspective*

### 4.2.1 IT disciplinary knowledge and skills, and the business applications

In the research interviews, all the practice-led teachers indicate that IT discipline equates to practical and applied and is essential for all IT degree students to keep their learning up-to-date if they want to work in the IT field. Two teachers are trying to denote what IT is, and the denotation can largely conclude what is IT. It is a hands-on profession as it is to get things done, and to design and apply; unlike other subjects such as history and art, that is no industry much learning (PLT-A). It is an applied discipline, for IT is related to what is going on in the industry. It is not purely theoretical, for a professor without industry experience or with industry experience, IT would be described as something that's applied (PLT-B).

IT knowledge and skills can be categorised into different levels; according to PLT-C and PLT-D, cybersecurity and risk management are regarded as advanced courses because the topics like risk governance and system hacking involve "high-end knowledge", "higher level of knowledge", "high-end skills", "more advanced skills", and "higher level of understanding". For database management courses, database design is treated as an advanced skill with complexity while other topics are relatively more general hard skills. Programming is treated to be "more skill-based" that can be segmented into advanced programming skills and basic coding skills, for the latter is coded just by following the syntax. Furthermore, teacher PLT-F points out that nowadays, the main focus in learning programming languages in academia is on high-end coding who's learning merely by "drag and drop" and thus, is very different from those low-level coding, like machine code, taught in his old days. As quoted, robotics becomes a popular topic, involving lots of programming effort in low-level coding development whereas the applications of robotics for commercial use are written by high-level programming.

Based on teacher PLT-C experience, some of the creation of new IT knowledge is found to be industry-driven rather than academic research-driven; meaning that the emergence of some IT knowledge is not originated from academic research outputs, but rather is coming from the new forms of technical solutions driven by the market direction. As illustrated, the

concept of cloud computing emerged from the professional journals written by IT practitioners who offer new practical solutions for the industry but are not used for solving philosophical problems. Besides, the knowledge needed for computer forensics in the aspect of IT security appeared from the phenomenon, requiring the industry or cross-discipline to first define the requirements, and then to locate a theory relevant to the definition before finally to practise on how it can be applied. It is, therefore, regarded as a "theory on industry-defined requirements" or "theory on cross-discipline-defined requirements".

In addition, there is inter-dependence between IT and business, observed by teacher PLT-E. Based on this rationale, he developed the whole set of lecture notes by combining these two perspectives into every single lecture topic. For instance, "How [do] companies use big data to enhance the business?". For banking, the first question is "how does the bank make money?" and the second question is "how do you make use of technology[,] help the bank [to] make money?". Accordingly, the teaching direction derived for this lecture topic is about how the actual deployment of technology can enhance the bank's business. He further explains that the profit formula is 'revenue minus cost'; when you can have the technology to enhance the revenue and minimise the cost, "the profit would look a lot better". The above is how he articulates the inter-relationship between technology and business.

### 4.2.2 The most difficult set of IT industry skills and knowledge in teaching

Regarding the interview question on the most difficult set of IT industry skills and knowledge taught by the practice-led teachers, their comments are summarised in Table 4.3. It shows that the most frequently mentioned is the soft skills, including teamwork, professional report writing, negotiation skills and presentation skills, IT projects' process and methodologies and organisational issues whereas IT knowledge and hard skills are more difficult only when it comes to the advanced level.

| | PLT-A | PLT-B | PLT-C | PLT-D | PLT-E | PLT-F |
|---|---|---|---|---|---|---|
| **IT projects** | | | | | | |
| • Process and methodology | Y | | | | | |
| • Organisational issues | | | | Y | | |
| **Soft skills** | | | | | | |
| • Teamwork | Y | Y | | | | |
| • Professional report writing | | | Y | | | |
| • Negotiation skills | | | | | Y | |
| ○ Pricing negotiation | | | | | | Y |
| ○ Contract negotiation | | | | | | Y |
| • Presentation skills | | | | | Y | |
| **IT knowledge** | | | | | | |
| • High-end knowledge | | | Y | Y | | |
| **IT skills** | | | | | | |
| • Advanced IT hard skills | | | | Y | | |

*Table 4.3 The most difficult set of IT industry skills and knowledge*

For *IT projects*, the main difficulty is for students to understand processes and methodology in real-life projects as it is a key challenge to "really project that [of the] work environment", such as the architecture's scalability, timeline, and implementation decisions, in the university. Regarding IT project implementation decision-making, there are different factors for consideration, like selecting the languages in terms of easier to program, which program can use less memory and storage, less processor power, easier to maintain and so on. For *organisational issues*, though the teacher can share a lot of the previous experience in project delivery, it is the "most difficult [topic] in student learning" as it involves different stakeholders and some of them may disagree with the others because "each stakeholder can have their own agenda" in terms of the benefits derived from the project. When most of the students do not have work experience, even smarter students, they can only memorise conventional terms like a leadership role, executive support and top-down approach as they "do not possess that level of maturity to understand the meaning"; for example, without leadership support, "nothing can be happened or implemented" in a

commercial organisation whereas the students may not be able to understand the implications in the classes. Compared to the programming courses, students can simply follow the given coding steps; through the output display, the looping logic can be proved as "a workable method", thus they can fully understand the coding method.

In terms of *soft skills*, includes teamwork, professional report writing, negotiation skills and presentation skills. Teamwork can be on a project level, company level and both while the latter refers to the corporate blueprint set by the organisation. Once given a job, you are part of a team, and the job of the staff is to understand the company goal and do the job well to help the company achieve that goal. Professional report writing refers specifically to the client's report which is used to document security risk assessment work, including practical solutions and recommendations. Therefore, it is more than just writing the technical findings. The difficulty in teaching presentation skills is about the skills of presenting oneself as a professional, say, making a 15-minute presentation in front of a large audience. That means, IT students can be very good at technicality but if they can be good at these soft skills, they are "one step ahead of their fellow students" when looking for a job. Negotiation skills are referred to any person who has a job, who needs to know how to survive in a commercial world, negotiating with others or external parties like contract negotiations for business deals; even an IT project team, needs to negotiate the project plan with the business users to get the project budget.

In terms of IT knowledge and skills, the difficulty in teaching is more on the advanced level, such as cybersecurity and risk management whose courses require the students to possess some prior working experience whereas, for the latter, the nature of knowledge makes the understanding easier in a company setting. Taking cybersecurity as an example, unless the students have the foundational knowledge of the IT environment setting and the knowledge about some types of security schema, they will know how to locate the loopholes in the systems before coming up the security solutions. Regarding some advanced IT hard skills, the level of difficulty is varied, largely depending on the learners because some may feel it very difficult to learn. In database management courses, a database query is rather

straightforward, such as SQL - “select * from table A” but database design requires a more complicated skill set. Some advanced programming languages like low-level coding are very difficult for learning, however, programming can be very interesting for some students.

### 4.2.3 Some cannot be taught for student understanding in the university

According to some practice-led teachers, some types of knowledge are unable to be taught in the university environment for it is required to be done wrongly several times before the graduates can get to it finally. Some industry experience or practices cannot be put into the course learning due to the issues of learning authentic intellectual work (Newmann et al., 1996, 2001) in the university, which is shown in teacher PLT-C’s class when trying to have the student learning in some techniques as “practical practice”. In any IT project, the most basic task to start with is collecting requirements through meeting with the users but this kind of learning cannot be taught in classes; in the workplace, it may be performed by having the senior colleague bring the junior one along to attend the customer meeting where the junior staff can acquire the experience by observing how the senior colleague is talking to the client.

Risk governance is seen as the high-end knowledge whose teaching approach is conducted through complex case sharing for higher-level learning. Knowingly, most of the students cannot understand the meaning but the teacher needs to keep on teaching this topic to the students who need to be aware of these management concepts at work though they can only memorise the notes. Even someone working in a company before, he or she could never have the chance to be involved in this area; thus, it is too visionary for them to understand these concepts in classes. Lastly, it is about the basic job codes or requirements in the workplace, such as “more well-defined deadlines, more well-defined tasks and how to make different people work together”; all of these are highly important in the workplace but very difficult to teach the students to appreciate that unless they get to the industry.

### 4.2.4 Controversial over the minimum set of industry knowledge and skills

Regarding the minimum set of industry knowledge and skills that IT graduates should be acquired, there are very different perspectives among practice-led teachers. Except for teacher PLT-B, the others refer to it as the programme design's intended learning outcome, the combination of business skills and IT skills, the fulfilment of industry requirements, or logical thinking as the minimum.

Teacher PLT-B rejects the act of imposing the minimum set of industry knowledge and skills on student learning, reiterating his standpoint, "I don't think, I don't believe university's job is to train students for [the] particular industry" as it is no need for the university to do something very concretely to require the student to be professionally qualified in a certain way. For he equates the minimum set to be training for the specific, he disagrees with the requirement for a minimum set; however, he can accept for the university to give the students a chance to learn some knowledge in a particular discipline as additional training, as that can let the students become more mature before entering the workplace.

Teacher PLT-A explains that there is no such thing as the minimum set in the industries. But PLT-A and PLT-D are trying to map it to the intended learning outcome in the programme design, which is identified as a set of skills that all the graduates should be possessed when they are graduated. Teacher PLT-A appreciates the set of skills – half are technical skills (like programming skills, database skills) and half are soft skills (like communication skills, teamwork skills) – that "will make our students highly attractive in terms of employability"; therefore, this appreciation resonates seamlessly to the research findings of Humburg et al. (2013) and Radermacher and Walia (2013) about the increasing demands on soft skills by the employers. Teacher PLT-D elaborates that there are different sets of skills set in core units and speciality streams as specified in the programme design, and this approach of core subjects with distinctive concentrations has been proposed by Lee et. al. (1995) and Noll and Wilkins (2002).

Teacher PLT-E approaches the minimum set from both the business side and IT side, expecting the IT graduates to possess some business knowledge, such as basic accounting principles and project management skills. On the pure technology side, knowing one programming language is the most basic requirement as when most people are talking about Java, the students learning one additional programming language can enjoy the additional advantage. Teacher PLT-C takes the perspectives from the employers and the industry; the graduates need to prepare themselves to find jobs and the minimum set should be referred to as the set of knowledge and skills required in the industry. As explained, commercial organisations do not expect to teach the newly hired graduates from scratch that the graduates are expected to be ready to "speak the common languages". In terms of personal learning experience and reflections, teacher PLT-F suggests that logical thinking and a good foundation in Mathematics are the basic requirements for IT graduates.

## *Part B: Students' perspective (Student surveys)*

### 4.2.5 Analysis on student feedback on most difficult topics learned

*Q1: What do you think to be the most difficult topic(s) that you learned in this course? Please give example(s).*

Based on 45 out of 47 students provided their feedback, the most difficult topics in the course were summarised into four categories: technical skills (42%), project management knowledge and skills (40%), soft knowledge (11%), and some theories and concepts (7%). Some of the examples are:

- Technical skills: Java, agile software development, information security, software application, risk assessment technique, business intelligence, regressions, data mining
- Project management: (16 responses)

- Specific project management concepts: Scope management (5), cost management (3), schedule management (2), risk management (2), stakeholder management (2), critical path analysis (2)
- Soft knowledge: IT industry standards, risk control, conceptual knowledge areas

### 4.2.6 Analysis on student feedback on most practical skills learned

*Q2: What do you think to be the most practical skills that you developed in this course? Please give example(s).*

Based on 46 out of 47 students provided their feedback, the most practical skills that they developed in the course were summarised into five categories: Microsoft Project management software (35%), soft knowledge and skills (20%), technical skills (20%), project management (13%), and risk management (13%). For clarity, the examples of the soft knowledge category include how to construct a plan, analytical thinking, critical thinking, problem-solving skills, group work, knowing how to read data, and problem reframing.

## *Part C: Summary of perspectives between teachers and students*

### 4.2.7 Highlights of both views on most difficult knowledge and skills

Regarding the most difficult topics, both practice-led teachers and students feel that project management knowledge and skills are difficult but in different areas. For the items of project management's theories and concepts and soft knowledge and skills, only 7% and 11% of the students respectively expressed difficulties whereas the teachers perceived the overall soft knowledge to be more difficult. Regarding technical skills, there were 42% of student respondents, the highest percentage, expressed the most difficult learning but the teachers perceived only the advanced technical skills to be very difficult. When I reviewed the list of technical skills written down by the students in the student surveys, it is found

that those skills can be regarded as more advanced technical skills, like agile software development, information security, risk assessment technique, business intelligence, regressions, and data mining; even for Java language, these are generally regarded as high-level learning with advanced knowledge and skills. In other words, the viewpoints on technical skills between teachers and students are consistent, except for some soft knowledge like risk control, which is not perceived by the students as difficult as that of the teachers.

## 4.3 IT Curriculum design, the Understanding, Skills, Self-Efficacies, and Metacognition (USEM) model of employability, and Work-integrated learning (WIL)

### *Part A: Teachers' perspective*

### 4.3.1 Summary of IT academic courses and programme activities

Based on the findings from the research interviews, below is the summary of IT academic courses and programme activities that the practice-led teachers have been involved in teaching, arranging for the experiential learning activities, and/or serving as the internal mentor or academic supervisor during student learning, see Table 4.4.

| **IT Courses** | **Professional practices (Classroom)** | **Experiential learning** | **Work practices (Outside the classroom)** |
|---|---|---|---|
| **Required** | | | |
| Software application | Industry learning | | |
| Engineering practices | Industry learning | Company visits | |
| IT professional practices | Industry learning | | |
| Co-curricular course | | Guest speakers | |
| Final year project | | Industry or experts | |
| Industry placement | | Industry learning | Work practices |
| *Summer workshops* | *Skills training* | | |

| | | | |
|---|---|---|---|
| **Elective** | | | |
| Cybersecurity practices | Industry learning | | |
| Consulting project course | | Industry learning | Work practices |
| Summer internship | | Industry learning | Work practices |
| Work-study programme | | Industry learning | Work practices |
| | | | |
| **Extra-curriculum activities** | | | |
| Industry seminar | | Guest speakers | |
| Mentorship | | Guest speakers | |
| Site visits | | Company visits | |
| | | | |

*Table 4.4: Summary of IT academic courses and programme activities involved by the practice-led teachers*

## 4.3.2 Professional practice-oriented courses

### 4.3.2.1 Required: Co-curricular design with experiential learning

This was the course newly developed by teacher PLT-B who plans to focus "more soft skills, more practical skills, more practical knowledge and professional knowledge" for student learning. The details of the course design have been summarised in Table 4.5. The course objectives aim for helping the students to understand the IT industry while company visits and group project presentations are treated as "professional training" for the students to create their understanding of contextual knowledge in the social environment (Kolb and Kolb, 2013). Industry learning is to let the students "get a sense of the industry", serving as the industry background or foundational knowledge for the students to conduct the company visit. Leveraging the teacher's social knowledge (Kolb and Kolb, 2013) in form of the professional experience in the commercial field and also current academic experience, he prepares "first-hand" lecture materials on the IT industry over the past thirty years as well as the analysis on industry players in the most recent five years. He believes that this part is "very important knowledge" and practical for the students, which can "fit the course curriculum very well" to provide the students with a professional view of the IT industry's evolution before and after the emergence of the internet, and how the Internet age makes

all things connected and how the mobile devices make all people connect, in addition, to demonstrate the current landscape of IT industry through the study on industry players in the last five years.

These course materials are prepared by the teacher who read the published documents from the industry players like whitepapers and then develops the analysis; the prepared analysis will be taught in a few lectures before each student group starts the company visit. Before the end of the course, all student groups are required to deliver their group presentation from which the whole class can have a good time to have "a glimpse of different kinds of companies in different types of industries in IT and see how they operate" through the sharing made by all the student groups. It is well-designed in purpose as all the companies identified, selected, and invited are carefully considered to show a rather complete picture of the IT industry because each identified company is viewed as part of the full picture, meaning that it is done by the teacher's thoughtful course design. Regarding the grading, every student group needs to submit the written report for the company visit, and together with the group presentation delivered in class, both are graded as the assessment for learning and teamwork.

The company visit is designed as a professional practice for all the students, for example, teamwork to conduct the company visit, interview with the company representative, and deliver the group presentation after the visit. Moreover, each student group is supported by one professor as an internal mentor in the department and the company representative visited by the student group becomes the external mentor. The role of an internal mentor can teach the student group how to prepare for the company visit, such as how to set up an appointment, how to prepare the interview questions, how to discuss in a group, how to behave in front of an external party, how to seek career advice from an external person and so forth. More than twenty industry contacts are known by the teacher who has pre-invited each of them through a phone call to explain the purpose of the student visit and the expected support from them; leveraging these contacts as the students' external mentors who can "help the student groups to appreciate more about what the industries like"; when

each student group interviews with the company representative, they need to seek some career advice from the visited company.

| | **Course: Engineering Practices**<br>**Level: Undergraduate level, the required course** | | |
|---|---|---|---|
| | **Course design** | **The role of Teacher B** | **Student groups**<br>**(4-5 students per group)** |
| 1 | **Industry background**<br><br>Aims:<br>❖ To give students some understanding of the IT industry.<br>❖ To serve as background information for the students before they visit the companies. | Introduce the landscape of the IT industry:<br><br>• How the industry evolved in the last 30 years<br>• To analyse different major players per the whitepapers published on their company website | |
| 2 | **Company visits**<br><br>Aims:<br>❖ To create some opportunities for students to learn what is like - to work in the industry and the different types of industry.<br><br>Types of companies chosen:<br>• Start-ups, or<br>• Multinationals, or<br>• Research labs | More than 20 company visits pre-arranged<br><br><u>External</u><br>• Identify someone from each of the companies while the person's background can allow the students to learn something from<br>• The person serves as the external mentor to the group<br><br>Selection criteria:<br>○ Knowledgeable, who are practising in the industry<br>○ Willingness to explain / to have dialogues with students<br>○ Willingness to help students understand the followings:<br>- *what is that company's role in the industry?*<br>- *what are their competitors?*<br>- *what are the different jobs in that company?*<br>- *how do they try to succeed?* | Each student group needs to visit one company only<br><br><u>Three-stage action items</u><br>Before the visit:<br>• Contact the named person provided by teacher B<br>• Set up the company visit<br>• Prepare some questions for the interview, such as<br>- *Company role in the industry*<br>- *Their position in the company*<br><br>During the preparation, each student group needs to meet up with the assigned internal mentor (another professor) for advice.<br><br>During the visit:<br>• Visit the named person<br>• Interview the contact person<br>• Seek some career advice |

| | | | |
|---|---|---|---|
| | | • Contact each of them personally to make sure they understand the goal<br>• Invite them to participate<br>• Give them a souvenir<br><br><u>Internal</u><br>• Invite more than 20 professors from the department<br>• Each group to have a professor as an internal mentor<br><br><u>The role of the internal mentor</u><br>• meets up with the student group<br>• goes through the group's preparation for the visit and the interview:<br>- *how to talk to external people, how to prepare yourself, how to behave, how to get the most out of the visit.* | |
| 3 | **Sharing session in class**<br><br>Aims:<br>❖ All student groups need to share what they have learned during the visit.<br>❖ Each student can get, even a glimpse of different kinds of companies in IT.<br>❖ Each student can see how these companies operate in the industry. | <u>Format</u><br>Group presentations, 10-15 mins each<br><br><u>Presentation rule</u><br>• It is a shared group presentation<br>• Each student gets a chance to say something<br><br><u>Management</u><br>• Make sure each group has a responsible person, a leader, like a coordinator<br>• Define the role of the coordinator<br>• Assign privilege to the coordinator who can report any free rider in the group<br>• Deduct some points for that student who failed to participate | After the visit:<br>Each student group needs:<br>• to submit a group report<br>• to conduct group presentation in class<br><br><u>Arrangement</u><br>• Each student in the group says something about some different aspects of the visit<br>• Each group has a leader to do coordination<br><br><u>The role of the coordinator</u><br>• to coordinate the group's presentation preparation<br>• to get everybody together<br>• to give feedback to the teacher if there is any teammate who does not participate |

*Table 4.5: Engineering Practices, course development in co-curricular design*

#### 4.3.2.2 Required: Co-teaching on theory-and-application course

It is a co-teaching course that teacher PLT-E and the course director are sharing the teaching effort equally while the course design of the six lecture topics is constructed by the teacher, see Table 4.6. In each of the lecture topics on IT professional practices, the set of principles or guidelines is supported by real-life examples; through the close integration between the theories or the guidelines and the examples adopted in the real world, the students are expected to know how to apply it in their graduate job. The design rationale is to "maintain the academic, the theories behind the learning itself, but knowing the industry is doing and how the technology to enhance the business would be the essential part of educational students". Therefore, the lecture topics are focused on the usage of technology rather than the technology itself, and the teaching approach is to integrate the application side and the business side to form a holistic view of how these two sides can work together to facilitate a better understanding for the students. Taking the lecture on data security in the banking sector as an example, the part of technical knowledge, like firewall and database management system design, is covered by another professor while his teaching focus is on how the banks use the technology to protect the customer data and the best practices for the banks to implement the solutions.

In the lecture, the regulatory requirements like the implication of GDPR, and the General Data Protection Regulation in the course are covered. Leveraging on his real-life professional experience in the business-IT environment in the global financial sector, and the previous committee member in some of the statutory public bodies, these international experiences can allow him to prepare and design the whole set of lecture materials as well as come up the respective group assignments in a project case format. His passion in teaching is to nurture IT graduates to understand the value of technology deployment, and how can it enhance the business in the financial sector, in addition to the traditional focus purely on technology; for example, how to use technology to protect the personal data for the banking sector in compliance with the data privacy ordinance. All the group assignments are designed in research-based group projects, and "the project scope is loosely defined by design" which can allow the students to find out more about the

assignment topic by themselves and each student group is required to deliver the group presentation at the end of the course. During the group presentations, the teacher can assess their learning effort as well as their understanding through the Q&A session after each presentation. If there is any important information missing that is supposed to be covered in the presentation, the teacher can inform the whole class so that everyone can learn about it.

Samples of the lecture topics mentioned by the teacher during the research interview:

*Topic 1: IT security and banking*

- Content: Why do we need IT security in banking? Why is it important? What is two-factor authentication, such as one-time password? How do people use it?
- Examples: SSL encryption, two-factor authentication, different types of security schemes that banks can use, what are the common technology adoptions like security tokens
- Group assignment: Compare and contrast the 3 top-tier banks in online banking, with a set of questions prepared for the students to do research and presentation

*Topic 2: Big data in banking*

- Content: How banks use big data to help the business
- Examples: Customer profiling, analysing profitability, predicting customer behaviour

| | **Course: Professional IT Practices**<br>**Level: Undergraduate level, required course** | |
|---|---|---|
| | **Course design** | • It is a co-teaching course.<br>• Both practice-led teacher E and the other professor are sharing the teaching effort equally.<br>• Practice-led teacher E is responsible for 6 lecture topics and 6 case studies.<br>• Every 2 weeks for one topic, with one hour in week 1 and two hours in week 2.<br>  ○ Week 1: Lecture<br>  ○ Week 2: Tutorial and Lecture |
| 1 | **Lectures** | **Aims:**<br>❖ Give lectures |

| | | |
|---|---|---|
| | | ❖ High-level introduction of the project case assignments<br><br>• Teacher E segments the lecture content into 6 lecture topics and develops the lecture notes based on his own professional experience.<br>• Lecture topics are related to effective IT management, IT security and banking, data privacy and protection, big data analysis, future of banking in the cyber world.<br>• All the lecture topics are related to IT practices in the banking industry and covered real-life examples.<br>• Week 1: one-hour lecture and high-level introduction about the assignment and the related research scope<br>• Week 2: one-hour lecture after the first hour of the tutorial session |
| 2 | **Research-based group assignments** | **Aims:**<br>❖ To require the students to do industry research in the case study assignment which covers the areas of technology and business.<br>❖ To present the research result to show their understanding.<br><br>• All the group assignments are designed in a case study format.<br>• Each assignment requires 2-3 student groups to make a presentation in the class. |
| 3 | **Tutorial sessions** | **Aims:**<br>❖ Group presentations<br>❖ Assess the research effort and the understanding of the students<br>❖ Create the feedback loops for the presentation groups and the rest of the class<br><br>• There are 2-3 group presentations in the 2nd week for each assignment.<br>• Each group presentation takes 30 minutes, and all groupmates need to share some part of the presentation.<br>• Q&A sessions are used for giving feedback by teacher and fellow students. |

*Table 4.6: Professional IT Practices, a new course in lecture-and-tutorial design*

#### 4.3.2.3 Elective: Lecture-and-lab course for practical practices

Teacher PLT-C did not mention the lecture part in the course but said to combine both lecture and lab sessions for the sake of having longer lab sessions in each of the classes. The lab sessions are designed for practice on those project steps and tasks derived from the real case project written by his technical team in the company. This course design is

summarised in Table 4.7. The rationale of course design is based on the question of "why did the students choose this course and how the course can benefit the students in their future job?", implying that most of the students who chose this course are interested in IT security as thought by him. He affirms, "our focus is to put effort to let them know the needs of the external world in security, the current knowledge in security that is required in the industry and the foundation where the current security knowledge is sitting on". Other than the IT security theories, he wants to train the students in practical skills. As such, the system hacking practice is covered in the course because it is aligned with the course's aim to do more practice. It is the three-step approach in doing the actual industry practice, how to do the security risk assessment, how to interpret the findings from the assessment exercise, and how to hack into the system running the web application. It is understood that many students feel excited to hack into a system; but he reiterates that doing hacking practice, students need to know at least how to set up a system before doing the practice. "It is not something you like hacking and then you can hack it!". Even the students can easily find those hacking techniques in books, they cannot understand how to do them unless they can have the chance to practice them in the lab.

Though there are a few teaching assistants arranged by the university department, he arranges for additional manpower resources, two to three staff, coming from his own company. According to the lab experiences in the previous years, he observed that some teaching assistants did not know how to do the lab exercises while some students were unable to follow the lab exercises. So, he knows that would require more support in doing the lab practices. The purpose of the group project is to encourage the students to continue learning, and to find out more about the field and more practices, requiring them to pick an advanced topic which needs to be related to the latest development in the IT security field. "If the students show interested in this area, they can continue to learn it by themselves after the course is completed". Once they go out to work, hopefully, they can show employers what they have learned at the university. If they do not throw away the class notes, they should be able to read those again to recall what they had ever practised in the labs. At the end of each academic year, the teacher will update the course materials and the updates are based on the industry changes as well as the student's learning progress

observed in the lab sessions in which the teacher finds out how much the students can understand the course contents. Moreover, the course design is also set for providing updated knowledge relevant to the latest requirements in the professional certifications because he expects some students to seek the certifications later.

| | **Course: Cybersecurity Practices**<br>**Level: Undergraduate level, an elective course** | |
|---|---|---|
| | **Course design** | • It is a hands-on course, with training in lab sessions.<br>• Class duration is 4 hours, in the computer lab. |
| 1 | **Lectures** | • The course content for the lecture sessions is consolidated whereas the scope of lab sessions is enlarged.<br>• The outline of the lecture materials is referencing some relevant books while the contents are developed by himself. |
| 2 | **Lab sessions** | **The lab sessions are designed and guided by a case project written by Teacher C and his team.**<br>❖ It is designed on the rationale about the foreseen work that their future job will get involved, about the requirements in the local job market.<br><br><u>Overall scope</u><br>It is the kind of basic systems setting or work processes that they need to perform before they can start to work on the system tasks.<br>• The must-know settings include how to set up the servers, how to do server configurations, how to set virtual machines and so on.<br><br><u>Approach</u><br>The instructions for lab sessions are kept as minimal as possible because we want to let them try doing more.<br><br><u>Lab assignments</u><br>• The instructions are given before each class.<br>• The lab session in week 1 is to set up the servers, in week 2 to set up the VM by installing the DNS, web server and FTP server, and so do the remaining weeks.<br><br>***One of the lab assignments is to do "Hacking into a system".**<br>From setting servers to hacking into the machine, from hacking into how to fix the problem, inside the hacked machine, what needed to be done, like how to set up the firewall, how to activate the intrusion & detection mechanism and so on.<br><br>*Pre-requisites:*<br>- *Students need to learn about operating systems, what is programming, how to write web programming, how to set the* |

| | | |
|---|---|---|
| | | *different types of servers, and to know something about networks; with all these, they can then consider taking the course.* |
| 3 | **Home assignments** | • Compared with the lab assignments, students have fewer guided instructions and need to think more when doing the individual assignments. |
| 4 | **Group project** | • Students need to pick an advanced topic.<br>• They then form groups to work on the topic.<br>• At the end of the course, each group needs to do a group presentation:<br>  ○ In the presentation, they need to cover the topic related to the latest development in the market. |

*Table 4.7: Cybersecurity Practices, course development in lecture-and-lab design*

#### 4.3.2.4 Required: Final year project designed for practical-orientation

The final year project, whose credit is counted for two courses, is compulsory for all the final students for graduation and it can be done by one student or a team of up to three students. Over 70-80% of the projects are designed by professors while the students are allowed to provide some inputs but they "need to convince the professor to take that [their idea]". Some of the final year projects are linked up with the industry players or some experts in the industry as it is aimed at helping the students to "do something creative, and very practical", and some can be related to professional training. The project grading system requires all the final year projects to be graded altogether so that all the projects can be compared before deciding which project can get A, A-, B and so on. There was one proven practical and outstanding final year project mentioned by teacher PLT-B whose student initiated the project idea to prevent losing something important like a wallet. The student's project idea was triggered by his father who lost something very important, making that struck the student's mind always because his father felt very frustrated. As the student got a very clear idea, PLT-B decided to let him do the project and just gave him some feedback; upon graduation, the student set up his own company to develop the product based on what he did in the final year project, which turned out to become the goal of the company. The teacher is proud of "using some of his industry experience" to help the student appreciates what can be done.

#### 4.3.2.5 Required: One-year industry placement in work-and-study mode

Out of the 4-year degree programme, all the students have to spend one year working in the industry to gain some industry experience and they can gain credit for it. The characteristics of this placement are work-and-study in parallel during the entire year and arranged in the third year of the programme. That is, the students go to work for 4 days, Mondays to Thursdays, after 5 pm and on Fridays, they go back to the university to attend classes. The main objective of the placement is to make sure the students gain new skills and new knowledge and thus, their learning progress is monitored by a "work supervisor [from the company] and an academic supervisor". The course itself is a pass-or-fail course, but the students need to submit several reports as well as weekly logs on what they have been doing each week. According to teacher PLT-A, it is a win-win scenario between the students and the companies because those companies can get to learn about the university students while the students also learn about the companies they are working for. Very often, due to the creation of relational bonds (Tomlinson, 2017), "the company after spending one year training the student, they would like the student to stay"; and it is why many companies want to offer placements to attract more students to work for them.

#### 4.3.2.6 Required: Summer workshops for practical skills training

The summer workshops are designed to deal with the need for very practical skills training for the students to pick up those practical skills, such as programming languages, and how to use the system command lines in a specific type of operating system. It is required as part of the programme requirements but is non-credit bearing, that is, the attendance is displayed on the academic transcript, but the students do not get any grade on that training. In other words, the university where teacher B works, distinguishes the practical workshops from the regular curriculum.

### 4.3.3 Outside the classroom: Work practices

The work practices are found in three types of elective courses. The c*onsulting project course* is a relatively light-weighed consulting practice project for student learning, and the course objective is to let the students have the chance to perform the feasibility study and then submit some recommendations to the company. It is also designed as a credit-bearing course for them to earn credits after completion. Three out of the six practice-led teachers mentioned *summer internships*, and it is commonly seen as a good chance for the students to acquire some industry knowledge so that they can have a better understanding of those learned in the classroom. There is a *work-study programme* more suitable for the senior students to acquire some basic knowledge about the discipline while the professional learning may be different from that of the placement. For every student in a work-study mode, the department assigns a mentor to serve as the student mentor who needs to visit both the student and the company to get some feedback from them.

### 4.3.4 Extra-curricular activities for experiential learning

All the extra-curricular activities in this study are optional for the students, supporting their experiential learning (Kolb and Kolb, 2013) to create the network capital (Huggins, 2010) in a range of networking activities organised around mentorship programmes, industry seminars, and company or site visits to build up the calculative ties (Huggins et al., 2012) between students and industry speakers as well as between universities and firms.

#### 4.3.4.1 Industry seminar talks and University-wide Industry week

Teacher PLT-F takes up the role of industry liaison for the department, organising industry seminars for the current students and the alumni. The agenda for one FinTech event was set out in Table 4.8. These industry seminars are expected to be useful for the students to "understand further textbook knowledge as well as about what the society is expecting

from the university graduates". Importantly, some industry speakers told him that they were "very impressive" to see different audiences attend the seminar, "not just the students, but also some professors". Based on the class observations conducted for the two industry luncheon talks, I saw the programmer director sitting in the first row in the lecture room who was the one to ask the first question during the Q&A session. Other than the above industry events, there is the university's yearly Industry Week where he provides support to the department to liaison with the industry speakers. All students in year one are set to study the generic courses and they need to decide the major stream in year two, leading to all faculties who "make use the Industry Week to invite their respective industry speakers to deliver the speeches" to talk about the job market and the career prospects in the field. It is said that even within the same faculty, each academic department is also competing to get more students to stay in the department.

| | **Theme: FinTech**<br>Remark: Non-credit bearing | |
|---|---|---|
| 1 | Opening | • Teacher PLT-F was responsible to deliver the opening speech. |
| 2 | Global perspective | • The 1st speaker was an executive representative from a global bank, introducing FinTech from the global perspective, in breadth and depth. |
| 3 | The impact of new technologies on the financial sector and its regulatory requirements | • The 2nd speaker, possessing author experience in the technical whitepaper discussed the relationship between FinTech and the local government authority for the regulation. As he is knowledgeable in new technology development, his role can share the different angles on how the latest technological development can affect the financial industry. |
| 4 | Current IT practices | • The 3rd speaker, the current IT practitioner possessing experience as an application developer, he conducted the sharing related to mobile banking anytime and anywhere. |
| 5 | Q&A session | • Teacher F was leading the Q&A session. |

*Table 4.8: Industry seminar on FinTech*

#### 4.3.4.2 University ranking comes into effect in experiential learning

It is common to have the mentorship programme organised but for one teacher, the scale of the mentorship programme is university-wide, made up of 4 levels. Level 1 is to have senior students mentor junior students, Level 2 is to invite alumni mentors and Level 3 is industry mentors, while Level 4, is the university level that helps to look for the executive mentor to support the students seen as the elites. It is the university's overall direction to support student learning and once the students joined this programme, the mentorship support is kept running throughout the four-year study in the university, but the resources allocated to this arrangement are decided by the individual department.

The student feedback can be divided into two areas; firstly, they can have some ideas about the job nature, daily tasks, and what kind of jobs are available in the market; and secondly, for those who have decided to go for a particular career path but no ideas about the job interview process, such as the aptitude test, group interviews, etc., they can ask the alumni speakers to share the interview tips with them. This mentorship programme is kept evolving, mainly motivated by achieving a higher global university ranking. When the university wants to do better, they want to allocate more resources to support the students so that "it can help to raise the bar of their students". Ironically, it is heard that some universities at higher ranking are relatively spending fewer resources on this aspect because their students are relatively more active, and they always take more self-initiative to look for chances by themselves. Coincidently, another teacher also mentioned that the mentorship programme is useful for the students, but the students' participation rate was very low at the university. Checking with Times Higher Education's university ranking, the ranking of the second teacher's university is higher than that of the first teacher, which probably may be the reason why that university's student participation was very low.

Three of the teachers are responsible for arranging company visits or site visits for the students, aiming for building up more connections and more technology updates directly from the industry. When the students have the chance to meet up with the company representatives, the question is who will be the spokesperson to show up during the visit. It is found that if the students are coming from higher-ranking universities, the more senior executives or even the CEOs are available to meet and talk to them in person. During the visit, company executives are very interested to understand the current university students

from different universities; and secondly, they would observe the students and see whether they can find some potential candidates that they want to hire later.

## *Part B: Students' perspective (Student surveys)*

### 4.3.5 Analysis on course items and activities on the level of usefulness in the study

Based on the list of 15 course items and activities, students were asked to rate each of them on "the level of usefulness" in the study of the IT degree programme, see Figure 4.1. The course item of "real-life case studies and examples" was the only item rated by all the students as useful-and-above as no students thought it to be not useful. For another course item *(b)* "experience sharing of industry practices", 96% of the respondents rated the same level of usefulness as three of the traditional course items in category *(a)* understanding of the subject knowledge, practical lab exercises and class exercises and assignments; and had 3% more respondents when compared with that in technical skills (93%) and summer internship (93%). Both the work practices activities *(e)* and the extra-curriculum activities *(d)* had more respondents rated them as useful-and-above than that in the co-curricular activities *(c)*. The co-curricular course activities like guest lectures and company visits, having 68% to 75% of respondents rated them as useful-and-above, were relatively less useful than all other categories of course items, whereas this category of course item was also rated as not-useful-scale by 7% of respondents.

| | Course items or activities | Ranking | Total (%) = 3+4+5 | 1 - Not Useful (%) | 2 - Less Useful (%) | 3 - Useful (%) | 4 - More Useful (%) | 5 - Very Useful (%) |
|---|---|---|---|---|---|---|---|---|
| b | Real-life case studies and examples | 1 | 100% | 0% | 0% | 32% | 39% | 29% |
| b | Experience sharing of industry practices by professors/ instructors | 2 | 96% | 0% | 4% | 29% | 43% | 25% |
| a | Understanding of the subject knowledge in the field of study | 2 | 96% | 0% | 4% | 39% | 29% | 29% |
| a | Practical lab exercises | 2 | 96% | 0% | 4% | 29% | 32% | 36% |
| a | Class exercises and assignments | 2 | 96% | 0% | 4% | 36% | 46% | 14% |
| a | Technical aspects like programming skills, database design, network architecture & etc. | 3 | 93% | 0% | 7% | 29% | 32% | 32% |
| e | Summer internship | 3 | 93% | 4% | 4% | 14% | 25% | 54% |
| d | Industry seminar talks | 4 | 89% | 4% | 7% | 50% | 25% | 14% |
| a | Group projects and presentations | 5 | 86% | 7% | 7% | 25% | 36% | 25% |
| a | Theoretical frameworks and methodologies | 5 | 86% | 0% | 14% | 29% | 32% | 25% |
| e | Work placement | 5 | 86% | 4% | 11% | 7% | 25% | 54% |
| d | Mentorship | 6 | 79% | 4% | 18% | 36% | 32% | 11% |
| c | Guest lectures | 7 | 75% | 7% | 18% | 39% | 29% | 7% |
| c | Company visits | 8 | 71% | 7% | 21% | 25% | 29% | 18% |
| c | Field trips | 9 | 68% | 7% | 25% | 25% | 29% | 14% |

*Figure 4.1: The ranking of course items and activities in the level of usefulness in the study of IT degree programme. Note: Total (%) = total percentage of respondents to give the rating on 3 - useful, 4 - more useful and 5 - very useful.*

*(a) Traditional course items: Understanding of the subject knowledge in the field of study, Theoretical frameworks and methodologies, Technical aspects like programming skills, database design, network architecture & etc., Practical lab exercises, Class exercises and assignments, Group projects and presentations*
*(b) Teaching tools and techniques: Real-life case studies and examples, Experience sharing of industry practices by professors/instructors*
*(c) Co-curricular activities: Guest lectures, Company visits, Field trips*
*(d) Extra-curriculum activities: Industry seminar talks, Mentorship*
*(e) Work practices: Summer internship, Work placement*

### 4.3.6 Analysis on course items and activities in terms of helpfulness for graduate jobs

Based on the list of 15 course items and activities, students were asked to rate each of them "in terms of helpfulness" for their jobs after graduation, see Figure 4.2(a) and 4.2(b). The highest percentage of respondents (89%) perceived both summer internship and work placement to be helpful in their future jobs after graduation. Real-life case studies and examples got 71% of respondents said to be helpful, which was found to be consistent with the top five ranks of course items or activities which were perceived to be helpful as no respondents or as low as 4% of respondents rated them as not helpful. Experience sharing of industry practices by practice-led teachers, though no student thought it to be not

helpful, was the most uncertain course item as 43% of the respondents did not know whether it will be helpful or not in their future job. The second rank of the most uncertain course items perceived by the respondents were field trips (36%), mentorship (36%) and guest lectures (36%). Class exercises and assignments were ranked as the third, about two-thirds of the respondents (61%) perceived it as helpful but one-third of the respondents (32%) were not sure whether it will be helpful in their job after graduation.

| | Course items or activities | Ranking | Yes (%) | Ranking | Maybe (%) | Ranking | No (%) |
|---|---|---|---|---|---|---|---|
| e | Summer internship | 1 | 89% | 8 | 11% | 1 | 0% |
| e | Work placement | 1 | 89% | 9 | 7% | 2 | 4% |
| a | Understanding of the subject knowledge in the field of study | 2 | 82% | 7 | 18% | 1 | 0% |
| a | Technical aspects like programming skills, database design, network architecture & etc. | 3 | 75% | 5 | 25% | 1 | 0% |
| b | Real-life case studies and examples | 4 | 71% | 5 | 25% | 2 | 4% |
| a | Practical lab exercises | 5 | 68% | 4 | 29% | 2 | 4% |
| a | Class exercises and assignments | 6 | 61% | 3 | 32% | 3 | 7% |
| a | Group projects and presentations | 6 | 61% | 4 | 29% | 4 | 11% |
| a | Theoretical frameworks and methodologies | 6 | 61% | 6 | 21% | 6 | 18% |
| b | Experience sharing of industry practices by professors/instructors | 7 | 57% | 1 | 43% | 1 | 0% |
| d | Industry seminar talks | 7 | 57% | 4 | 29% | 5 | 14% |
| c | Company visits | 8 | 54% | 4 | 29% | 6 | 18% |
| c | Field trips | 9 | 46% | 2 | 36% | 6 | 18% |
| d | Mentorship | 9 | 46% | 2 | 36% | 6 | 18% |
| c | Guest lectures | 10 | 43% | 2 | 36% | 7 | 21% |

*Figure 4.2(a): The ranking of course items and activities in terms of helpfulness in graduate jobs*

In the graphic presentation of Figure 4.2(b), it was clearer that no respondent rated the following four course items as not helpful: understanding of the subject knowledge, technical aspects, experience sharing of industry practices and summer internship. However, guest lectures (21%) were ranked the most as not helpful for their future job while the second rank for mostly not helpful were theoretical frameworks and methodologies (18%), company visits (18%), field trips (18%) and mentorship (18%).

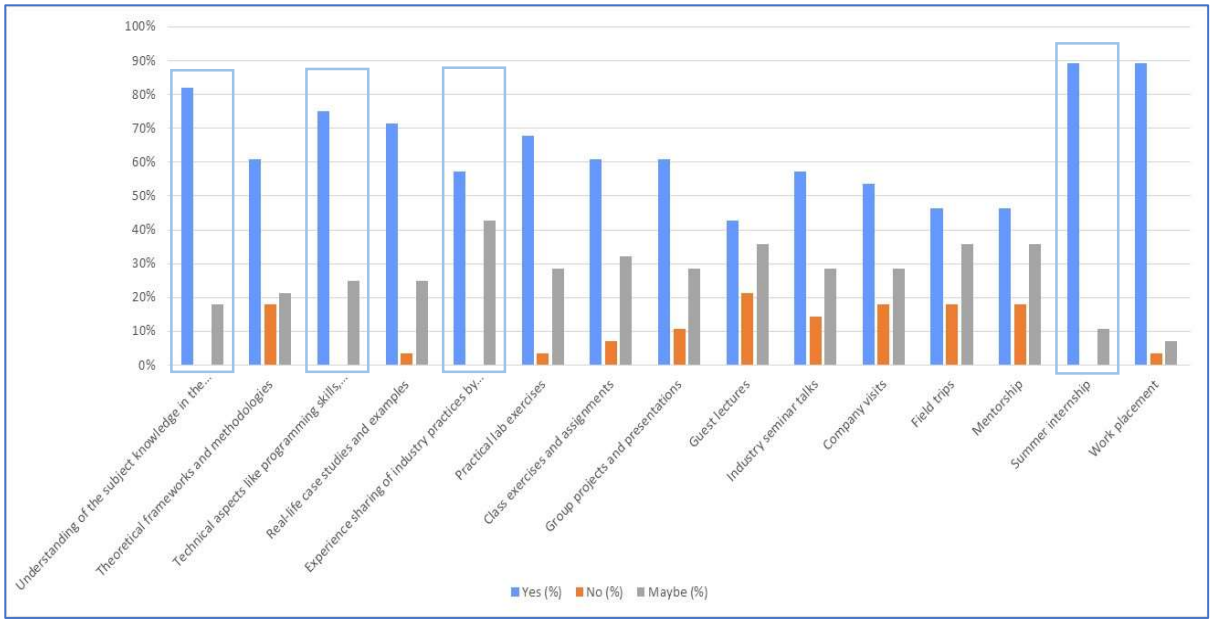


*Figure 4.2(b) Graphic presentation: The ranking of course items and activities in terms of helpfulness in graduate jobs*

## 4.4 Practice-led teaching pedagogy, educational authenticity, and disciplinary inquiry

### *Part A: Teachers' perspective*

### 4.4.1 Experience sharing

#### 4.4.1.1 First-hand, concrete examples and the best practices

Based on their working experience in the industry, all the practice-led teachers can share their first-hand experience with the students. The characteristics of the sharing are lived, more realistic, more practical, and highly relevant to the student learning because they can explain the problems more practically through their first-hand experience, which is different from those teachers who "just explain examples from the theoretical point of view or a third party's view" through the reading from some textbooks. In terms of technology use, the

sharing of teacher PLT-E for the best practices is related to its support to the business in compliance with the guidelines and principles involving legal and security concerns. Another simple but useful example for website design is one of the criteria in the Internet that some of the basic principles, such as the 3-clicks rule for e-visitors who can reach the webpage to locate the information they need. These are the guiding principles that the taught students can put back into practice at work.

When the practice-led teachers articulate the theoretical standpoints and explain those questions on what, why and how, they use concrete examples to provide more practical scenarios, more realistic and highly relevant for the student's understanding. It is very common for them to use their real-life experiences as part of the teaching materials as these practical scenarios can give the reasons on how the theories work, such as how information is encoded and communicated, and why the protocol is "designed one way versus the other way" (PLT-B); and the actual examples from the field can promote the understanding of the students in the real environment because those are "highly relevant to the students, they need live, something that they can relate to easily"(PLT-A). Besides, these practical practices learned in the labs can allow the graduates to recall the practices if they do not throw away the class notes (PLT-C) when doing job mapping in the future (PLT-D and PLT-E).

#### 4.4.1.2 Embedded work practices

Since experience sharing is contextually lived and practical, there can be work practices embedded in the contexts, including soft skills and even some hard skills. When making the technical decision, the IT staff needs to consider the trade-offs between different choices in addition to the understanding of the technical piece, like the scalability to meet the future expansion, and the selection of programming languages for less maintenance effort if doing the system updates. Knowing the existence of some trade-offs is sure to be one type of learning for graduates. For some soft skills requiring a higher level of understanding, the experience sharing of the practice-led teachers is extremely valuable and useful, such as the

topic of authority during IT project delivery quoted by teacher PLT-D, as some staff can have more authority (positional power) while others can have more say (leading domain experts). It is the reason why there can be different bosses asking you to work things out in a project, and how you can handle their different requests. Teacher PLT-D states that having experience sharing is better than not, and it is true "even in those seemed to be hard skills". For example, in coding practice, it is very common to have typo errors in coding, (if….., the syntax …..), and very often, students were at loss in the lab when the program was not working after all the codes had entered but no result was displayed on the screen. The teacher's immediate instruction is to tell them to do "self-checking" because the set of sample codes is 100% working. By experience, it is highly likely due to the reason of typo errors, semicolons but in commas, capital letters but in small letters, and single-coded but double-coded; it is almost 99.9% fallen into these errors. Or the students can use the desktop checking function. For problem-solving in programming, there is a debugger tool to help locate the errors, too. That is the reason why experienced teachers can offer more than one way for the students to learn more effectively.

#### 4.4.1.3 Work code of practices

The work code of practices in IT projects can directly affect the completion of an IT project or even fail it. Whenever teaching the project management course, PLT-D teacher reminds the students about the work practices for delivering IT projects; for example, every time "after you collected the requirements from that person (the user), to remember – the most important thing – putting down the requirements in black and white, and then to meet up that person again to ask for feedback on whether my (the student) understanding of the requirements was this and that" as were previously said. Elaborating on that, the purpose is not about worrying that person to come back to change the user requirements, but rather there may be some misunderstanding on the requirements during the process of collecting user requirements. If there were some misunderstanding existed but you did not know, then, you went ahead to start the software development and waited until the project was delivered to the users who then told you that these were not the system requirements they wanted. So, the value of such sharing is to teach the students to learn "how to minimize the

many possible problems at the later stage during project delivery", meaning that "don't be lazy". Writing in point form and emailing it back to the person you collected the requirements will do, and this work code of practice was to document what you have done – the requirements were collected from the users. In addition, it is common for the students to make mistakes in doing assignments like writing numbers, but teacher PLT-D emphasises that there are some mistakes, such as "missing one digit of zero", which can be totally unacceptable at work.

#### 4.4.1.4 Analogy as an option

Due to some kinds of experience learning being very difficult to be taught, it is suggested to use analogy as an option (Pirolli and Anderson, 1985) to help the students to convert what's heard to become their own experience. Teacher PLT-D cites the example of how to learn what is 'yoghurt' for a person who never tried it before. Explaining what yoghurt is, you may say, you ate ice cream and drank juice before, and then you tell the person that yoghurt is not as thick as ice cream and you can imagine mixing the juice into the ice-cream, in which the texture will turn a bit to become more fluid but not as heavy as ice-cream. This approach is to leverage something the students have some experience with before, and then explain how it is similar to what you want to teach the students for understanding. When one had ice cream and juice before, the simple way is to treat it as a mixture of the two things, ice cream and juice which can make it easier for memory and the learning of yoghurt is 'juice plus ice cream'.

### 4.4.2 Practical lab sessions, educational authenticity, and authentic intellectual work (AIW)

#### 4.4.2.1 Practical lab design and the learning environment

There are four practice-led teachers required to conduct the lab sessions in the taught courses. Teacher PLT-D has not mentioned how the lab sessions are conducted in the interview and thus, this sub-section covers the lab teaching by PLT-A, PLT-B and PLT-C and that is summarised in Table 4.9. They understand very well the university's teaching and learning environment which is different from the workplace, and it is impossible to impart industry practices to the students. Since the contextual barriers (Tomlinson, 2017) are recognised, they work around the constraints by allowing the students to make mistakes and to re-do them in the lab, promoting their self-efficacies (Dweck, 1999); through the design-in-purpose, they are not fully resembling the work practices as suggested by Gulikers et al. (2004, 2006), making it become practical practices and improve the technical understanding of the students through visualisation in the computer lab environment.

| | **Teacher B** | **Teacher A** | **Teacher C** |
|---|---|---|---|
| **Course nature:** | **Computer Engineering** | **IT application system development** | **Cybersecurity** |
| **Inside-the-lab setting** | Computer network with IT equipment setup like computers, routers, monitors | Computer lab | Computer lab |
| **Learning objectives:** | • Understand the technical knowledge in textbooks<br>• Reinforce what is taught and learned in classes | • Learn the current IT tools, the current programming languages<br>• Learn the current IT practices<br>• To demonstrate their understanding | • Training-oriented<br>• Understand the need for IT jobs<br>• Able to perform those job tasks, if previously practised in the lab exercises, in the future |
| **Learning mode:** | • Practical<br>• Hands-on | • Practical<br>• Hands-on | • Practical<br>• Hands-on<br>• Do the practices through guided assignments |
| **What do the students do?** | • Connect the nodes between routers<br>• See how the information gets transmitted from and to the | • System design<br>• Coding | • Different types of server setup<br>• Virtual machines setup<br>• Equipment configurations |

| | | | |
|---|---|---|---|
| | machines electronically<br>• Through the monitor, display to see what the different packets are back and forth to make it happen | | • Installation of software<br>• Hacking practice<br>• how to fix the problem in the hacked machine<br>• firewall setup<br>• activate the detection mechanism |
| **What are the teachers prepared for the lab sessions?** | • Prepare the lab exercises based on the technical knowledge from the textbook<br>• Scenarios setting with the industry's messy situations and complexities extracted out | • Realistic data sets, not toy problems<br>• Industry scenarios like aviation systems, railway systems | • Develop a set of lab exercises in the form of tasks and steps for practices<br>• Scenarios are derived from the case study written by teacher C<br>• Background of case study is based on the project cases done for the industry |
| **Does it relate to the industry?** | "The lab is the ideal live which is closer to the industry, but it is not the same." | "Follow the technology development very closely" and teach the "up-to-date" skills and knowledge. | The lab assignments are "very close to the industry" as it is "very similar to what we do in the job". |
| **Is it the same as the industry?** | "There is a gap between the lab and what is going on in the industry." | Very close to the latest technology and the data sets are "real" data. | What is performed at the customer site are "the same kinds of steps" as those practising in the labs. |

*Table 4.9: Practical Lab Design, teachers PLT-A, PLT-B and PLT-C*

#### 4.4.2.2 Scenarios-setting with industry-context versus without industry complexities

In the lab sessions, both teachers PLT-A and PLT-B have designed the lab practices on a scenario-based, but they handle the industry elements completely differently. PLT-A prefers to let the students solve real problems, "not toy problems" through the provision of real data sets from the industry related to artificial intelligence (AI) in the lab sessions. With the real-life examples of industry scenarios in aviation, railways, and some others, together with some local industry information, it is expected that the students can "design and code the

program to demonstrate their understanding". Such understanding can be articulated further through "lots of project-based works" completed by the students who can frame a more realistic picture in the respective industries and come up with different practical scenarios between these industries. The teacher is confident that the students can relate to the learning easier because what he does is "definitely" practical with up-to-date knowledge followed closely in the technology development.

For teacher PLT-B, he promotes the learning on both classroom teaching and practical lab sessions are of equal importance whilst the lab environment is set as the "ideal live", reflecting the lab is not just "an ideal situation but it helps to understand what's in the textbook". The purpose of lab practices is hands-on, for the students to "understand the theoretical things in a more concrete way" as well as to reinforce what they learned in classes. However, he reiterates that hands-on thing is not the same as the product in industry as the latter targets producing very concrete products. In the industry, there are many messy situations that needed to be solved but in the lab sessions, all the messy situations are "extracted out" so that the students do not need to deal with all the complexities, making the environment more suitable for student learning. That is, the students can just do the lab practices in "the extracted scenario but hands-on". For instance, if the lecture teaches "there is a network, there is a router and the two nodes connected together", the lab is where there will have a router for the students to examine the signals, to make the connection between the two nodes and then to find out what kind of information are transmitting from one side and what will be received by the other side. In between these two physical settings in the lab, it requires to have a monitor to display what are the data packets back and forth to make it happen. Therefore, the students can visualise all these processes in working, and it is very practical. "The lab is the ideal live thing, which is closer to the industry, but it is not the same". He reaffirms that "there is a gap between the lab and what is going on in the industry".

#### 4.4.2.3 Real project case converted into learning tasks for practical practices

The lab sessions prepared by teacher PLT-C are resembling the practices at the customer sites, through a set of practical assignments which follow the work steps or tasks derived from the real case projects implemented in the industry, claiming that "the lab assignments we prepared are very close to the industry. The steps practised by the students in the lab are the same kinds of steps that we are performing at the customer site". Briefly, the students are asked to set up servers and virtual machines assuming in a data centre environment, configure some network equipment, and install some applications. The teacher explains that though many textbooks are written about how to do server settings, how to do machine hacking, firewall settings and detection mechanisms, the students need to practise it before they can understand how to do it.

However, the students are facing difficulties to follow the lab practices in the lab and commented it was a very demanding course in the course evaluation. As discussed in the earlier part, some students cannot follow the lab exercises or instructions, leading to some interruptions in the teacher's original plan for very minimum teaching instructions in the lab practices. That means, he is required to adjust the lab teaching approach, letting the students follow the given instructions to do the simple steps whereas, for some critical steps, the students are told to wait for a while to think about how to do the task before the teacher instructing them to continue the lab practices. As most of the students do not have industry experience, the course cannot be covered too much on professional or industry practices. The alternative for the teacher is to put "some techniques" into the lab exercises only, which is seen as more towards putting "practical practice" in the course, that is, to impart some knowledge about the practices.

For the teacher, it is perceived that the students can "use common sense" in doing the lab exercises in front of the lab computer and thus, he does not understand why some students don't know how to make the choice when there is more than one option in some of the tasks. Concerning the above learning problem, the students may encounter issues of

performing cognitive action or cognitive authenticity (Herrington and Herrington, 2006) in the lab practices. Based on some student feedback in the course evaluation, it is found that they felt very rushed for them to learn so much in the course. As some of the course contents were new to them, they were unable to manage the lab exercises. Even those students who were serious about learning prepared some materials at home before attending the lab sessions, but they still could not finish it in the lab. That means, only those extremely hardworking students could make it because "they brought the exercise of the whole computerised lab session back home to do trial and testing to make sure they can get hold of everything in the lab practices".

### 4.4.3 Tailored-made industry case studies for professional practices

Teacher PLT-E is the one, who gave me the most real-life examples during the research interview. An example of cheque clearance operations for banks is quoted. Since many people have the experience to deposit a bank cheque, after the sharing on how technology works in cheque clearance, some students said that they learned a lot because previously, the only thing they knew was for them to write a cheque to deposit money and the money was then shown in my account; but for now, they have the better idea about how the workflow is working and what is the technology behind it. The above shows that the teacher can articulate the student's learning through the student's reflection process on what they experienced before, it is the metacognition process (Knight and Yorke, 2002) to promote the students to become reflective thinkers, implying that teachers sharing can add "a lot of the value to the learning process" and makes a big difference in student learning. There are other actual examples quoted in PLT-E's lectures, including some horizontal project cases, like data privacy, and internet banking; and some industry-based cases, like business process automation and workflow analysis.

Both teachers PLT-C and PLT-E leverage heavily on industry cases in conducting the teaching in the lab assignments or the lectures. The preparation of the practical lab exercises is based on the two real project cases written by teacher PLT-C and his team. The first project

case was an e-commerce system implementation completed several years ago, and the recent project case is related to the university's election system. For teacher PLT-E, he designed the group assignments to let the students do some research work around the topic of the actual technology deployment and to understand how these kinds of deployment can support the companies to make the services to the customers, such as security token and one-time-password for online banking. The scope of the assignments is open, not restricting the scope of research and not dictating the answers. It is welcome if they want to dig out more information to show their learning effort. Based on the content and the quality of the presentation delivered by the students, plus the feedback loops after the presentation, the teacher can assess how much they have picked up from the lectures and how much they learned from their research.

*Examples of Project case assignment:* The background of each group assignment forms part of the lecture contents as the theory like principles for business process re-engineering (BPR) is taught under the lecture topic of workflow analysis. So, all students possess some basic knowledge and understanding before starting to do the research-based assignment. One of the lecture topics is about IT security and Banking, and the group assignment is set for studying the top three banks' websites, with some technology websites given by the teacher, the students are asked to "compare and contrast" these banks according to the following list of questions:

- How do they do the two-factor authentication for IT security in banking?
- What devices do they use?
- What security schemes do they use?
- What are the pros and cons of using different options, like security tokens, a short message for a one-time password?
- What are the transactions allowed for different types of security login?

The project case assignments are done in student groups who need to present their group project in front of the class whereas the feedback session can be served for giving them "feedback and critique on what they have done in the research". Referring to the course

evaluation, teacher PLT-E said that some students wanted to have more time to do the research project. Surprisingly, there were two student groups exceeding the teacher's expectations. In terms of *breadth*, one student group spent extra research effort to discover that one of the banks on the assignment list has extended the same level of online security to the mobile login services. In terms of *depth*, one student group paid the extra research effort to locate the actual coding, which caused the security incident of a data breach at a national bank in Southeast Asia a few years ago.

### 4.4.4 Final examination in practical lab, and authentic assessment

The design of the practical lab examination is identical to the lab exercises in the computer lab, and it aims for practical, not like those paper-based examinations to test for "the memorising stuff" and are not expected to let students get higher marks by memorising the notes. According to teacher PLT-C, the preparation effort for the lab examination is significant which takes more than 2 weeks preparation time for a 3.5 hours' examination paper, involving the coordination effort from the university's IT department to help set up the virtual environment for that specific practical lab examination. One exam question is set to do system hacking, meaning that the university's IT team must be involved in setting up the protected virtual environment in the university for that the practical examination in the lab. However, it is found that some students repeated the same mistakes as made in the practical lab sessions, indicating that some students sat for the examination but not reading through the lab instructions, thus requiring them to re-do the system setup. Once the students did it wrongly, the problem was that they could not get back the preparation time for the examination. Strictly speaking, the teacher has alerted the students before the exam, reminding them that "there is one step that they must do it first before they can start to do the lab examination". By the examination result, out of the 60 students, about one-sixth of them (about 10 students) did not follow the exam instructions to do what needed to be done during the lab preparation time.

## *Part B: Students' perspective (Student surveys)*

### 4.4.5 Students' feedback on course design and learning

#### 4.4.5.1 Analysis on course design

There were 98% of the students agreed that they had a clear idea of what was learned and expected in the course while indicating that both technical skills and IT industry knowledge were covered in the course. In terms of rating the level of usefulness of five types of course items or activities in their study, see Figure 4.3, "understanding of the course subject in the field of study" was regarded as the most useful with 73% of students rating for very-useful-and-above, followed by technical aspects with 63%, class exercises and projects with 62%, experience sharing with 54% and the other like company visits with 35%. But the surprise is, 15% of the respondents rated technical aspects as less useful in their study, just seconded to course activities like guest speakers and company visits with 20% of the students rated as less useful or not useful. Only 11% of respondents claimed the course item of experience sharing of industry practices and real-life examples was less useful or not useful. In the category of others like guest lectures and company visits, 20% of students gave the response of not useful and less useful, the highest percentage among all the five types.

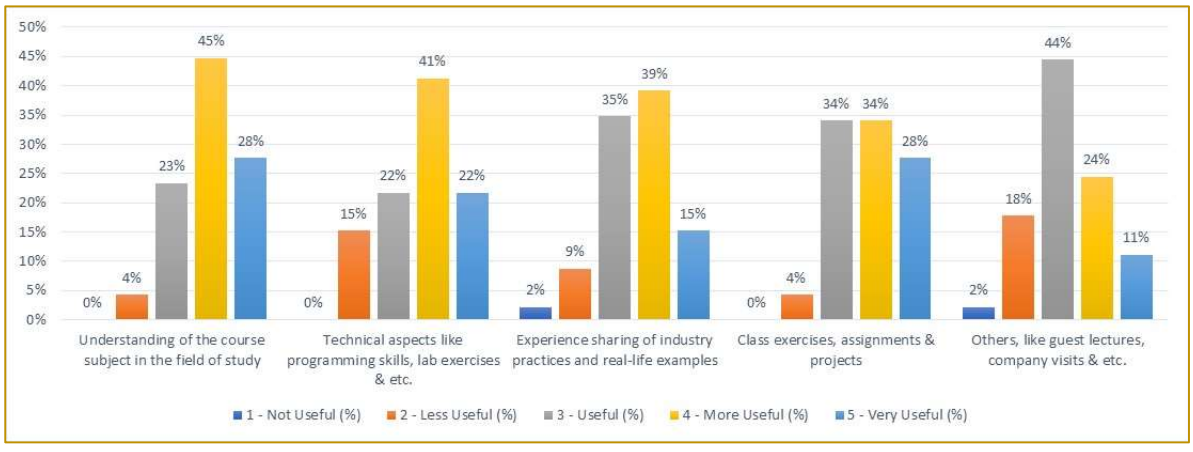


*Figure 4.3: The level of usefulness on five types of course items or activities*

In terms of course workload and assessment, 96% of students agreed that course assignments and projects were effective to help them practise what they learned in the course and 98% of students agreed that their course understanding was consistently assessed through the course assessments. According to the comments collected from the respective open-ended questions, the top three most practised areas were project management and its related technical knowledge, technical skills, and business knowledge; and the examples are listed in Table 4.10. Based on the student responses to course assessments, it was found that the students understood in-class exercises being used for assessing their learning and understanding in addition to the standard course assessment in the course. Examples of in-class exercises quoted by the respondents covered writing up a project charter, a risk registrar, a project interim report, critical path analysis, business analysis by using the analytical tool, risk analysis on different frameworks on a case level, and developing a database using MySQL.

*Table 4.10: Examples of students' feedbacks on Course Workload and Assessment*

- Project management and its related technical knowledge: These were related to the knowledge areas and the process in project management methodology, such as how to prepare the project management plan, project planning, budgeting, and project charter; and the technical skills include work breakdown structure, net present value calculation and the use of Microsoft Project management tool.
- Technical skills: Examples were coding, data management, system analysis, Excel, Java, SPSS, Gantt chart, information Management, mobile application, python project and SEO and web analytics.
- Business knowledge: Examples were real business case analysis, business project management, digital marketing, e-business, performing different risk scenarios and risk management.

#### 4.4.5.2 Analysis on student learning experience

The analysis of student learning experience covered three dimensions: learning resource support, practice-led teaching, and learning environment. There were 94% of the student respondents agreed that the course materials were comprised of theories and applications

in the IT industry whereas all respondents agreed on the study materials covered the relevant case studies and industry practices in the IT field, meaning that all the respondents perceived the study materials, like case studies, closer to the industry than that of the course materials. It can be explained that the study materials prepared by the teacher were seen as supplementary materials in the course. In terms of learning resources support, only 6% of respondents said not to be clear. Referencing the responses collected from the open-ended question, the vast majority 94% gave some examples which could be categorised into four main sources of learning support: the first and the most cited was online resources like some project management templates offered on some websites and online manuals of some software applications. Second was the lecture materials, the third was the support from the teacher and tutor on lab demonstrations and the last one was the guest lectures and career talks.

For practice-led teaching, 94% of the student respondents agreed that the teacher was very experienced in conducting the course more practical and interesting while 62% very agreed with this statement. When asked how useful to you if teachers possess IT working experience, they showed very positive responses containing a comprehensive list of written expressions: 18 wrote for “very useful”, 4 for “useful” and 2 for “quite useful”, one for “really useful” and one said it was perfect “10/10”. In addition, other written responses were consolidated into four categories, namely, understanding the IT industry, real-life experience sharing, career support, and academic support. Their exact quotes are provided in Table 4.11(a). Over 70% of the students very agreed that the teacher made a real effort to understand the difficulties in their study. When they were asked what the teaching staff had done, they gave a whole range of examples of teaching support they received, see the examples of direct quotes in Table 4.11(b).

Basically, all respondents agreed that they learned to express ideas confidently in front of the teacher and classmates and no students disagreed with it. Over 65% of them were very confident in expressing their ideas whereas there were 4% disagreed. However, there were

96% of the students agreed that the teaching staff always encouraged them to understand the course from different angles.

*Table 4.11(a): Examples of students' feedbacks on Practice-led teaching*

- Understanding the IT Industry: They expected the teachers to be "more familiar with the real IT industries" and possess the "updated knowledge and understanding of market requirements". They hope the teachers can help them to "better understand the real cases in [the] IT industry", "know the latest trend in the industry", have a "clear picture on the industry and how they work", and understand "IT fields with more real-life examples".

- Real-life experience sharing: They hoped the teachers can "compare differences between mock project management and real-life project management", share "more real-life experiences" or "actual experiences" with them, let them "know the practice of the industry", "very useful and important to me if they can share their real-life experience from working in any related industries".

- Career support: They expected teachers who are "willing to give suggestions and guidance" to them. The teachers can share with them "more about how to apply the skills on career", "high degree for career reference", and "highly useful because *[the teacher's name is made anonymous]* who shared some of the experiences in [the] work field to make it easier for students to understand the abstract concepts".

- Academic support: They also mentioned the teachers can "provide the big picture and more understanding on the theory", "use related knowledge to answer my questions", "can answer IT specified questions", able to provide "more practical examples", "some concrete examples", "very useful as it can help me to apply the theory into [the] real world".

*Table 4.11(b): Examples of students' feedbacks on Teaching support*

(1) To encourage them to ask questions in classes: "asking question for ensuring our understanding of the course", "ask if we have any questions".

(2) To proactively make responses to student enquiries: "actively answer our concern"; "willing to answer my questions"; "we can ask questions and they'll try to explain the answers; if we do not understand, they'll try to explain them in another way"; and "quick respond to my emails".

(3) To provide the detailed explanation: “gave detailed explanation and examples”; and “use examples to illustrate the theory”.

(4) To provide direct support in student learning: “try to explain the code one by one”; “they help us to fix the app building”; and “assist [to] demonstrate how to use the program”.

(5) To arrange individual consultation: 4 students specifically mentioned it.

(6) Feedback on submitted assignment: “they marked clearly on our group's internal report and answered our questions patiently”.

(7) Advice on group projects: discuss with us “which part of our project should be improved”; “find focus for doing group project”; and “I raised some questions about the project, and the tutor tried to elaborate on the real environment and clarify their job roles [in the project case] to me”.

(8) Guest lectures: “invite guests who are currently working in IT fields and conduct a lecture to us”.

#### 4.4.5.3 Analysis on student learning outcomes

This section is to collect the student feedback on practice-led teaching in three areas: “professional skills”, “graduate qualities” and “intellectual motivation” around the topics of technical skills, problem-solving skills, teamwork, confidence in facing challenges, applying what has learned, creating new ideas and the ability to do self-reflection.

**Professional skills:** There were 96% of the respondents agreed that the course helped them to develop IT technical skills and prepared them as good IT project team members in the future while 94% agreed that the course sharpened their problem-solving skills in handling IT tasks in the future. Looking into the specific scales of very agreed and strongly agreed, more students (83%) felt that the course helped them to improve their problem-solving skills than that (68%) in the IT technical skills. This applied the same to the soft skills in teamwork, 79% of the respondents felt that the course prepared them very well as good IT project members than that for IT technical skills. Among all questions in this section, the responses to the question of tackling unfamiliar problems indicated it to be the toughest for

the students, having the highest percentage (13%) of the students who could not tackle unfamiliar problems and the lowest percentage (4%) of students could have full confidence in handling it.

**Graduate qualities:** The student responses showed a very consistent pattern of consensus about their learning in the IT field of knowledge, applying the learned principles to new situations, and the confidence to investigate new ideas. The total number of respondents rated very agreed and strongly agreed were 70%, 72% and 70% respectively. All the respondents considered what they learned in the course valuable for their future. When they responded to the open question to elaborate on how the course is valuable to their future, their responses (a total of 46 responses and only one student not answered) can be categorised into four major areas, including, future careers (39%), project management knowledge and skills (28%), practical knowledge and skills (26%), and mindset (7%). Their direct quotes are summarised and provided in Table 4.12. There was one student who wrote, "the course can help me not to afraid [of] when I have IT project in the future".

**Intellectual motivation:** According to the student responses, 57% of the students were very agreed and strongly agreed that the course has stimulated their interest to study in the IT field as well as inspired them to pursue a job in the IT field after graduation. However, there were 8% of respondents not agreed to stimulate their interest and 11% not agreed to inspire them to an IT job. In terms of personal development, there was 94% of respondents agreed that the course developed their ability to self-reflection on what they learned and 66% were more agreed with it.

*Table 4.12: Examples of students' feedbacks on how the course is valuable to their future job*

- Future careers (39%):

  *The relationship between the course and their future job*

  - "This course is valuable to me when I aim to work in the related field in the future. I can talk about what I have gained in this course."
  - "The course focus is exactly the same as the job I am anticipating after graduation."

- "This course is really practical and very similar to what I actually did in an IT company (which I have worked for an internship)."

*Benefits for job interview and the future job*

- "Learn the skills of using those software and programming language. I can apply the knowledge in my future interview and job."
- "Learning the basic knowledge in this industry and support my future career (e.g. knowledge for interview)"

*Career choice*

- "The knowledge I gained from this course will be useful if I want to become a project manager or any other related positions."
- "To pursue my career as a business analyst."
- "After having a basic knowledge on project management, I think I can work on this field and become a professional on IT or IS project management."
- "To understand that whether I am suitable to the related career field."
- "It helps broaden the choice of future career, as I can apply for risk management related job duties."
- "I can learn different concept and knowledge in this course which is helpful to my future career."
- "It may change my career path."
- "Valuable for future career"
- "Useful in long term"

*IT industry*

- "Explore the industry."
- "Understand the potential market of IT industry."
- "I would like to engage in IT industry."
- "I learnt different IT skills that I can choose to work in an IT industry, rather than general business industry."

❖ Project management knowledge and skills (28%):

The list includes how to develop a new business project, the framework, the process and the procedure of project management, learn the entire process of planning, implementing and evaluating an IT project, how to prepare project budgeting and assigning tasks to members, how to handle a project from the start till the closing part, project skills like balancing the time, cost and scope, evaluate the risk I encounter in the future.

❖ Practical knowledge and skills (26%):

For examples: business applications, risk management, increasing the knowledge area in both technical and theoretical, SEO, updated technical skills like big data tools, giving some direction for self-learning, “Concepts to be actualised”.

- Mindset (7%):

  Two of the students just wrote down “very useful” while one student said, “the course can help me not to [be] afraid [of] when I have [an] IT project in the future”.

### 4.4.6 Analysis on disciplinary inquiry through interactions between teachers, fellow classmates, and student project presenters

As suggested by the practice-led teachers, class observations were arranged at the end of the courses by attending the group project presentations as it is perceived as a good time to observe the interactions between group project presenters, fellow classmates, and the teachers in classes when the practice-led teachers promote the classroom community of disciplinary inquiry (Splitter, 2009) to get the students engaged in the learning as reflective thinkers. There was a total of 20 student presentation groups, covering 11, 7 and 2 group projects in the classes of teachers PLT-C, PLT-D and PLT-E respectively. The class of teacher PLT-B contained 16 individual projects and there were 2 industry luncheon talks observed for teacher PLT-F. The analysis of class observations is focused on teaching pedagogy and learning environment. It is observed that the practice-led teachers deployed different teaching approaches to check for the level of student understanding, to encourage them to do self-reflection on what has been done in their project, and to find out whether the students can apply some of the key technical concepts in their chosen projects.

#### 4.4.6.1 Observation analysis on learning environment during Q&A sessions

One practice-led teacher created an open discussion learning environment for the students to exchange ideas with each other, which could also support the learning for the entire class (Splitter, 2009). When the students could not answer the question, he tried to give them

pointers to recall the technical concept. Blockchain technology is increasingly having wider adoption, therefore, the teacher wanted to leverage two of the student projects which were using two different implementation solutions to handle the same problem. After the two presentations, the teacher said, "for the benefit of the class, we discuss the two presentations together".

> *Teacher: "Each of you, explain from your view…. What is the key difference?"*
> *Presenter 2: "Blockchain do not ……."*
> *Presenter 1: "I don't agree with him ……."*
> *Teacher: "Let me use another way. What is the key difference between these schemes?"*
> *Presenter 2: "There is no mining."*
> *Teacher: "Yes, that is one difference."*
> *Teacher: "What additional thing you have to do? One thing you forgot to mention. One ingredient…… in proof of work, the Byzantine agreement ……."*

It was also observed that if some fellow classmates felt the presentation topics or contents which were close to their daily lives, that could arouse their interests, making them more enthusiastic about asking questions in the Q&A session. Students 1 and 2 were asking questions from the same project presentation while the remaining were asking the separate project presentations.

> *Student 1: "I want you to take consideration ……., people may not want to drive for 10-mins to enjoy 30-mins in traffic congestion……..need to consider the distance between ….."*
>
> *Student 2: "After doing the study, do you think the ultimate solution is to build one more tunnel? Then, we will have three tunnels."*
>
> *Student 3: "How can e-learning replace field trip? Do you think staying in simulated environment to be the same as natural environment?"*
>
> *Student 4: "If I donate money to crowdfunding, do I take risk? May be some illegal projects that do I commit crime?"*
>
> *Student 5: "How long do I need to wait if I want to become an investor?"*

#### 4.4.6.2 Observation analysis on teaching pedagogy (1) during Q&A sessions

The practice-led teachers deployed multi-dimensional assessments on the individual or group projects presented by their students. Except for the project management projects, all the other projects were highly technical. Hence, I managed to have a high-level understanding of what they have been presented in classes; but I could not understand the exact technical details like blockchain algorithms and system hacking techniques when the students responded to the teacher's questions. Regarding the project management project presentations, I can have a full understanding of what the students presented, and the questions raised by the teacher. In this section, my analysis is focused on their interactions and their dialogical conversations during the Q&A sessions which were about 10-15 minutes for each group.

First, they adopted two teaching tactics to evaluate the first-level understanding of the students after each group project presentation, (1) seeking the elaboration or explanation, and (2) asking for the comparison, and the examples are quoted in Table 4.13(a).

*Table 4.13(a): Examples of practice-led teaching tactics to assess the students' first level of understanding*

- Teaching tactic one: Seeking for elaboration or explanation
    - *"What's the biggest problem of using cloud based DDOS protection?"*
    - *"How many data samples needed to bias a machine learning model?"*
    - *"You mentioned that there are some potential attacks on e-wallet, which include reverse engineering. Is there any case you observed or read about the reverse engineering?"*
    - *"In your demo, I can see that you have changed something to show the CSRF attack. Can you explain a little bit more what have been modified in order to protect from the CSRF attack?"*
    - *If those are packages offered from [the software] ……, can we customise it by changing some of the items for us to do the testing? Or is it possible for us to modify some of the items for us to do testing? Or we need to do all during the testing?*

- Teaching tactic two: Asking for doing comparison
    - *"What is the difference between mobile wallet and [bank] account?"*

- *"What is the difference between SDN and NFV?"*
- *"Yours is supervised learning model or federated learning. How about for unsupervised, the other method of discrete clustering*?"

Second, the teachers looked for the students' deeper understanding of their project and they were trying to do the learning assessments in terms of the solutions' deployment, feasibility and effectiveness as proposed in their projects, such as, how to coordinate, what to install, how to perform, how effective, is it feasible? See examples in Table 4.13(b).

*Table 4.13(b): Examples of practice-led teaching tactics to assess the students' deeper understanding*

- *"How do they coordinate? Is there any spectrum guideline?"*
- *"What is the pre-requisite in order to install it (sandbox) to use?"*
- *"What components, items that need to be installed?"*
- *"I wish to know a bit more about how to perform the pass checkbox capture with ……."*
- *"The famous example you mentioned is volumetric attack. How effective is the Cloudflare in defending the application layer, the DDOS attack?"*
- *"One of the future directions is to use the hardware wallet, instead of the software wallet apps. Do you think it's feasible to secure the e-wallet more?"*
- *"I mean, by considering application-level attack, is it effective to use cloud-based filtering?"*
- *"What is the feasibility of stoler on IIS and Tomcat perspective? Performing stoler attack on IIS and Tomcat, is it effective or not so effective?"*

Third, in responding to what has been presented by the students about the shortcomings or vulnerabilities in the applications developed in their projects, the practice-led teachers wanted to test the problem-solving abilities of the students in their chosen project as that should be the topic, they are interested in. The questioning techniques included simple question setting and scenario-type question setting. See examples in Table 4.13(c).

*Table 4.13(c): Examples of practice-led teachers' questioning techniques using simple question-setting and scenario-setting*

❖ Simple question setting:

- *"You list out a number of vulnerabilities related to SDN. How do you solve those vulnerabilities?"*
- *"You mention, poisoning type of attack during the testing phase. What's the detection and mitigation strategy for that?"*
- *"Are there any vulnerabilities in affecting the blockchain implementation?"*
- *"You have mentioned quite a lot, the cons about Solaris. Have you thought any way to improve it?"*

❖ Scenario-type question setting:

- *"You mention, the benefit of smart contract is that nobody can change the figures in the block. If I really find that some of the blocks are incorrect, what will happen?"*
- *"How about the system-level vulnerabilities, like buffer overflow?"*

Fourth, they assessed the students on whether they could apply the technical term or concept learned from the lectures to the group project they have chosen. For example, the teacher asked, "To use the term, 'indicator of compromise', how can we determine that this type of machine learning can be detected?" The answer given by the student group was not very concrete. Example two was related to the concept of 'proof of work' in Byzantine agreement for blockchain whereas the students could not answer it, therefore, the teacher provided the answer to the presentation group as well as the whole class so that all students could know the answer.

#### 4.4.6.3 Observation analysis on teaching pedagogy (2) during Q&A sessions

There were 7 group project presentations observed in the project management course. Each presentation was followed by 2 questions, but one group only got one follow-up question due to a long discussion on the first question. The practice-led teacher had placed a mini-alarm clock in front of the teacher's desk to count the time for each presentation and the Q&A sessions. A total of 13 questions were raised by the practice-led teacher, and it was observed that the teacher adopted the knowledge areas under project management methodology to frame the approach for questioning. The questions were summarised as 4 on project time management, 4 on project quality management, 3 on project scope management and 2 on project cost management. The ways of asking questions were up to

the point and meanwhile, the students were expected to give the exact answers. If the students did not answer it properly, the teacher continued to try to get the answer from the groups. It seemed that the teacher hoped to make sure the students have a clear understanding of the knowledge areas of project management from the perspective of their own presented project. It was also discovered that some technical terms in project management could easily be mixed up with other words that carry similar meanings.

Project time management was the knowledge area that the students made the most mistakes or overlooked very easily. Through the question-and-answer sessions, the practice-led teacher wanted to educate the students on what is meaning of "date" in the project plan, why it is so important, and the logic in deciding the project task schedule. See examples in Table 4.14(a).

*Table 4.14(a): Examples on project time management*

- Example 1:

  *Student: "..... we will create the manual and then submit to AWS available for download."*

  *Teacher: "So, what's the date?"*

  *Student: "Feb 21"*

  *Teacher: "When will the app be available? That is a very important date for customers to download the app." and "How long?"*

  *Student: "5 months"*

  *Teacher: "Elaborate more"*

- Example 2:

  *Teacher: "Only items, no dates, when are you going to complete?"*

  *Student: …… "we have activities and sub-activities" …….. "we only select 5 key activities to present"*

  *Teacher: "When will be the project closing date?"*

  *Student: (Observer: can't hear it clearly)*

  *Teacher: "When will be the completion date of the app development?"*

  *Student: (Observer: no response)*

  *Teacher: "Even for the collection of user requirements, once completed, it is also a very important date."*

- Example 3:

  *Teacher: "Why to spend 6 months?"*

  *Student: "I need to spend time to talk to the users and also to add a new opening method in the system."*

  *Teacher: "Can I ask you to shorten it to 5 months?"*

  *Student: "Yes, I can start the coding earlier!"*

  *Teacher: "Will it affect the quality?"*

  *Student: "Should not be." (Another student jumped in: "We are XXX bank!)*

  *Teacher: "If then, why you spend 6 months!"*

Project quality management was the most confusing knowledge area encountered by the students because they mixed up the term quality control with other similar words. See examples in Table 4.14(b).

*Table 4.14(b): Examples on project quality management*

- Example on security versus reliability:

  *Teacher: "Back to the slide - "Things we will monitor", the bullet point of Reliability, can you elaborate?"*

  *Student: "To protect the account information….."*

  *Teacher: "That is security!"*

  *Student: "Yes"*

  *Teacher: Then, it is security, not reliability. So, it is how you can do the monitoring in quality control."*

- Example on reliability versus app bugs:

  *Teacher: "What is the difference between reliability and the number of bugs?"*

  *Student: "The number of bugs will affect the mobile app."*

  *Teacher: "The bugs are expected."*

  *Student: "When we make some queries, it is not function[ing]."*

  *Teacher: "If the function is not working, it's not a function."*

- Example on problem versus risk:

  *Teacher: "Under the Risk Register, ……. why to stop the website to do the updating. Customers need to do shopping online…... the website cannot be stopped."*

  *Student: "We will do it at midnight, …….different periods will offer different discount, …….as the coupon discount needs to do updates…….this is the problem."*

  *Teacher: "This is a problem. Should not be treated as risk."*

- Example on change control:

  *Teacher: ……. project delay due to changing requirements, use crashing and the other method in the project. "Why we need to entertain those changes from customer?"*

  *Student: If the customer asks for changes ……., "we will explain to the customer the changes, is it necessary?"*

  *Teacher: "We can't unconditionally allow the customer to make changes."*

For project scope management, the teacher wanted to ensure that the students knew the meaning of project scope as the out-of-scope work must be justified though requested by the project sponsor or the business users. See examples in Table 4.14(c).

*Table 4.14(c): Examples on project scope management*

- Example 1:

  *Teacher: "You mentioned about to blast out email to customers, is it within your project scope?"*

  *Student: "We want to do it near the end of the App development process to see whether the customer likes it."*

  *Teacher: "Our job is to develop the app, not to promote the app."*

- Example 2:

  *Teacher: "You mentioned about the availability at 99.9%. Availability should be handled in the system maintenance phase. Suppose we will pass the project to the client to do the maintenance. Why we need to do this part?"*

  *Student: "We just want to show it to the client that our system can achieve it."*

  *Teacher: "It's okay. But it is not part of our job."*

Project cost management was relatively easy for the students to understand as they could provide satisfactory answers to the teacher's questions. See examples in Table 4.14(d).

*Table 4.14(d): Examples on project cost management*

> *Teacher: "The project cost is $180K. How do you make sure the budget not to be exceeded?"*
>
> *Student: "The cost budget is based on labour cost, which is based on the days of labour. We have reserved 10% as the contingency budget."*
>
> *Teacher: "If then, there is delay in project?"*
>
> *Student: "We use SPI. If people do it longer time, PM will keep track the days and to handle."*

#### 4.4.6.4 Observation analysis on Q&A session after industry seminar talks

Two industry seminar talks were conducted the class observations and the topics were related to new 5G applications, and the acceleration of digital transformation for business, respectively. There was a total of 14 questions and answers at the end of the presentations and thus, the Q&A sessions were very engaging. All the questions asked were technical-oriented, except for two of the questions which were related to industry jobs and asked by the course director who wanted to seek comments from the industry speaker about IT job prospects and whether technical people need to have people skills. The dialogue between the course director and the industry speaker, see Table 4.15.

*Table 4.15: The dialogue between the course director and the industry speaker*

> *Course Director: "You started to tell us about yourself – started from tech but in doing selling job, …… and then to become a General Manager ……..; which is very different from us. How do you view the jobs like systems developer, business analysis?"*
>
> *Speaker: "Good question! Sales and marketing are customer-facing…. In my current company, we have……., 60+ staff are customer-facing including technical, …….. We don't have pure admin staff nowadays."*
>
> *Course Director: "So, tech people need to have people skills!"*

*Speaker: "It depends on the type of project. Tech people needs to come out to talk about the tech solution for me because they need to build the credibility while I can't do it. So, I also need to upgrade myself…….. I regularly spend 4-5 hours to keep up my technical knowledge to the latest technology."*

## 4.5 IT certifications

### 4.5.1 Recognising the difference between university education and industry certification

Both teachers PLT-B and PLT-C recognise the difference between university education and industry certification, but they take a different approach to handle such differences, largely reflecting their contrasting perspectives on university education which have been discussed in the earlier sub-section. Teacher PLT-C admits that a university degree certificate is proof of academic achievement, helping to reflect the person's ability in their learning in the long run; therefore, he encourages universities can support the students to get more certificates from the industry.

For teacher PLT-B, the department received a proposal from a global IT vendor who proposed a whole series of technical classes which could be developed into one course for the department. When the student completed the course, the vendor could offer the (vendor) certificate to the student. It looked very attractive to the students as the vendor's IT certificates are very prestigious in the IT field while their certification examinations are best known for their difficulty to get a pass. After careful consideration internally, the department turned down the proposal and the decision was based on two reasons; the department hopes to retain what they believe to be good for their students, i.e., to learn more about the fundamental principles and the general knowledge but "not very specific to certain vendor's approach" though the difference is very subtle. If the university learning is so specific to a particular vendor, it not only violates the academic objectives of the department but also creates a risk or a vendor bias, making the department and the

students towards the vendor's view, leading to the issues of creating commercial bias in student learning for it is too specific for the trade in that particular industry. Once again, he reiterates, there is definitely some difference, in student learning in university versus industry and we try to distinguish that.

Between university education and industry certification, there are some differences but some courses in the university follow some of the international or local accreditation frameworks developed by professional bodies, such as Project Management Institute, Inc., and The Hong Kong Institute of Engineers, aiming for getting the courses to be endorsed by the professional bodies so that the students can get some exemptions in the process of certification in the future.

### 4.5.2 Interview-and-online-research analysis on IT project management and its path to professional certification

Project management skills are found to be mandatory for all students studying in IT degree programmes because all practice-led teachers do touch on something related to project management in their respective research interviews. Some mention the difficulties in teaching IT project management while some highlight its importance for the students to work for the IT industry and the need for professional development after graduation. As emphasised by teacher PLT-E, project management is important as "every company needs good project managers".

In the research interviews, I got the below information about how to count the length of working experience in IT jobs and how it can be recognised in the industry.

- *First 2 years for industry learning after graduation*: Teacher PLT-C points out that even very outstanding IT graduates are still in learning mode in the first two years for the acquisition of technical skills.

- *Total for 7 years from university study to become a project team member (IT security services project):* Based on the observations of teacher PLT-C, the maturity of IT security staff is at least 7 years, counting from studying the 4-year university programme and then joining the field to involve in some projects until "he is confident to place them into the project as a project member". It is because when they start to work in this field, they need to spend 3 years accumulating experience before they can be a 'real' technical person.
- *Become a project manager, after 5 years of working experience in the field*: Teacher PLT-D mentions that one alumni speaker was invited to be the speaker in the mentorship event, he has been working in the industry for 5 years and is now promoted to the role of IT project manager. Therefore, his sharing can successfully attract the attention of many of the students who are starting to think about being "him" in the future.
- *Project management certification: 4-year degree plus 3 years leading projects experience*: The certification of project management professional® (PMP®) is globally recognised as the professional qualification for project managers across different industry sectors, particularly in the IT industry. Both commercial organisations and government sectors accept this certificate as the formal qualification of a qualified project manager. Referring to the PMI website (Project Management Institute, 2020), there are over one million PMP® certification holders worldwide. In the website section under how to get your PMP®, it states that "before you apply", the candidate needs to possess the experience of "36 months leading projects" for "a four-year degree holder".

In a summary, the above information is very consistent with each other. The project manager is the essential staffing category in the IT industry, taking project management certification, PMP®, as an example, that requiring the degree holder to possess 36 months of experience in "leading" the project(s), that is, the candidate needs to work for IT job longer than 3 years because probably, no company will place a fresh graduate into IT project team once hired. According to teacher PLT-C, he requires the graduate staff to spend the first 2 years learning the job and starting from the 4th year, he is confident in placing them

in the IT security services project as a project member. In this scenario, to become a project manager with PMP® qualification in IT security project requires the staff to spend 10 years including both university study and industry experience. Back to the alumni speaker invited by teacher PLT-D, he is a project manager after possessing 5 years of working experience; together with the 4-year degree study, it is for him to spend 9 years to get to the position. Importantly, he successfully passed the formal PMP® examination, too. Based on the above analysis, becoming a project manager in an IT security project is expected to take longer than that in other IT system projects.

### 4.5.3 Analysis on students' interest in IT Professional certifications

There 82% of the respondents showing interest in pursuing IT project management certification, 18% will plan for the certification before completing the degree programme, 28% will plan for it after graduation but 36% are not sure when they will go for it. However, there were 11% of the respondents not showing any interest in getting the professional certification. The remaining 7% of the respondents indicated that the professional certification will not be relevant to them, implying that they do not plan for applying jobs related to IT projects.

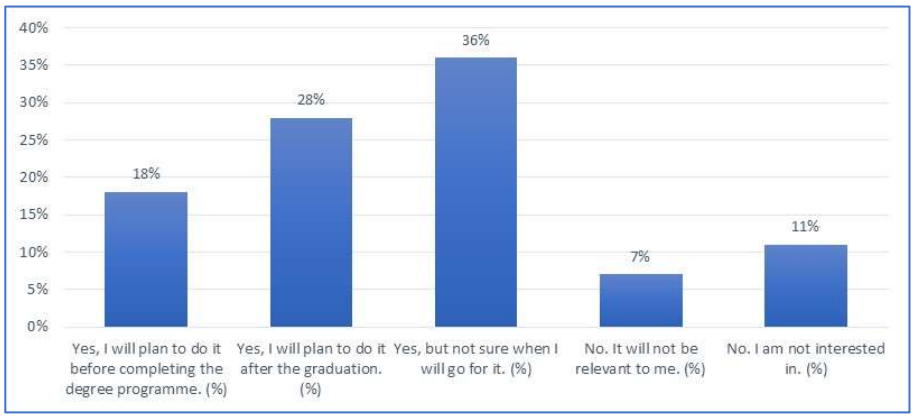


*Figure 4.4: How do the university students plan for IT project management certification?*

In addition, when asked, was/were there any IT professional certification(s) that the students would be interested to pursue, a total of 93% of the student respondents said "yes". But 57% of them were not sure which certification they want to pursue, requiring them to look for more information. Only 7% of the respondents said "no" and this percentage was equivalent to the percentage of the 'not-relevant' responses made in the previous question about IT project management certification. There 36% of the respondents showing interest to pursue IT professional certification, meaning that among those showing interest in IT certifications, project management certification is only one of them. In the last question inviting them to provide the list of IT professional certifications that they were interested in, there were 15 responses clearly mentioning the exact name of PMP® or Project Management Institute (PMI), that was, 54% of the survey sample.

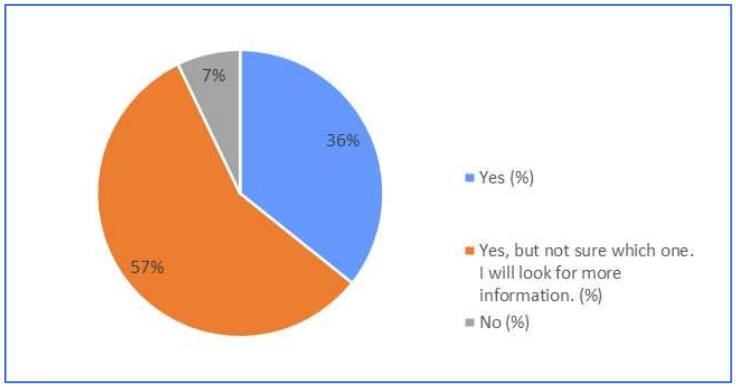


*Figure 4.5: The percentage of university students pursue for IT professional certifications*

## 4.6 Challenges in teaching and learning

Teaching is multi-dimensional. All the practice-led teachers have their unique perspectives on teaching but different expectations. PLT-A feels the difficulty in the teaching technique in classes in terms of grasping the pulse of the class and handling the dynamics in classes. PLT-B views teaching as an art and there are different teaching skills and factors that can affect teaching and learning. PLT-E treats teachers as role models to the students through their experience sharing while the role of teachers is more like an observer and facilitator, who needs to earn respect from the students as there is a reason for the students to sit

there for three hours and listen to you! Both PLT-C and PLT-D focus mainly on the responsibilities of a teacher, such as teaching is the basic duty of all staff to deliver quality teaching as set in the teaching standard; teaching is quantifiable in terms of the number of hours you taught, the number of students you had in classes, and the grade in teaching evaluation, all of these are numbers.

Teachers PLT-A and PLT-B are relatively more sensitive to the past and ongoing changes in the IT industry as well as the new industry trends. They both are trying to inform the industry changes the students and cover the most up-to-date knowledge and tools in teaching, taking the view that "the industry IT trends are [made of] what we teach. What we teach is [made of] what the trend is". In addition, some practice-led teachers are actively supporting the graduates' career development in terms of role modelling (e.g., to model the profile of the head of IT), job analysis for graduates, how to prepare a good resume, and professional certification and development.

Some practice-led teachers indicate the challenges in teaching and learning. Facing the impact of massification in education makes teachers PLT-D and PLT-F concerned about the current tertiary education, especially about the quality of the students as the quality is relatively dropping when compared to the early days of the elites-centric system. The students' learning attitudes are also very varied whilst the number of capable students is relatively less than those in the old days whose admission requirements were very demanding as required by universities. Most top-grade students are very concerned about their academic results for the sake of working for high-profile organisations after graduation. Teacher PLT-C has ever encountered a situation with one student who asked him why he could not get a grade A+ after so much effort spent in the course. That can be viewed as the expectation gap between teachers and top-grade students because these students may try to equate the study effort spent to the academic result they expected to achieve. But for teacher PLT-C, the grade A+ can only be awarded to those students who can exceed all the assessment requirements in the course.

The learning gap is caused by factors on the nature of knowledge, students' capability in understanding, and the maturity level in students' mindsets. As teacher PLT-D said, "Students are students" and "it is impossible" for the teacher to expect the students to learn everything on what was told. Teacher PLT-C, holding the same view, does not expect the students to understand everything at the time they graduated from the IT degree programme. Three of the practice-led teachers share their thoughts about the issues on student mindsets. Teacher PLT-B admits that the students are "still young" and may not be able to get "the big picture" about the industry landscape when he taught them as the big picture incorporates many elements and they may probably not be ready to absorb it at that level, however, it is hoping that after a few years, the students can appreciate what was learned in the university. For teachers PLT-E and PLT-C, they want to proactively educate the students' mindsets for a better understanding of the industry; the former takes it seriously in educating the students to see the linkage between technology and business, "bear that in mind you talk in the language of the business" at work as they need to become a better IT professional after graduation. For teacher PLT-C, launching the apprenticeship programme in the company, he is ready to educate the staff on what is the meaning of quality in a project when delivering it to the clients.

The teaching gap is mainly derived from the pace of change in technological advancement. Teacher PLT-F is very aware of the situation in academia, saying that it is impossible to "daily" update the course curriculum and content to catch up with the changes in the IT industry. But for teacher PLT-C, he reviews the course materials after each academic year and then update if he finds that the existing course materials cannot meet his teaching expectation on the latest in the industry. As told in the past few years, he kept on asking himself to think from the student perspective, "how much they could understand and how much they could not understand". That is why, the course is needed to be adjusted every year to suit the student learning, too. Similarly, it can be explained why teacher PLT-A decides to use real industry data sets for the students to do the up-to-date practices in the lab sessions.

## 4.7 Conclusion

Overall, the six practice-led teachers bring their own personal resources and industry experience into the teaching practices, tailoring the course design with applied and practical learning. They are enthusiastic about teaching IT students and feel the obligation to prosper in the IT field with qualified and professional IT graduates. Having a professional profile and a passion for teaching, they are confident in enhancing the graduates' competitiveness in the job market with professional knowledge and practical skills, their awareness of the link between IT and business, and their industry sense and learning for survival. For authentic practices, they bring in the industry data sets for the students to learn up-to-date applications in lab sessions, which help to create the practising as the ideal live and very close to the industry environment for doing scenario-settings practices or practical practices. But the final examination in practical lab uncovers the challenge of having one-sixth of the students repeated the same mistakes previously made in the lab assignments. In terms of the Hong Kong context, it is found that it was barely mentioned by the practice-led teachers in the research interviews. Two pieces of local information briefly described were to let students relate the subject matter to the local government regulations and also cover the local accreditation frameworks in the course design to benefit graduates' certification needs in the future.

Pedagogically, some industry elements are added to the curriculum and their professional experience is largely embedded in the industry case studies and the case scenarios; those are conducted through their first-hand experience sharing and explanations, by analogy if needed, and even the work code of practices are covered. Dealing with the practical integration between theories and applications, it is the reliance on research-based group assignments which demands the students to learn the current technology and practices with applications. Two of the group presentations in teacher PLT-E's class managed to show their self-efficacy in exceeding the teacher's expectations; one group extended the research scope to discover something new but relevant to the project assignment while another

group performed the deep-diving into the exact coding in causing the data breach encountered by that national bank.

The findings of class observations showed the learning-driven approach in the disciplinary inquiry, promoting the students to do self-reflections on what they have done in the project, whilst teachers' questions were focusing on the students' first-level understanding, deeper understanding, and their capabilities in solving the problems identified in their projects. But for some technical terms and concepts related to their presented projects, the students encountered problems in giving the answers and only one student group could give a satisfactory answer. One final year project led by teacher PLT-B was found to be very outstanding, but the project idea was initiated by the final year student himself. Outside the classroom, there were experiential learning activities organised for the student's learning, however, it was discovered that the impact of university ranking can affect the experiential learning activities in two aspects: one is that the higher ranking of the university, the more senior company executives are willing to show up in the university events to meet up with the students, including company visits and industry seminars; and the other is the university-wide hierarchy of mentorship programme to support the students to becoming elites, which in turn can support the university to achieve a higher ranking in the global league tables.

IT discipline is an applied and highly practical discipline, but students find it difficult to learn advanced knowledge and skills as the pre-condition for actual understanding requires some prior industry experience. In the survey findings, most students appreciated the industry learning, and had 100% preference for the relevant case studies and practices, expecting that class exercises and study materials were close to the industry and guest lectures were seen as offering some learning support. In terms of the helpfulness in graduate jobs, they ranked high on summer internship and work placement; though no student said experience sharing is not useful, it is the most uncertain item as responded by the students. Assessing the teacher's practical teaching, 94% agreed to have their problem-solving skills sharpened, 70% and above could apply the learning to new situations and feel confident to investigate

new ideas whereas the most difficult task was to tackle unfamiliar problems. Narrowing the knowledge gaps in teaching and learning, some teachers will update the course materials after each academic year as the IT industry is very dynamic and affected by the fast pace of technological changes.

# CHAPTER 5 DISCUSSIONS OF DATA

## 5.0 Introduction

In this chapter, the key objective is to interpret the data in the findings from the academic perspective with respect to the current academic theories, models, and concepts. The main themes of the study are to examine the IT practitioners who are now academic teachers to teach IT degree students in acquiring IT knowledge and skills and the professional practices, from which, in what ways they can support the graduates' employability. Firstly, the relationship between practice-led teaching profiles and the notions of capital will be discussed as the concept of capital can help to elaborate on their strengths and resources, together with the expectations and motivations they are bringing to the teaching profession. Practice-led teaching consists of curriculum design and teaching pedagogy. In the findings, their curriculum design is largely related to the approach of experiential learning and thus, experiential learning and networking will be discussed accordingly. IT discipline is applied and practical, allowing the notions of work-integrated learning and authentic learning to be explored for understanding those applied and practical practices conducted by the teachers. The topics of the first principle's teaching approach and vocational training approach will be discussed in association with the concept of knowledge structures. Upon investigating the above areas, the relationship between practice-led teaching and graduate employability can be derived through the application of the USEM model of employability and interpreted in the forms of graduate capital, preparing the graduating students to transit from the university to the labour market.

The fieldwork of this study was conducted in Hong Kong, but the context was barely covered by the research participants. When the practice-led teachers design the course curriculum, they consider industry requirements from both local professional institutions and internationally recognised professional bodies for accreditation purposes. Take project management as an example; the PMI (2020) strives for global standards in methodologies

whilst the certification process is centralised, with local chapters located in over 80 countries where local offices like the PMI HK Chapter and PMI UK Chapter are regarded as part of PMI global community to organise the local networking events. Revisiting section 1.2, the above phenomenon can be justified. Based on the study report published by the National Research Council (2001), it is observed that both the primary and secondary IT sectors are operating in a 'global dimension' in terms of 'markets and talent', and the range of IT employers is 'highly heterogeneous'. That means, IT workers can be found in 'all sectors of the economy'. In addition, the growing trend of globalised markets has demanded IT systems not purely to support the local market; therefore, practice-led teachers teach the students to understand the industry perspective and industry standards, but not restricted to any single market.

## 5.1 Relationship between practice-led teachers' profile and the notions of capital

The practice-led teachers possess human capital (Coleman, 1988) which is presented in different forms, including the 'educational attainment' (Benhabib and Spiegel, 1994) from IT or engineering degree, and that can be accumulated through 18 to 35 years of working experience in the field (Mathur, 1999). Besides, they are the current members of some IT professional bodies, gaining social recognition and reputation (Bourdieu, 1986) as well as connecting to the IT communities of practice whose formation is built around trust, cooperation, and collective action (Nahapiet and Ghoshal, 1998). As they are elected as the council members of some professional bodies, they can engage the social and individually held capital (Huggins et. al., 2012) whilst the retired teacher PLT-E is still the current committee member of some public bodies in addition to the professional institutions; all of whose professional and public entities are regarded as 'restricted' knowledge networks (Nahapiet and Ghoshal, 1998). Some of the teachers possess very strong network capital (Huggins, 2010) as their previous network contacts can be maintained even after leaving the companies and now become their personal knowledge network in teaching. Previously, they worked for international or global companies embedding with strong inter-

organisational networks or knowledge networks (Nahapiet and Ghoshal, 1998) which are expected to create economic benefits (Hite and Hesterly, 2001), thus promoting access and exchange of knowledge in the firm's innovation process. Teacher PLT-B can connect to more than 20 companies for the arrangement of company visits as part of the practical course because some of the company representatives as local contacts are already known by him at the time he worked in the US, indicating that his previous companies have set up the global knowledge networks (Gertler and Levitte, 2005) relying on the non-localised networks (Garnsey and Heffernan, 2005) to strengthen the knowledge base (Wolfe and Gertler, 2004). Teacher PLT-A won the local and regional awards while PLT-D won the university's teaching award, meaning that both of them possess good social standing in terms of symbolic capital (Lindberg, 2013) or cultural capital (Tomlinson, 2017).

The human capital, further expanded through the 'accumulated' (Mathur, 1999; Tymon and Stumpf, 2003) capitals in social, network, symbolic and cultural forms, have become the personal resources possessed by each of the practice-led teachers who can develop their unique professional identity as identity capital (Tomlinson, 2017). For they have joined the teaching profession in the social context of the university environment, they can articulate their value propositions in the profession as they have dedicated their effort to teaching, fulfilling the social obligations (Bourdieu, 1986; Coleman, 1988) to support the IT field by educating more qualified IT graduates, as well as, having the confidence and expectations on their contributions to the student's learning, the university, and the industry; all of which are largely driven by their repository of social assets (Coleman, 1988) which in turn influencing their human capital. Moreover, all the practice-led teachers are experienced IT practitioners, possessing the practical relevance (Srinivasan et al., 1999; Riihijärvi and Iivari, 2008) of field working experience who know both the factors of critical success and the causes of failures in their jobs; implying that each of the teachers possesses their own successful lived experience of the real world on a single continuum (Dewey, 1938) in the domain of IT discipline, starting from their education in the university. For now, as a teacher in the university, they are supporting young people, and their students to prepare for their forms of graduate capital and their single continuum starting from the IT degree programmes.

## 5.2 Industry knowledge as foundational knowledge of contextual social knowledge

In terms of IT disciplinary industry knowledge, as a form of human capital (Tymon and Stumpf, 2003; Tomlinson, 2017), it is designed by the practice-led teachers as the foundational knowledge, which can be later transformed through experiential activity and recreated as the contextual social knowledge for the students. The analysis of technology evolution in the past 30 years in the IT industry and the recent 5 years of industry players is not a history lesson, but rather is used for illustrating those factors driving technology change and the actual changes made in the past, and the current state of IT industry in terms of the prominent technologies and the active industry players in the market. Underneath, there are two reasons. First, there is a roadmap or blueprint for technological advancement and the foundation knowledge of the IT industry can prepare the students to understand the upcoming industry changes like Web 3.0 and Industry 4.0 as part of the S-curve of technology (Szabo and Szabo, 1988), that can help to explain why knowledge is seen to be easily obsolete by both employers (Humburg et. al., 2013) and educators (Lee et. al., 1995; Noll and Wilkins, 2002). Second, the analysis of the industry players of the recent 5 years in the market is not a business and marketing lesson, but rather offers the full picture of the IT industry from the macro view, which is lived by different industry sectors in providing the hardware, software, and services and that can be matched to the IT infrastructure framework, explaining on why each technology or consultancy firm has a role to play in the industry.

During the company visits as experiential activities, the students can have a sense of the industry through interviewing and speaking to the company representative directly, whose experience can help to transform into their social knowledge. It showed that the teacher is well-thought to require all the student groups to deliver the presentation in front of the whole class because the full picture of the most up-to-date IT field can be created for the

student's learning. The foundational knowledge is acquired on an industry level and thus, the analysis can help the students to better understand the other courses in the degree programme. In the USEM model of employability, it is part of the domain-specific knowledge (U) to be acquired by the students and if they can have a higher level of abstraction through self-reflection (M), it can support their learning in other courses in the degree programme, see Figure 5.1.

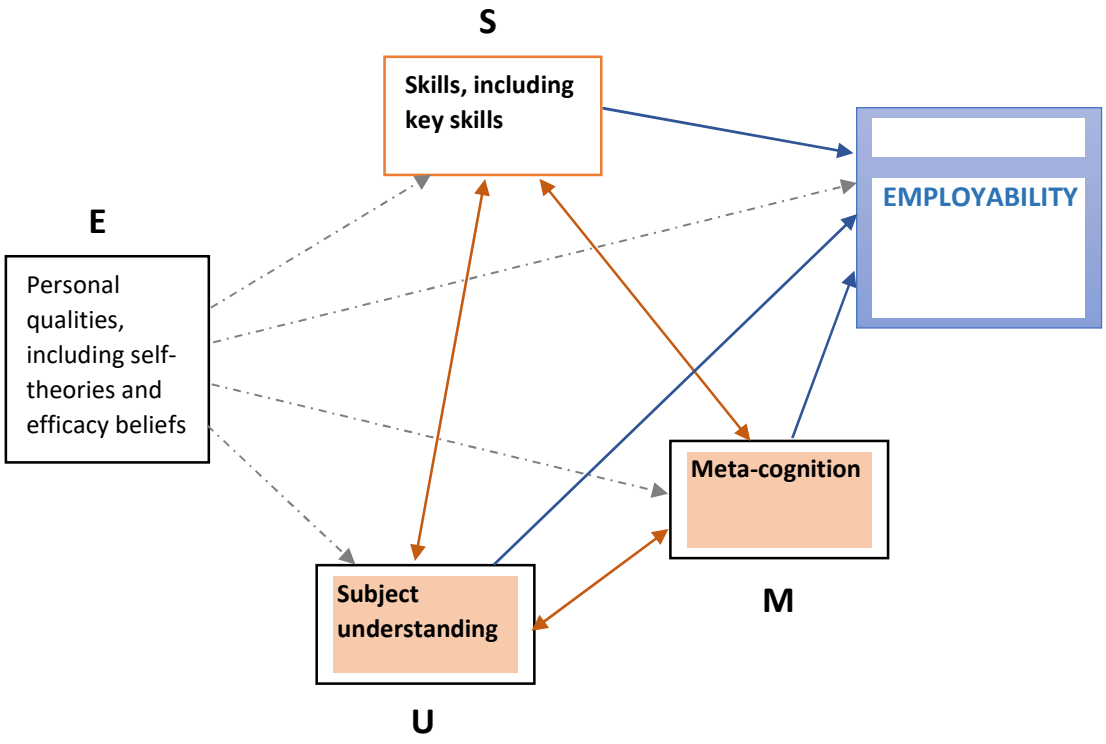


*Figure 5.1: The USEM Model – the close interactions of U, M and S towards graduates' employability*

## 5.3 Experiential curricular activities, network capital, and networking

### 5.3.1 Experiential learning, relational assets, and network capital

Experiential learning, the resources being viewed as part of identity capital (Tomlinson, 2017), is embedded in the course structure to become the co-curricular course, supported

by the activities of guest lectures, industry talks or company visits. Social knowledge (Kolb and Kolb, 1984, 2013) is constructed through the transformation of experiential learning and recreated in the personal knowledge of the learners, which means, students can acquire social knowledge through guest speakers and company representatives, which is socially bounded in context. As these experiential activities are part of the course content, not standalone, the students should be able to do self-reflections on that industry sharing, together with those taught by the teacher for the sake of building up their social cognition (Vygotsky, 1978) in the context.

The practice-led teachers possess their own personal and social networks. When they involve in the co-curricular course, they need to invite some industry contacts, which can be personal or from the department, to be speakers in guest lectures or industry seminar talks, or to invite the company representatives to act as the external mentor for the students during company visits. Particularly for teacher PLT-B, he made calls to them one by one to talk about the expectations on their support for the student learning; from the student's perspective, the company contact is a stranger, but they have to set up the meeting as required in the group project. Therefore, the tasks are designed for the students to acquire some communication skills with external people, social knowledge and to practise self-theories. According to the USEM model of employability, the self-efficacies (E) are malleable, but require positive interventions (Dweck, 1999; Knight and Yorke, 2002) which have been achieved through the phone calls made in advance by the teacher but behind the scenes. In addition, each student group is further supported by one more professor in the department, who acts as the internal mentor helping the student group, such as the preparation of interviewing questions, and that can also be seen as a positive intervention, see Figure 5.2. The practice of self-efficacy can enhance the students' psychological capital (Tomlinson, 2017) as one form of graduate capital; each student group has 4 to 5 students visiting the company and thus the social knowledge can be co-constructed between group members as a new form of contextual knowledge (Kolb and Kolb, 2013) about the IT company whereas the information collected during the company visit is required to be consolidated, analysed and produced in a written group report before the group presentation is delivered in class.

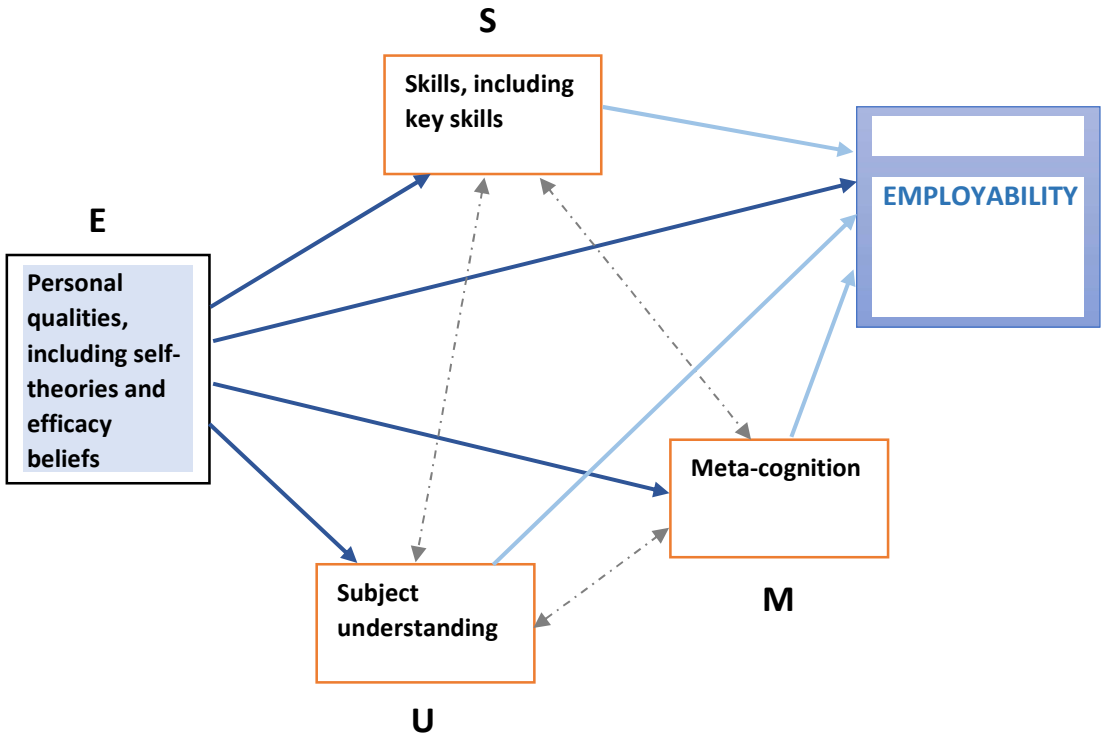


*Figure 5.2: The USEM Model – the direct interactions between E and U, S & M towards graduates' employability*

From the perspective of structural-relational embeddedness (Granovetter, 1992) in network capital, when the practice-led teachers arrange the company visits, site visits or guest speakers for the students, they do the invitations on behalf of the department or the university, creating the network ties (Scott, 1991) between the university and the company as relational social assets (Nahapiet and Ghoshal, 1998) for the university; that is why, the speaker will be honoured with a trophy showing both university logo and company logo after the activities, including those company representatives to be sent after the visits conducted by the student groups. For network capital, there are calculative ties (Huggins et al., 2012) in the calculative (Williamson, 1993) network where not just the universities need support from the industry but also the technology firms show interest to meet up with the university students because it is the good chance for them to talk to the university students currently studying IT, trying to find some potential candidates for their companies. One teacher mentioned that the higher rank of the university, the more senior executive, like the

country head or CEO, would prefer to be the speakers or representatives to join the events and speak directly to the university students, and so do the universities prefer to invite the multinational or global IT and consultancy firms; in other words, both higher rank universities and larger corporations are interested to create strong ties (Granovetter, 1973) through the experiential learning activities for the students. Those previous organisational contacts are turned to the personal contacts possessed by the practice-led teachers, when they invite the contacts to provide support for student learning, once agreed by them, the teachers can articulate the personal network resources to become the relational assets or network capital for the university.

### 5.3.2 Networking, social space, and network space

Embedded in the activities of company visits, guest speakers and industry seminar talks is the value of social capital and network capital. The networking activities are performed in the shared space (Kolb and Kolb, 2013) where the relational bonds (Tomlinson, 2017) are created for the graduates, offering value to promote learning concerning care, trust, and commitment. When industry speakers come to the university to deliver speeches and their sharing (industry-related, company-related and personal), the university environment becomes the network space to encourage interactions based on the 'logic of professional expectations' while the lecture theatres and conference rooms are the social space based on the 'logic of sociability and social expectations' (Huggins, 2010) where the speaker, the students and the university staff can socialise with each other to make new contacts and personal touch. The same concept can be applied to the mentorship activities organised by the department if speakers are company representatives, whereas alumni speakers are more inclined towards the latter's logic of socialising purposes to interact and support the junior classmates through personal sharing of feelings, thoughts, and experiences like some interview tips and aptitude tests which are usually required in the recruitment process by many large firms. According to Luthans et al. (1998), networking is individual and goal-directed behaviour, aiming for seeking information benefits in "access, timing, and referrals"

(Nahapiet and Ghoshal, 1998, 252) when the 'know-whom' is valued almost as much as the 'know how'.

If the company visits are led by a teacher or university staff, the company sites are treated as the network space where both university staff and students conduct the visit as a group. Per teacher PLT-B's course arrangement, all student groups need to set up the appointment and conduct the individual group visit to interview the company representative, seeking for some industry information and professional advice, turning the company office into a social space. When the student group's visit is viewed as a personal visit as a form of social capital, the role of company representatives acts as the senior mentor, showing more caring to the students; though in parallel, the senior executives can also show interest to know more about the current university students who are possibly the potential staff in the future. In this sense, the calculative ties (Huggins et al., 2012) can be present in the social space in targeted networking activities. Therefore, the theory of social capital and network capital in terms of the relationship between the university and the industry are dynamic concepts and can be co-existed with the participants and in place-bound environments. The above may be characterised by the nature of the entities and the compositions of participants but both parties cannot be coming from the same kind of entity or the same type of person's role.

## 5.4 Classroom practices and authenticity

### 5.4.1 Applied practical practices and knowledge structures

The centrality of IT discipline is applied and practical and the practice-led teachers leverage their industry experience to customise the course teaching materials and offer experience sharing when teaching the applied practices. That is surely practical, for instance, using concrete examples in their previous jobs, like the trade-offs in the decision-making process, and the deployment of one technology (e.g., AI) in different industry sectors. Concrete

examples can be some actual technological applications in compliance with the regulatory guidelines (e.g., GDPR) set by the industry's statutory bodies. When practice-led teachers use concrete examples or practices to inform the students, they are sharing their first-hand experiences and those are lived experiences, such as what can be done and what cannot be done in the workplace.

In terms of educational authenticity, the teachers focus on the criteria of relevance and meaningfulness for the students in their learning process. Based on the concept of knowledge structures (Kinchin et al, 2008) for expertise development, practice-led teachers can dialogically explain how to apply expert knowledge through the visible chains of practice that involve the networks of understanding for the students. When expert knowledge is defined as an integrated framework of understanding, the teachers can still hold the expert knowledge structures though they may lose the expertise (know-how) for not practising anymore (Dreyfus and Dreyfus 1986; Kinchin et al., 2008). Sharing the work code of practice, like the collection of user requirements for project delivery, involves a deeper understanding of the consequences of not doing properly whose criticality can determine the success or failure of the IT project. It shows that the teachers' sharing of applied practices is the authentic experience derived from those they had gone through their process of judgement formation and meaning-making (Splitter, 2009) and they are now trying to convey the actual meanings and impart the knowledge to the students through the verbal expressions and communications; however, teacher PLT-B said that he is not sure whether his explanations are useful for the students.

Tacit knowledge is the 'black box of intuition' (Kinchin et al., 2008) but tacit knowledge and intuition are the critical features of professional expertise (Dreyfus and Dreyfus, 1986; Eraut, 1994). The practice-led teachers, the role of IT practitioners or experts, can exercise the "intuitive grasp of situations based on a deep tacit understanding" (Kinchin et al., 2008, 316) and hence, their students possibly may not be able to sense the meanings if they perceive the teachers' explanation as 'conceptual submarine' (Perkins, 2006). However, Hoffman

and Lintern (2006) interpret this phenomenon as the experts simply lacking 'tools and vocabulary' in explanation.

For teacher PLT-E, the focus of teaching pedagogy in all the lectures is applied practices; that means, he is modelling the applied practices in the real world whenever he delivered the lecture to the students, leading to the discovery of two outstanding student groups whose learning efforts have exceeded his expectations. The format of the group projects was research-based in loose-setting questions, requiring the students to find out the actual practices applied in the industry sector described in the assignments. In the banking technology assignment, one student group discovered the mobile login offered by one of the three banks, which could be located only when the students tried to go through the process as a bank customer, implying that extra research effort was made by the student group. In the data security assignment, one student group also invested extra time and effort to find out the exact coding of codes that caused the data breach incident of a national bank. These two student groups demonstrated their strong self-initiations to deliver the group projects with excellence, not limiting themselves to the project scope written on the assignment; therefore, they were rewarded by having applause after the presentation as well as obtaining higher grades in the project marking. It is quite certain that some of the teacher PLT-E students have gone through the process of self-reflection on what was taught in the classes. In the USEM model of employability, it is observed that applied practices derived from the teachers' authentic experience, can influence the students' understanding (U), self-efficacy (E), and metacognition (M) through instruction, supported by the student's own reflection, judgement, and meaning-making, see Figure 5.3.

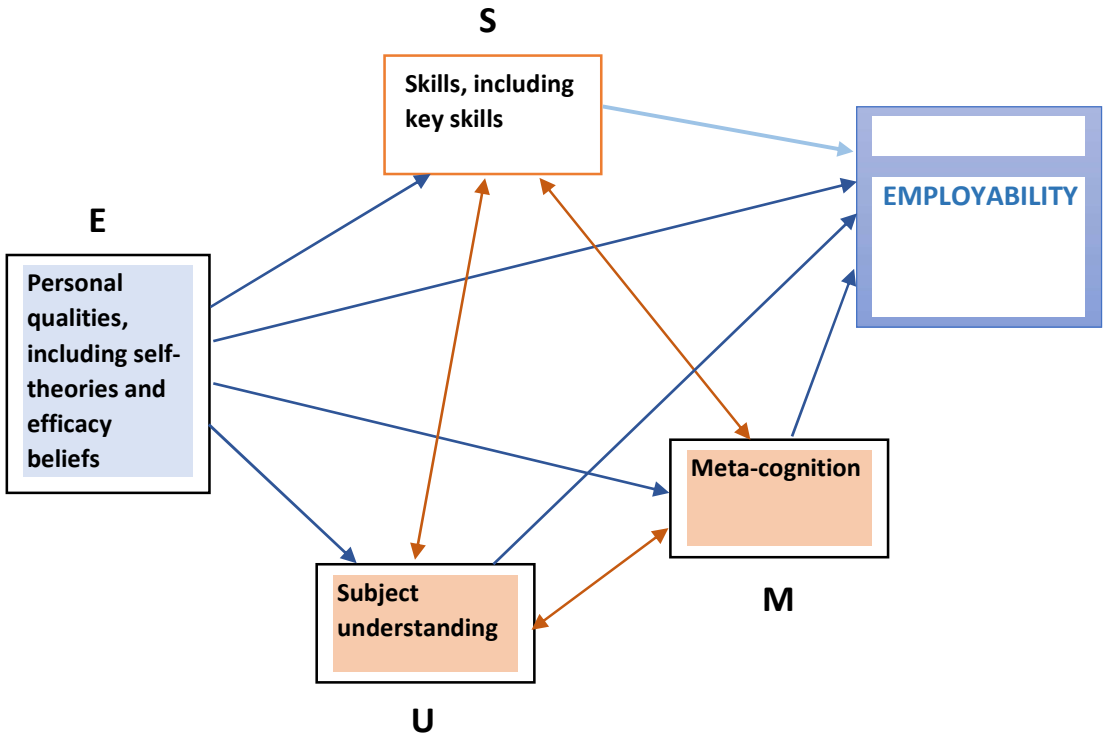


*Figure 5.3: The USEM Model – Applied practices promote U, E and M in the student learning through teacher's authentic experience*

### 5.4.2 Lab practices, closer to the industry, and work-integrated learning (WIL)

The practice-led teachers are all IT practitioners and recognise the contextual barriers (Tomlinson, 2017) between the lab practices in university and the industry practices. Hence, they do not treat lab practices as industry practices for the students, but rather focus the resources and efforts on setting up the learning environment in the lab as an ideal live while following the latest technology development. The lab environment set-ups by the teachers in this study are all designed as very close to the industry, achieving the close integration between university learning and professional practice and applications (Smith, 2012) for the students to do practical practices, thus enhancing their competency. However, these practical practices, including the practices on what is performed at the customer site, cannot be regarded as industry practices. It is indicated that practice-led teachers do not consider incorporating authentic work practices in the course design for students' learning.

In terms of curriculum development, they are trying to combine the practical aspect with the supervised practices to become work-integrated learning (WIL), used for integrating theories learned in lectures with workplace practices (Patrick et al., 2008) for the learning of disciplinary knowledge and skills in a real-world context. The purpose of the practice settings is to achieve relevance to their academic degree programme and also their future occupational needs, preparing the work-ready of the graduates (Orrell, 2004) as well as increasing their productivity gains in their jobs (Yorke, 2006).

As teachers PLT-A and PLT-B expected in the lab practices, the students are required to develop the application according to their design model. For the latter, the students are further required to understand the origins of technicality through different scenario settings in the lab, but without the industry's complexity. Based on the above teaching pedagogy, it is not regarded as instructional learning. The students are free to decide how to do; once their design is completed, they can perform their tasks; in the latter case, the students need to learn about the communication technologies and the protocols between different network nodes and therefore, they are free to plug and unplug between different types of devices to deepen their learning in the labs. Given the above learning settings, it is observed that they can construct their learning, knowing, and meaning in the labs and thus, the student learning does not require validation from the real world (Splitter, 2009) whilst their learning can be authentic. That is why teacher PLT-B reiterates repeatedly that he posits his teaching approach as a first principle, not expecting the students' learning confined to the industry's output as a product because learning a product can easily make the students miss something in their learning. Similarly, as teacher PLT-A said, provided that the students can develop the functional application, they have caught the understanding. The viewpoints from both teachers are consistent with that of Splitter (2009, 139), who believes that learning for knowing and meaning-making "does not depend upon any kind of fixed correspondence with the "real world" out there" because there "exists something unknown to people or even cannot figure in any account of knowledge in the world".

### 5.4.3 First principle's teaching approach, knowledge structures and educational authenticity

The criticality of teaching the first principle, as advocated by teacher PLT-B, is to focus on the foundational knowledge and the logic of thinking in student learning, also applicable to skills learning. Teaching programming language skills, he requests for covering the topics on the differences between different programming languages, the trade-offs when using one language over the other, in terms of easier to program, faster to program, more efficient in running the applications and so forth. In terms of knowledge structures, the first principle's teaching approach starts with teaching the networks of understanding to the students. Expertise is described as an individual's ability to navigate between underlying networks of understanding and chains of contextual practice (Kinchin et al., 2008, 319-322), but the crux rests on the person, who needs to be capable of moving "from linear [text] structure to a hierarchical [psychological] structure and back again" as it is the fundamental educational problem identified by Novak and Symington (1982). It is the rationale that can help to explain why the teacher insists on teaching the foundational knowledge, rejecting the vocational training in university as the learning is 'linear in structure' (de Cossart and Fish, 2005) and this kind of learning can easily "miss the target by miles". In addition, the teacher also disagrees with product training in university education because of "isolated chains of practice", which can hinder the student's ability to make informed choices in future due to the possible issue of 'broken stories' (Stronach et al., 2002) experienced by the graduates.

The first principle for teaching and learning can be regarded as the educational authenticity for knowledge construction as proposed by Splitter (2009, 140-141), who emphasises that the students have to be truly thinkers who learn without the need to go via the real world. When the students can internalise the skills and dispositions they learned, they can examine, test, deliberate over, and think hard in the learning process, representing that they can, at least, accept what they learned as "the (tentative) outcome of their own inquiry" as scientific knowledge in its own right. It becomes clear that the first principle's teaching approach places the learning in its original form without complexities, whose

learning can become self-sustained objects without dependence on other learning, enabling the notion of encapsulation (Tall et al., 2000). Even for programming languages, IT students should learn more than one programming language as IT systems need to allow access from different channels or other systems through the system interface, denoting the importance of programming languages' independence (Miller et. al., 2010). Each language has its logic of programming, meaning that learning one of them is just knowing one type of logic only. So, competent programmers are those capable of multiple languages and know the trade-offs when selecting the appropriate language in developing the system application; and that is echoed by the expression of teacher PLT-E, those IT graduates learn one more of the programming languages, in addition to those learned by other students, can stand out from the crowd in front of the employers.

### 5.4.4 Vocational training approach and the implication in cognitive authenticity

Teacher PLT-C plans for vocational training in the course by comparing the university to a football training school. He is assumed that those students chosen the elective course can indicate their interest in the subject area, for training them to learn the course to get a job is the logical motive. In the lab sessions, it is learned that the students were unable to follow through with the lab assignments because they did not know how to pick the option if more than one option was shown in some of the steps or tasks before moving on to the next step; that is regarded as associative learning (Bower and Hilgard, 1981). In some cases, some students did not listen to the class instructions when initiating the system program in the lab and were required to re-do the initiation so that the system environment for practices could be ready on their computers in the lab. During the practical lab examination, one-sixth of the students repeated the same kind of mistakes made in the lab exercises, implying that the students could not internalise what have been learned in the labs, even not have the process of self-reflection on what had been done wrongly in the previous lab sessions. Cummings and Maxwell (1999) criticise that in many educational practices, if the teachers

cannot internalise the underlying beliefs, the learning assessments are not truly authentic, too.

In this study, it is clear that teacher PLT-C wanted to prepare the authentic learning environment in lab sessions or workplace-situated learning (Smith, 2012), with the authentic assessment (Gielen et al., 2003; Gulikers et al., 2004) as practical lab examination. The teacher is the domain expert in the course subject, possessing the domain's PhD qualification and in-depth industry experience, the problem encountered by him can be viewed as the issue of "pre-authentication" (Petraglia, 1998) without taking proper consideration of the student learning, possibly due to the skills possessed by him has become part of him, largely automatic and non-reflective (Kinchin et al, 2008). Besides, the students expressed negative comments in the course evaluation in terms of heavy workloads and very demanding learning requirements. Both feedbacks can signal some inappropriate expectations set for the students in the course and the vocational training approach taken in the course is not matching some of the student learning styles. To be fair, per the class observation conducted for his class, the students were enjoying the course as the student groups' project presentation could reflect their efforts in doing research and technical development and they were trying hard to answer the teaching team's tough questions during the Q&A session.

The practicality of teaching pedagogy is the focus of this study, and it is important to review the design of the lab assignments. The real IT project case previously successfully delivered is now disaggregated into steps or tasks to become lab exercises, for the students learn to follow the logical steps to complete the tasks as the actual tasks at the customer site. According to the teacher, the students are required to pick a choice in some of the steps, and that can be interpreted as integrative learning (Smith, 2012), but some students do not know how to do the selection because of insufficient knowledge. If one step cannot be done properly, the student cannot move on to continue the lab exercise unless that step is completed. Based on these two scenarios, those steps and tasks are interrelated and sequential because each step or task requires the students to take technically cognitive

action or cognitive authenticity (Herrington and Herrington, 2006) for completion, not simply a step. So, those students attending the course are presumably possessed some prior related knowledge and such expectation is mentioned by the teacher who does describe it as the pre-requisite in the course.

### 5.4.5 The role of absorptive capacity in learning IT domain knowledge and skills

For IT domain knowledge and skills, it is pivotal for the learners to possess some related prior knowledge as absorptive capacity (Cohen and Levinthal, 1990) as it can support the knowledge and knowing capability in the learning of professional practices (Nahapiet and Ghoshal, 1998); in this study, it refers to the students in acquiring applied practices and practical practices in IT discipline. Concerning these practices, the role of related prior knowledge can be served as the pre-condition of innovative capability for the students, who are, in parallel, required to possess the ability to evaluate and utilise outside knowledge (Cohen and Levinthal, 1990). That is to say, the students need to rely on some of their prior knowledge acquired or the teacher's teaching to do some self-reflection before they can do the practice.

IT discipline is applied and practical and most of the IT knowledge and skills acquired are for problem-solving. Leveraging the system concept, IT systems need to first capture the inputs and then deliver the results or outputs through the system processing. Under this notion, the possible issues or risks of pouring insert knowledge on students or subverting their constructive learning process (Splitter, 2009) as imposed by the practice-led teachers are highly unlikely. On the contrary, the knowledge and skills imparted by the teachers as the prior related knowledge upon the students can accelerate their understanding, support their decision making and further enhance their self-reflection in the learning of the subject matters when practising the practices. When these practices are practised on some real problems in the lectures or the labs, it is valuable for the students to make mistakes freely

or have a chance to re-do and correct the errors; as what teacher PLT-F said, some kinds of learning are required to be done wrongly for several times before the graduates can get to it finally.

In work-integrated learning, there is an elective course on consulting projects mentioned by teacher PLT-D that the course's pre-requisite requirement is prior participation in the summer internship. This kind of light-weighted consulting project practice can allow the students to have the chance to perform the feasibility study and then submit some recommendations to the company. All these learning opportunities for students, both in university and beyond, are highly valuable in the student learning process; as Smith and Worsfold (2015, 37) observed, it "may help the individual to develop self-efficacy or confidence both as a student (where pertinent learning occurs) and as a practitioner (where useful outcomes or products are generated for the client)". The above can be regarded as the self-efficacy and self-theories (E) in the USEM model of employability (Figure 5.2). But in the workplace, many mistakes are unacceptable, such as the scenario of missing a zero digit as emphasised by teacher PLT-D, for example, 1,000 versus 10,000 in the financial statement, that can become a disaster. Therefore, if the students can develop more malleable self-efficacies in the university environment, they can discover their strengths and weaknesses to build up their strong sense of self-awareness supporting their employability in the longer run.

## 5.5 Authentic pedagogy, student project presentations and learning-driven

### 5.5.1 Classroom community of disciplinary inquiry on intellectual disciplinary works

The class observations are designed for understanding practice-led teaching in promoting the classroom community of disciplinary inquiry (Splitter, 2009) and the observations were conducted at the time when students presented their projects, all of which were group projects except for one teacher whose students presented an individual project. The Q&A sessions are interactive dialogues between the students and the teacher, sometimes involving some fellow classmates, that is, it is a learning-driven approach driven by the project work prepared by the students who proactively answer the teacher's questions for the sake of earning more marks through elaborating and defending their standpoints. Therefore, it is staging the most authentic moments during the teaching and learning process and that can be regarded as situated class observations. As the project presentations were arranged in the last lesson of the course, all the students possessed some knowledge about the subject matter and thus, the disciplinary inquiry is deemed to be reflective for the students. Disciplinary inquiry in a constructivist curriculum is the authentic pedagogy to require the students to conduct a structured collaborative inquiry with their peers, in addition to mastering and applying the disciplinary tools (Newmann et al., 1991, 1996); whereas Splitter (2009) demands the learning environment to promote the students to become truly thinkers and reflective inquirers. Through authentic engagement in the learning process, the discipline-based knowledge construction and interactive inquiry turn out to be meaningful and fulfilling to the students.

For the class observations on project presentations, those delivered by the students can act as a way of articulating the intellectual disciplinary works completed by them either as group work or individual basis, used for demonstrating their understanding of the course subject in form of their 'authentic' work constructed between university learning and the perceived application in the field. The scope of student projects delivered covers the latest development of technology-oriented applications, enhanced security risk assessment applications and tools, a framework-based project management plan for an application development project in a chosen company, and technology-enabled business application projects. The design of all the group assignments and individual projects is open-ended, the topics given by the teachers are just a few words, like bitcoin technology, e-wallet, project management plan, best practices on internet banking and so on; and the students are free

to decide the breadth and the depth in the project, and free to choose the field or a company that they are interested in. In other words, those students presenting the project are more knowledgeable than the teacher about the projects. Both parties are communicating dialogically to inquiry about the application of the disciplinary subject area bounded by the project work chosen by the students; therefore, the students observed in the study are all engaged learners (Splitter, 2009) as one teacher said, his role as a teacher is a good listener and facilitator.

### 5.5.2 Authentic learning environment, learner-driven, and reflective thinkers

For teacher PLT-B, he intended to let all the students have a better understanding of one technology through the student projects and thus, having two students work on two different topics but on the same technology while all other students are free to choose the topic they like. To achieve this, he created a learning environment in the class where, after the two individual presentations were delivered, he told the class to discuss the two projects together; through the very basic question, what is the difference between (……..) one student gave his answer, but the other student said, "I don't agree with you". When the student stated the difference, the answer surely touched a part of the other student's project work, making that student react to it. Both students became reflective thinkers, and their classmates might be, too. The learning environment during the class presentation is learning-driven (Brown and Long, 2006) in a shared space (Kolb and Kolb, 2008, 2013), open and trust, as the teacher's questions are not serving for judging the student presentations; instead, the learning environment is intellectually competitive as the student presenters need to negotiate their meaning and understanding and to persuade their teacher, the other competing student, and their classmates to accept their answer.

In addition, two student project presentations could attract some dialogic conversations between the student presenter and their classmates because, when the student presenters were trying to apply the technology in real-life situations, they successfully aroused the interest of their classmates, triggering their higher level of thinking and self-reflection. The

authentic moments of classmates' self-reflections are revealed as they asked, "do we really need the third tunnel as we have two road tunnels already?", and "When can I have the investment if …….?". When more students are engaged and reflective in the class, it demonstrates that teacher PLT-B's class can promote educational authentic learning for the students, which is very meaningful and fulfilling to the learners whose authentic learning is not required to go via the "real world" (Splitter, 2009).

### 5.5.3 Probing questions, student reflections, and weaknesses in technical concepts

In terms of student understanding of the subject matter of the course, according to the approach of authentic intellectual work, Newmann (1991) and Saye et al. (2018, 866) expect that teaching can be effective if the teachers can support cognitive autonomy to encourage the students to generate the solutions that can be meaningfully applied to solve the problems outside the classroom, as well as, can "pose challenging questions and press students to justify their answers with evidence". Whilst for Splitter (2009, 142), reminds us that "inquiry-based teaching is not context-free" and it is the job of the teachers to provide the appropriate contexts in the classes.

As mentioned earlier, all the student projects were required to show the application elements to demonstrate their understanding of learning. Reviewing the questions asked by the teachers, most of them were probing questions and some were framed in scenario-setting to require the students to give elaborations, explanations, and comparisons. The tough questions were those demanding their deeper thinking and understanding in terms of deployment, feasibility, and effectiveness of the solutions proposed in their projects. During the interactive looping of questions and answers, the students can go through their reflective process; this process is deemed to be effective because they have learned the subject matter in the course and the project work was delivered by themselves, though their answers based on their reflective learning outcome may or may not be effective as

that would request an additional level of verification but this part is not the focus in this study. In those group projects, the teachers can assess the understanding of the students based on their reasonings and justifications given during the disciplinary inquiry process. However, it is found that the students are rather weak in applying the technical concepts taught in classes in their projects; such weakness could be observed in the classes of teachers PLT-B, PLT-C and PLT-D in particular. Both teachers PLT-B and PLT-C cited the exact technical term and asked the students to give the answers, and PLT-B even tried to recall the student's memory on which part of the course the term was taught, but the students in both classes could not answer it.

### 5.5.4 Learning the subtle contextual difference in words and different perspectives on project management

All the group presentations in the class of teacher PLT-D were project management projects, and the students must understand the exact meaning of the knowledge areas stated in the project management framework, which forms part of the requirements for pursuing the professional certification. In the course of work, it is very common for IT staff to be involved in some parts of different IT projects as described by PLT-D and PLT-E, while the latter said that all companies need to have good project managers. Examining the disciplinary inquiry in project management project presentations, teacher PLT-D identified the weaknesses in the group presentations and picked up the knowledge areas for questioning, including time management, quality management, scope management and cost management. In this study, it is worth discussing time and quality in more detail in this section. For project time management, the teacher picked up the criticality of 'date', which represents a project milestone in the project task schedule, implying a trade-off existed between time and quality. For project quality management, the teacher tried to articulate the subtle difference in those meanings between 'security versus reliability', 'reliability versus app bugs' and 'problem versus risk'. To a certain extent, the pair of words look similar and sometimes can be used interchangeably. But when applying it in the context of IT project planning and implementation, each of these words is unique in its meaning and the subtle

difference must be known by all IT practitioners. That is the reason why these knowledge areas are formed as the body of knowledge in the project management framework. There was one simple statement made by teacher PLT-D when replying to the student group, *"If the function is not working, it's not a function"*. It is a very powerful statement to demonstrate that university education does need to put effort into educating the students on the basics before imposing any practical learning for the students, and those basics are merely on knowledge itself.

Based on the student survey results, many students enjoyed the project management course as they said to have good learning and showed appreciation to the teacher while indicating great interest to do IT projects after graduation, as well as, aspiring to be a project manager in the future. In the work of Reich and Nelson (2003, 42), they realise that the CIOs treasure the "project management standards, a common set of practices upon which they manage projects". One CIO said that his company does not hire any project manager without project management certification whilst having it, "that doesn't make them excellent either, but at least it tells me that they understand the concepts that we're going to be challenging them on". Project management certification is relatively more general, not regarded as the type of certification that Bailey and Stefaniak (2001, 98) describe as "a niche with a specific technology" or "highly specific skills". Hence, it is the preferred option of CIOs to "use people with company-specific knowledge to run their projects and give their people a reason to stay" (Reich and Nelson, 2003, 42). Drawing from the student survey results, they showed that there were 46% of students had a clear timeline to pursue the project management certification while another 36% of students did not know when they will go for it; implying that it is not an easy decision.

## 5.6 Knowledge retention and transferability

### 5.6.1 Intellectual capital and encapsulation

Knowledge is the most powerful engine of production (Marshall, 1965) whereas intellectual capital is regarded as a pivotal resource, driving economic development and growth (Stewart, 1997; Florida and Cohen, 1999); once applied, intellectual capital refers to the "knowledge and knowing capability" of professional practices, which are "socially and contextually embedded" (Nahapiet and Ghoshal, 1998, 245, 246) in this study. Knowledge is considered an object (Polanyi, 2009; Newmann et al., 1996; Nahapiet and Ghoshal, 1998) and "knowing as action or enactment", which can be actively "shaping of experience performed in the pursuit of knowledge" (Nahapiet and Ghoshal, 1998, 245; Polanyi, 2009; Splitter, 2009). The conceptual encapsulation explains how the learners can transform the learning, such as an action, task or operation into self-sustained objects or entities during the learning process. Piaget's notions of abstraction help to justify how the learning pieces are constructed into platonic objects through higher-level reflective abstraction, that is, an action or operation can be converted to thematized objects of thought or assimilation through abstraction. Dubinsky et al. (1988) claim that the transformation process does not destroy the physical object and recognises the concept of permanent objects by agreeing that an individual is capable of taking control of repeatable action.

The work of Tall et al. (2000) can give some insights into teaching and learning as the learning pieces can be protected during transformation and the learners can manage to control and repeat the action; by common sense, it denotes the notion of re-useability. If the students can transform and protect the learning pieces and have them become self-contained encapsulated objects in the state of portability, turned into high-level abstraction objects in the student's mind, that can imply that learning in university is transferable to the workplace environment. However, the most critical stage within the encapsulation concept is to make sure that reification (Sfard, 1994) is performed in the learner's brain before he or she can learn all the above in the learning process. Reification represents the transition from an operational to a structural mode of thinking in learning, and Sfard (1994) introduces the considerations of meaning and understanding which can be used to explain how reification is taken place. Once the operation of the reification process is understood, teachers can have better ideas for supporting student learning; and reification is influenced by two schools of thought, the objectivist approach versus the constructivist approach. The

former treats meaning as the relationship between symbols and the real world without the interference of the human mind, while the latter considers meaning to be conferred through the understanding of the learner.

IT theories and concepts are defined as different sets of well-designed frameworks, well-defined protocols, and industry standards; that can be deemed to form the bodies of knowledge in the IT discipline. In IT degree courses, every IT concept and term denotes a set of well-defined rules and meaning that IT students need to learn about the rules, industry standards and technical interpretations before they can apply the theories to come up the technical solutions in solving the problems. In this sense, the objectivist approach in reification should be adopted by IT students when learning IT theories and concepts whereas the constructivist approach in reification can be taken place when designing technical solutions to solve IT problems. If the above can depict the learning approaches and patterns in IT knowledge and skills, what are the implications for the teachers? We need to explore what are the teaching methods and tools deployed by practice-led teachers in IT degree courses.

### 5.6.2 Case-based learning scenarios and forward reasoning

In the study, practice-led teachers come up with different teaching methods and tools to inform their professional experience through teaching, comprised of scenario-based, case-based, concrete examples, and analogy, which can be used in combination by the teachers during teaching. In the lectures, when an industry-based case study, such as an aviation project, is used to illustrate how artificial intelligence works in the real world, different scenarios can be constructed to frame different possible situations for the sake of stimulating the students to generate different alternative solutions. The overall understanding of the technology and the industry cannot be confined to any single scenario because the real world can turn up many possible scenarios. The value of the practice-led teachers is not accounted for listing out all the possible scenarios to the students because it is unrealistic but rather, they can facilitate the students to look at the issues from multiple

perspectives and learn how to justify the practical solution on each of the possible scenarios derived by them.

Leveraging their professional experience in the field, directly involved in previous or even current IT projects, the teachers can make use the real-life scenarios to illustrate the relevance and appropriateness under the conditions. This rationale can be supported by their lived experience working in the field, and it is asserted that each of them had gone through the reflection process when assessing different issues and situations in the IT field, thus possessing relevant experience in tackling different challenges. The relevance of their experience can probably include the live cases of successes and failures (their own, other colleagues, or the competitors) that they came across at work because they possess industry experience ranging from 18 to 35 years in the field. Accumulating the sets of concrete examples in the jobs, they are ready to share the lived experience with the students and can explain to them what, how and why. The uniqueness is that they can flexibly pick any concrete examples to respond to students' questions without the need for any pre-determined answers since the courses for professional practices taught by them do not have textbooks and they need to develop the course materials by themselves. The scenario-based explanation can be viewed as an agile teaching tool, that can quickly help to clarify those stuck in the middle of the learning process when some students cannot understand what's taught in the class; however, it is pretty contextual that for effective teaching and learning, the teachers should use more than one scenario to illustrate the point to the students to trigger their self-reflection for better understanding. When case studies and concrete examples are used for explaining the current problems and applying what they have learned, it can be interpreted as forward reasoning learning experiences for the students (Bevins et al., 2012).

### 5.6.3 Scenario-based learning in lab practices, backward reasoning for real data sets

Practical lab sessions deploy scenario-based settings for student learning but with different approaches. Those scenario settings are ranged from technology-oriented without industry complexities, real data sets from the industry to embedded work practices. Embedded work practices have been discussed in detail in the earlier part and thus, this section focuses on discussing the first two types of practices. The scenario settings purely technology-based can facilitate the student's understanding of the compositions of IT network infrastructure, from which how different sets of machines, equipment and devices are communicating with each other in the practical lab environment, which can be served for reinforcing the students' theoretical learning previously taught in lectures. When the learning rests on the originality of the theoretical stand, it becomes a self-contained entity, portable and reusable, being described as an ideal live of the real environment, as well as, very close to the industry though not the same. Learning how to design and develop an application to tackle certain actual problems is not easy; when real data sets are deployed as teaching tools, it is invaluable for student learning because the complexities embedded in the data set are real and existed that the students can have the chances to 'touch' the complexities and learn how to solve the real-life problems; this approach can be viewed as backward reasoning problem-based learning, which is more difficult (Bevins et al., 2012). Strictly speaking, real-life complexities can never be intimidating and hence, practice-led teachers are highly appreciative to make real data sets as the learning tool because real data sets can help to train up the malleability of the students. Once the students can solve the real issue and come up with a solution, they show their understanding and are confident to tackle similar problems in the future when they encounter them. Hence, it is very effective to enhance the self-theories of the students, the self-efficacy (E) of the USEM model (Figure 5.2) and the psychological capital as a form of graduate capital.

## 5.7 Teaching and learning in IT discipline

### 5.7.1 Students' proficiency is more than skills

The topic of student proficiency seems to be referred to skill-oriented requirements; but in this study, the first principle's teaching approach focuses on student's learning foundational knowledge, which is not contradictory with what teacher PLT-E to advocate for students' proficiency at work because the latter refers it to promoting students' understanding on the dual role of IT in the technology-enabled sector while the application side of IT is more on supporting the business growth. Except for the primary IT sector of technology vendors, the role of IT staff in the secondary IT sector takes priorities on offering support to the business and the operations, such as customer relationship management system, banking systems and connection to suppliers' portals, all of these having direct linkages in running the businesses. Hence, IT departments and the staff nowadays are no longer treated as the cost centre in most companies and this observation is consistent with the study results obtained from Reich and Nelson's (2003) work. In terms of all IT system implementation projects, IT project staff are required to coordinate with the business users to collect the user requirements, implying that knowing some business knowledge is a part of IT jobs. Proficiency, in this sense, can be regarded as the knowledge and skills required to make the working process run smoothly when dealing with business users, collecting the relevant user requirements, turning the requirements into technical specifications of the new IT systems and so the upcoming user acceptance tests before the new system launch.

During the group project presentations, teacher PLT-D was concerned about one student group's understanding of change control in project quality management and thus, indicating clearly to the student group in the class, *"we can't unconditionally allow the customer to make changes"*. The question is why the agreed project scope stated in the project plan can be changed, it is largely requested by the business user group the sponsor of the new IT system. When the agreed project scope is changed, the system requirements need to make the corresponding changes accordingly. Why do the system requirements need to be revised, the common problem is about the user requirement specifications are not able to reflect the user requirements accurately. Here comes the big question: why is there a discrepancy? That is the reason why it is part of the best practices shared by the teacher, telling the students to have the habit to write down the user requirements every time they met and then asking them to confirm what has been written down, even point form is

sufficient if running out of time. The teacher elaborates further that it is not because of worrying the users to change the requirements afterwards but more importantly, needs to confirm the understanding of the user requirements to be accurate as a project team member responsible for this project task.

### 5.7.2 Challenges in teaching and learning

Based on the feedback from the practice-led teachers, their challenges in teaching and learning are mainly due to the nature of knowledge, students' mindsets and learning attitudes and the fast pace of industry changes. The advanced level of IT knowledge and skills is rather difficult for the students to learn because the learning requires the students to possess some prior working experience or demands them to have a high level of abstraction for understanding. Not all the students have joined the summer internship or one-year placement programme and thus, for those not, their learning is very much reliant on the teachers. Even for the students who possess some working experience, the mindsets of some students may not be mature enough to understand advanced IT knowledge like corporate governance and leadership skills. One teacher tries to use an analogy in helping the students to understand a principle or an idea whereas the selection of analogous things is necessary to be stuck to those the students are familiar with.

Cohen and Levinthal (1990, 130) argue that the approach to improve the learning capabilities of learners relies very much on the "development of the capacity to assimilate existing knowledge". For learning capabilities and problem-solving skills to have a similar mode of development, teachers may consider teaching the students through 'analogy-to-example' and if the students can understand how these examples are worked, such capabilities can also determine their success in developing new solutions (Pirolli and Anderson, 1985). It is observed that the possession of some related prior knowledge as the absorptive capacity (Cohen and Levinthal, 1990) can increase the students' creativity by associating and linking to those they had never considered before. Harlow's (1959) concept of learning sets can explain why the behavioural phenomenon of "insight" (Ellis, 1965, 35)

typically refers to the "rapid solution of a problem" (Cohen and Levinthal, 1990, 131). However, there are two conditions to be met: the examples relevant to the prior knowledge acquired need to be processed more deeply in the associations (Lindsay and Norman, 1977) and the capability in solving problems can be accumulated by practising more trials on related problems (Cohen and Levinthal, 1990).

Accordingly, the practice-led teachers' teaching approach should create strong associations between the concrete examples or scenarios they are quoted in the classes and practical labs, either by dialogic communications or by doing some exercises, while those examples and scenarios should be varied in multiple contexts (Bjork et al., 1989), for instance, teacher PLT-A illustrating the use of AI applications in the aviation industry and railway industry, to promote the students' understanding and their higher level of abstraction for reflection. In addition, teachers can consider using myths, stories, and metaphors to articulate the rich sets of meanings (Clark, 1972) for student learning. It is understood that metaphors can cut across different contexts by combining imaginative and literal observations with cognitions (Bateson, 1972) while storytelling is a very powerful narrative tool in the exchange process of practice and tacit experience between technicians, leading to the improved practices in solving the problems (Orr, 1990).

Improving the students' mindset in learning is the most difficult undertaking among all kinds of teaching, but this aspect is much required in those applied and practical subjects like IT whose charter is for solving problems in the real world and improving the lives of people. In this study, half of the teachers express concerns about 'not less' students who are very result-oriented, and learning is secondary to getting high grades on the transcript. In other words, their learning is mainly focused on those course contents more likely to be examined and they select the elective courses largely based on the level of easiness for them to get good marks and high grades. These students are seen to have fixed beliefs and are less persistent in taking on challenging or risky tasks and trying to avoid any failures (Dweck, 1999). It is the common understanding that working in top-tier organisations like investment banks and the 'big four', the four global accounting firms, are the ideal jobs for

many IT students. It is good for those students who are self-motivated to plan for their graduate job, but they may be relatively short-sighted or criticised as having 'a blinkered view of higher education' (Kinchin et al., 2008) when taking the exam-oriented approach to university learning. Having an outstanding degree transcript should be advantageous for them to get a job from those privileged firms, but the path to graduate employability is not as easy as it will be. However, self-efficacy is malleable through positive interventions. It is valuable for the teachers to motivate the students to learn something challenging, and to create a learning environment to accommodate making mistakes and allow corrections; in this aspect, teacher PLT-C is doing well to support the student's learning in the lab practices.

Due to the essence of interdependence between the IT industry and teaching, when the IT industry is kept innovating and advancing, the practice-led teaching approach is demanded to have some correspondence. As teachers PLT-A and PLT-C are conducting the teaching related to the latest technology development and the corresponding IT security, both have properly addressed the needs by having up-to-date materials for lab practices as well as reviewing and updating the course materials after every academic year.

## 5.8 Conclusion

All the practice-led teachers in this study possess similar kind of academic qualifications in terms of technicality and industry experience to deal with information technology, and thus holding IT domain-specific knowledge and skills. Besides, they possess strong human capital in IT discipline and good social standing in professional communities of practice (Lave and Wenger, 1991), influenced by the accumulated social capital with relational assets which is not a separate dimension (Peeters et. al., 2019) but allocated across all categories of employability dimension, retained, and enhanced throughout their career journey across the IT field and the university teaching.

The teachers leverage their personal assets, derived from the network connections accumulated in their previous employment, to convert them to becoming the university's network capital in the forms of experiential learning events attended by university students who can experience and acquire the relationship and connection with industry speaker or company's spokesperson. All these experiential learning activities are embedded with the 'desired' calculative ties (Williamson, 1993; Huggins et al., 2012) with economic or noneconomic considerations because all parties are rational actors (Coleman, 1988). Hence, the success of the practice-led teachers, leveraging their social assets and network resources, can support the students to get closer to the labour market through 'bonding ties' (Tomlinson, 2017) with company representatives and industry speakers as these are potential employers in the future. In addition, the practice-led teachers can extend the teaching team to support the students by having external mentors like company representatives and external teaching assistants in lab exercises, and the work practice mentors like the work supervisors during industry placements, internships, and elective consulting project courses. As a whole, the practice-led teachers are the master of the applied practices and practical practices in university teaching, self-developing the course teaching materials embedded with industry knowledge and turning the course design into a co-curricular format.

In the practical labs, the teachers aim for developing the learning environment to be ideal live, with real data sets as a teaching tool, and closer to the industry, and that is good enough for the students to understand the application of theory into practice because the students can have the chances to make mistakes and correct them as well as to have self-reflections in the learning process whose learning can be regarded as self-efficacies (E) and metacognition (M) in the curriculum design presented under the USEM model of employability. The role of metacognition in the model is said to interact and promote the other two variables of understanding (U) and skills (S) in the model whereas self-efficacies can influence graduates' employability directly. As the lab practices are very close to the industry for professional practices though not resembling work practices, the teachers can conduct the teaching of IT knowledge and skills through the work-integrated learning

approach for the students but not the exact WIL theory as proposed by Smith (2012) and Smith and Worsfold (2015).

The student's learning experience can be deemed as an authentic experience in its own right because the students are engaged in the practices and self-reflected whose learning can be further supported and strengthened by the experience sharing and explanations by the practice-led teachers as first-hand experience. In addition, the disciplinary inquiry during the Q&A sessions after the student presentations is observed to be learner-driven by the project works prepared by the students as the authentic engagement and experience for the students, their fellow classmates, and the teacher because the students are engaged learners and reflective thinkers, including the competitive conversations between student presenters and the questions raised by their fellow classmates who related the presentations' subject matter to the reality. The practice-led teachers were mostly using probing questions, but some were very tough questions asking for a deeper understanding of the subject matter presented by the student groups. However, it is found that the students are weak in learning IT concepts. Although there were only a few questions in total asked by the teachers relating to the technical concepts taught in the courses, all those students kept silent, and no student was able to answer. Whilst in the project management course, all the questions raised after each student group presentation were those seeking the students' understanding of the contextual meaning of the keywords in the knowledge areas of the project management framework. Though there is a very subtle difference in those words, it is critical enough for the teacher to spend each of the Q&A sessions in 10 minutes with every student group and all those keywords or knowledge areas were picked up from what they presented in their group project.

Hence, the disciplinary inquiry conducted by the practice-led teachers is truly domain-specific knowledge, fostering the students to be truly reflective thinkers. As these Q&A sessions are trusted and committed, the teachers can support the students in tackling challenging questions with positive interventions. Based on this analysis, student learning during disciplinary inquiry is regarded as self-efficacy (E) and metacognition (M) in the USEM

model of employability, promoting the variables of understanding (U) and skills (S) in student learning. In terms of the notion of transferability, the practice-led teachers use concrete examples, case-based learning and scenario-based learning that can strengthen the understanding of the students, backed by their first-hand experience in explaining and considering the trade-offs in different decisions. Therefore, they can foster the students to become engaged and reflective thinkers, for high-level abstraction and reflection are the essences of the university graduates to transfer the knowledge and skills from the university education to the workplace, but being productive and knowledgeable in the subject matter is the key for a longer term of employability.

# CHAPTER 6 CONCLUSION

Within a globalised world, the interconnectedness between the economic and political levels would impose changes on the business and labour markets (Slaughter and Leslie, 1997) while the correspondence in higher education policies is seen as an organising principle (Stevenson and Tooms, 2010) between economic agenda and government policies, aiming for producing more knowledge workers (Tymon and Stumpf, 2003) who are more educated, capable of increasing the productivity gains (Farrell, 2003; Yorke, 2006) and can make contributions to the economic growth. In the new economy, the productivity gains are economic considerations, following the policy-oriented framework to create the relationship between new technology and productivity (Godin, 2004), leveraging new technologies as an internal engine to facilitate the structural economic change; and therefore, economic globalisation can drive for superior economic structure (Pohjola, 2002; Olssen et. al., 2004) in a global competitive knowledge-focused society (Hagen, 2002).

Under the global influence, the role of higher education is of increasing importance to provide support for economic growth and so do the growing impacts of teaching and learning on the labour market. The lack of Hong Kong context in this study shows that the universities are highly sensitive to the IT industry and market needs (Mok, 2000), adopting the market-oriented approach of governance and marketisation (Clark, 1983; Shin and Harman, 2009) to meet the needs of internationalisation where the higher education sector follows the trends of globalisation. This chapter summarises the key topics explored and concluded in this research study.

## 6.1 Practice-led teachers possess different forms of capital

Through the work of Benhabib and Spiegel (1994), it is confirmed that the growth of total factor productivity is a function of human capital and human capital is treated as the "significant input in the production of knowledge ideas" whilst "human beings with

knowledge produce more knowledge" (Mathur, 1999, 205). Influencing the development of human capital (Coleman, 1988), social capital is consisted of the assets and the networks (Bourdieu, 1986; Burt, 1992) in a web of social relationships, creating values in the development of intellectual capital (Nahapiet and Ghoshal, 1998). Hence, the concept of capital distinction can show the social relationships between human, social, network and intellectual capital; and that can help to explain why social capital is unable to be identified as separate dimensions but loaded on all dimensions of employability.

In this study, the practice-led teachers possess the forms of human, social, network, symbolic, and embodied capital, accumulated by their academic attainment in a technology discipline, their industry experiences and professional practices in the IT or technology-enabled sector; and further extended through the university teaching experience in IT discipline on the single continuum of their lived experiences. For now, they are helping IT degree students to create their work-related identity (Tomlinson, 2017) and pre-professional identity (Jackson, 2016) to develop their form of graduate capital on a single continuum starting from the university degree programme.

## 6.2 Behavioural competences are of growing importance to IT graduates

In the 21st century, economic globalisation drives the globalisation of trade in goods and services (McBurnie and Ziguras, 2001), including higher education as an industry under the framework of the General Agreement on Trade in Service (GATS) (Knight, 2002). Meanwhile, the massification of higher education is becoming a worldview phenomenon shown by the rapid increase of student enrolments in higher education as well as the emergence of academic mobility (Altbach et. al., 2009) with increasingly more international students, creating the possible impact of imbalance global workforce in supply and demand. In general, universities are regarded as the largest knowledge-based institutions (Moscardini et. al., 2022) and knowledge factories (Aronowitz, 2000) or academic factories (Jacoby,

2001) that it is the standard practice for policymakers to initiate the "government policy drivers" (Neary et. al., 2012, 53) to influence the supply of graduates and the occupational skills through the mechanism of government funding allocation.

The massified system of higher education can bring up the issue of an overcrowded graduate labour market (Anderson and Tomlinson, 2021), leading to the increasing pressures of credential inflation (Tomlinson, 2008) and the declining status of credentials. When a degree certificate is no longer a complete entry ticket to get a job, the graduates are required to strengthen their form of human capital to distinguish themselves from the other job seekers in the recruitment process. Employers are worried about the issues of knowledge being easily obsolete (Humburg et. al., 2013) and taking the consideration of competencies and interpersonal skills as the preferred selection criteria, though is criticised to create 'social magic' (Ingram and Allen, 2019). Therefore, it is suggested that graduates develop more behavioural competence (Tomlinson, 2008) to strengthen their personality package (Tomlinson, 2017).

## 6.3 New dimensions in IT jobs affecting teaching and learning

Surrounded by global and local pressures, the IT industry – consisting of the primary and secondary IT sectors – is facing its own sets of opportunities and challenges. Because of the fast-paced technological advancement, e-business is interpreted as the new business model (Higgin, 1999), pushing companies to transform into "digitally networked enterprise", heralding the new economy (Kettinger and Hackbarth, 2000, 78). Referening the global report published by The United Nations, it was estimated that "the global value of e-commerce sales (B2B and B2C) reached almost $26.7 trillion in 2019. This corresponded to about 30% of GDP and represented an increase of 4% from 2018 ($25.6 trillion)" (UNCTAD, 2020, 4). However, e-businesses can create a new dimension of risks in data fraud or theft and cyber-attacks, denoting that security becomes not just a technical issue but also a strategic and potentially legal one (Birman, 2000) because cyber risks have heightened to

the global risks (Bilan et. al., 2019) whereas the massive incident of data fraud or theft, predominantly driven by economic motives. Based on the global risks report published by World Economic Forum (WEF, 2019, 8), 'data fraud or theft' and 'cyber-attacks' were listed as the top 5 global risks in two consecutive years in 2018 and 2019, implying that the standard practice in revealing the cost-and-benefit analysis (Reich and Nelson, 2003) as required in any kind of business models is being challenged to add the new dimension of risks into the overall analysis.

Bessen (2019, 615) identifies that "new productivity-improving technologies will likely bring a disruptive reallocation" in the labour market and the impacts of process automation are estimated to be 8 to 14 per cent across occupations (UNCTAD, 2021, xviii). However, it is pointed out that "the distinction between occupations and tasks is critical since even occupations at high risk of automation can perform tasks that are hard to automate" (UNCTAD, 2021, 40). Taking 5G technology as an example, the forecast is, "by 2035, the global 5G value chain is expected to support 22 million jobs" (UNCTAD, 2021, 19). Hence, the expected changes in the IT job market will cover the changes in the existing IT job requirements, and the creation of new job roles like cyber-security and also, new job groups like CTO.

## 6.4 Practice-led approach is multifaceted teaching and student support

The practice-led teachers, possessing contextually rich industry experience in IT discipline as applied and practical, are enthusiastic and passionate to support the IT degree students in acquiring the IT disciplinary knowledge and skills and professional practices. Through the practice-led approach, the teachers strive to strengthen their behavioural competences (Tomlinson, 2008) as embodied capital (Tomlinson, 2017), enhance their career adaptability (Savickas and Porfeli, 2012) as psychological capital, and create the 'bridging ties' (Putnam, 1999) to connect the students with the industry. Based on the findings in the study, they

offer multi-dimensional teaching and direct support on the student's academic and practical learning, experiential learning, and their graduate jobs, distinctively focusing on the co-curricular course design, practice-led pedagogical approach, extra-curricular programmes, IT professional development, and having the face-to-face dialogues and job analysis discussion with the IT graduates about their job offers.

## 6.5 Lab practices are applied and practical practices, not industry practices

Facing the contextual barriers (Tomlinson, 2017) between university education and workplace practices, the teachers do not expect to teach the students about industry practices, preferring 'not resembling the lab practices' with that of the industry. Pedagogically, they design the lab environment very close to the industry settings, application-oriented practices with industry data sets, practical understanding of theoretical application with the industry complexities extracted and have client-oriented IT practical practices. In the academic environment, they allow the students to try errors and correct the mistakes, thus encouraging the malleability in their self-efficacies. The lab practices are designed to complement the lectures, therefore, can promote the students to do self-reflections at the time of practising. In terms of educational authenticity, they leverage their industry experience to articulate the students' understanding of the subject matters through their dialogic explanations as first-hand experiences and also, through concrete examples in the formats of case-based or scenario-based exhibited in classes.

## 6.6 Direct relationship between practice-led teaching and reflective student thinkers

Based on the feedback from the student surveys, in terms of usefulness in their study, 100% of the student respondents thought that real-life case studies and examples were useful and

96% were for experience sharing of industry practices was useful. When it comes to the helpfulness for their graduate jobs, these two course items were ranked 4th (71%) and 7th (57%) respectively. Reviewing the student responses further in detail, it is revealed that 43% of the students were not sure about the helpfulness and chose the option of "May be", though no students selected "No". Based on this feedback, it can be read as university students know about teachers' industry experience of values for their learning but not knowing how to relate it to their graduate job upon graduation. Probably, those students, who selected "May be" as the response, haven't started to think about or look for a graduate job.

The teaching contents and materials are highly contextual-based with industry perspectives, and some are involved the statutory guidelines and principles like GDPR, all of these can be seen as applied practices and practical practices for student learning. Through dialogic conversations and the use of analogy on some difficult topics, practice-led teachers can impart disciplinary knowledge to the students and in the meantime, promote their reflective thinking followed by group assignments and projects. Facilitating a deeper understanding of IT domain knowledge, they conduct the teaching through classroom-based disciplinary inquiry following the student project presentations. The teaching is learning-driven and led by the students who conducted the group work and presented it. The role of practice-led teachers is a good listener and facilitator who raises disciplinary questions in a probing approach to encourage the students to give more elaboration and explanation. It is found that the students were highly engaged as reflective thinkers and proactively took up some tough questions. Through the above practice-led teaching, they can foster the IT students to achieve a higher level of thinking and reflection in the university environment. They also allow the students to make mistakes which in turn can increase their malleability to take up challenges. Since they can effectively teach disciplinary knowledge and skills to the IT students whose learning interacts with their self-theories and metacognition in the classes, these practice-led teachers can get the USEM model of employability (Knight and Yorke, 2002) operating in the IT curriculum.

Furthermore, the experiential learning activities are embedded either in co-curricular activities like guest lectures and company visits or in the networking events like mentorship programmes with alumni speakers to share job interview tips. For work practices, IT degree students can acquire working experience during industry placement, internships, and elective consulting project courses. More subtly, the practice-led teachers offer more learning support to the students by extending the teaching arm to have external mentors like company representatives and work supervisors, and the alumni speakers as senior mentors for informal learning and job support.

However, they do encounter some challenges in teaching and learning. With respect to the nature of tacit knowledge as a 'black box of intuition' (Kinchin et al., 2008) and the skill model of proficiency (Dreyfus and Dreyfus, 1986), the acquisition of advanced IT knowledge is expected to possess the analytical skills in decision making and the intuitive understanding of the particular situation. Since the practice-led teachers understand the fundamental educational problem of moving linear structure to hierarchical structure (Novak and Symington, 1982), they simply let the IT students memorise the learning and hope they can do the job mapping in the future if the job will cover some of the subject area learned in the university. It is acknowledged that some university students are not mature enough to understand completely what is taught, probably waiting for them to have some years of working experience in the field and then, they might recall some of their learning in the university.

## 6.7 Practical lab teaching materials not equal to industry implementation projects

In this study, the greatest challenge is practising the practical lab assignments close to the workplace-situated learning (Smith, 2012) as the same mistakes were made by the students repeatedly in the practical lab examination which is regarded as the authentic assessment (Gielen et al., 2003; Gulikers et al., 2004). The teacher is the course subject's domain expert

and thus, the problem may be caused by the teacher's 'pre-authentication issue' (Petraglia, 1998). The situation is particularly problematic in associative learning which requires the students to follow the logical steps and make choices in the technical steps and tasks as integrative learning (Smith, 2012) when doing the practical practices in the lab exercises. This example can demonstrate the problems of using a real-life project in the industry as authentic workplace learning for the students because the actual project is implemented intellectively and cognitively, which cannot be simply disaggregated into a sequence of steps or tasks as the learning tasks for the students to do practices as every step is dependent on the other factors and also needs to be done with reasoning, implying that it is not a simple task or step and thus cannot be purely instructional. To perform cognitive actions, the students need to possess some related prior knowledge (Cohen and Levinthal, 1990) as the prerequisite for knowing capability (Nahapiet and Ghoshal, 1998). For those students without some prior knowledge but who want to attend this course, it is suggested that they can sit next to those classmates who have prior knowledge when doing the lab exercises and also do self-learning after school to catch up with the course.

There are two suggestions to handle the requirements on prior knowledge, firstly, the teacher can prepare a more concrete list of knowledge areas related to the learning in the course and then inform the students on the first lesson of the course so that they prepare in advance for lab practices. Secondly, based on the knowledge structure for expertise development (Kinchin et al., 2008), 'expert knowledge is interpreted as networks of understanding' and the teacher should come up with the blueprint of the real project, mapping with the sets of lab assignments or at least a clear pre-briefing on the whole set of exercises, that can help to encourage the self-reflections of the students to the higher-level. Considering using backward reasoning in teaching professional practices or similar kinds of industry practices, the question is whether completing the whole set of lab assignments can re-build the original project case delivered at the customer site; that is, whether that can achieve the same result as that of the original project can be achieved in meeting the needs of the client. That can help to explain why there is a debate between educational authenticity (Splitter, 2009) and authentic intellectual work (Newmann et al., 1996, 2001), even though both schools of thought agree that good teaching pedagogy depends on the

"capacity" in letting students "make meaning and form judgements based on good reasons" (Newmann et. al., 2001; Splitter, 2009, 147).

## 6.8 Practice-led teaching on IT degree programmes is blended academic-teaching and vocational-training approaches

The controversial views between academic teaching and vocational training in higher education have become a long debate, but this study is not aimed at answering the university level. This study, however, can provide insight because an organising principle between these two teaching approaches can be applied at the course level or programme level. Pedagogically, the purpose of education or teaching and learning is following the essence of knowledge (Anderson 1984) whilst, for IT discipline as applied and practical practices, the notion of knowledge structures for expertise development can be resonated. When IT expertise is seen as an individual's ability to navigate between underlying networks of understanding and chains of contextual practice in applying IT theories into practices, the complementary nature of linear and networked knowledge structures as well as their contextual significance need to be recognised, while avoiding the issues of isolated chains of practice (Kinchin et al., 2008).

The core values of the first principle's teaching approach are to understand the originality of the technical theories as it stands, before applying them into practice. Vocational training practices are generally regarded as an effective way of training students to complete IT tasks efficiently. In this study, it is reviewed that the practical practices in the labs and practical exam are demanding the students to possess more than skills in taking cognitive actions. That is why vocational training practices may not be appropriate if no other learning support is made available for the students, especially for those students without related prior knowledge. Therefore, the blended teaching approach between academic teaching and vocational training on IT knowledge and skills will be more effective for teaching IT courses after taking into consideration the nature of IT knowledge and skills.

Therefore, both approaches can be considered and employed by the teacher, if deemed to be appropriate or even mixing, in teaching a concept or skill. As reflected in this study, it is necessary for university students to possess some related prior knowledge as absorptive capacity (Cohen and Levinthal, 1990) when acquiring IT disciplinary knowledge and skills in the courses.

Per the above discussion on the two teaching approaches for students' practical learning, though it is contextually related to IT disciplinary knowledge and skills, the blended teaching approach as an organising principle can be applied to any discipline applied and practical, following the concept of knowledge structures for expertise development. For the question I raised earlier, the conversion of real-life IT implementation projects to become authentic work practices for workplace learning, to what extent can the completion of the whole set of practical lab assignments re-build the original project case delivered at the customer site? I would suggest that this question can be considered a new research area which can be further explored in understanding the gaps between practical practices or professional practices and industry practices. The potential contributions can be relevant to bridging the gaps in future teaching practices from the practitioner's perspective whilst the academic contribution can be related to further studies on the academic concepts of authenticity and resemblance as well as the knowledge structures for expertise development.

## 6.9 My self-reflections

As a research degree student, I have lots of learnings in this study and all the self-reflections are life-enhancing. At first, I have countless experiences of back and forth to do verification and justification between the academic view and practitioner view because I need to build up the linkages and associations between the two sides while allowing for consensus and contrast. It has the similarity between forward reasoning and backward reasoning that I have discussed these approaches under the topics of case-based learning and scenario-based learning. It is a challenging but very meaningful process and highly relevant to me.

Secondly, it is the learning of the subtle difference in the meaning of some words as a synonym. Many English words can be used interchangeably, and it is also very common in writing articles to have more varieties. But for disciplinary knowledge, the meaning of some words is contextually bounded, and some examples can be found in the dialogues between teachers and students in the findings chapter. It has helped me to observe the subtle difference in the meaning between 'basically' and 'fundamentally' in this piece of writing though I have already known when to use the words. It is so amazing! Castells (2000) describes information technology workers as 'self-programmable' workers, and for me, I am a 'self-programmable' research degree student.

Regarding the reflections on my research journey, I have some ideas on the research theme, but I have taken the exploratory approach in conducting this study, meaning that I am open mind during the process of data collection and analysis. For instance, the research interview instrument is semi-structured. The set of interview questions can guide me to cover all the key topics in the research interviews that it can also leave room for me to focus on the discussions with the interviewees. Even more, to further explore the relevant sub-topics if any, based on what the interviewees said. The initial selection of the research methods was interviewing teachers and conducting student surveys. Since most of the practice-led teachers expressed the difficulties in conducting student surveys, they initiated to let me have class observations on their students' project presentation and it is a bonus to me. Class observations not only can have allowed me to collect data on taught students' perspectives but also to understand the perspective from teaching on one occasion of teaching and learning. So, building trust with the research participants is key for academic researchers to be successful and I do think the timing is critical too. As for me, I did the follow-up on the student survey with the teachers right after the face-to-face research interview.

Above all, this experience of undertaking academic research has helped me reflect on the nature of knowledge, and the claims for knowledge (and truth) that we hear so regularly. These have always been important issues, and I understand they have always been complex.

We are often brought up to believe their a ‘truth’ or a ‘reality’, and that all else is opinion. Undertaking this research, through engaging with literature relating to the nature of knowledge and knowledge construction, has helped me reflect more on what we know and think more deeply about what we can genuinely claim to know. This is of great importance as it helps me to navigate the complex world we live in with little more confidence, where there is more ‘information’ available to us than ever before, generated from a diverse range of sources.

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# List of Appendices

## Appendix 3.1: Participant Information Sheet

**Postgraduate Research Study**: How does professional experience (or the professional experience of practice-led instructors & professors) inform the educational experience of university students on IT programmes in Hong Kong?

**Researcher: Ann Lai-Ping, CHAN**

**Information Sheet For Semi-Structured Participants**

You or willing members of staff from your department are being invited to be involved in this research study. Before you decide whether you want to take part, it is important for you to understand why the research is being conducted and what your participation will involve.

Please take time to read the following information carefully and discuss it with other members of staff from your department if you wish. Please contact me if anything is unclear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

Aims: The aims of the project are to gather information about the value propositions of professional and industry experience in university education, how do these industry experience through practice-led instructors and professors inform the educational experience of students on IT programmes, what are the current teaching practices while the aspects of their students' learning outcomes, and potentially their graduates employability and professional development, will also be explored and discussed.

Requirements: The interview will be carried out on the campus in between May and July. The interview will be based around a semi-structured interview pattern and will take approximately 60 minutes. The interview is intended as an opportunity for you to express your views on the value of teaching professional experience in IT programmes as well as your own sharing.

The interview will be recorded, and later transcribed into text form. Recordings of interviews will be deleted upon transcription.

Anonymity/Participation: As part of the presentation of results, your own words may be used in text form. This will be anonymised, so that you cannot be identified from what you said. All of the research data will be stored in a secure place in a separate, password-protected file from any data supplied.

Please note that:

- You can decide to stop the interview at any point
- You need not answer questions that you do not wish to
- Your name will be removed from the information and anonymised. It should not be possible to identify anyone from my reports on this study.

It is up to you to decide whether to take part or not. If you decide to take part you are still free to withdraw during the interview or any time up until. If you withdraw from the study all data will be withdrawn and destroyed.

If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form.

Once the thesis arising from this research has been completed, a brief summary of the findings will be made available by the researcher upon application. It is also possible that the results will be presented at academic conferences and journals. The data will be kept securely for five years from the date of Doctor of Education degree awarded, before being destroyed.

If this study has harmed you in any way you can contact the University of Nottingham using the details below for further advice and information:

Supervisor's Name: Professor Sarah Speight (Sarah.Speight@nottingham.ac.uk)
Supervisor's Name: Professor Howard Stevenson (Howard.Stevenson@nottingham.ac.uk)

Contact for further information
Research Ethics Coordinator, School of Education
University of Nottingham
Email: educationresearchethics@nottingham.ac.uk

## Appendix 3.2: Participant Consent Form

**CONSENT FORM FOR SEMI-STRUCTURED INTERVIEW PARTICIPANTS**

**Project Title-Postgraduate Research Study**: How does professional experience (or the professional experience of practice-led instructors & professors) inform the educational experience of university students on IT programmes in Hong Kong?

Researcher - Ann Lai-Ping, CHAN
Supervisors - Sarah Speight, Howard Stevenson

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified, and my personal results will remain confidential.
- I understand that I will be audiotaped during the interview.
- I understand that electronic data only will be stored in a password protected computer that only the researcher has access to.
- I understand that I may contact the researcher or supervisor if I require further information about the research, and that I may contact the Research Ethics Coordinator of the School of
- Education, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Signed …… (research participant)

Print name …… Date ……

Contact details:
Researcher: Ann Lai-Ping, CHAN
University of Nottingham
Email: lai.chan@nottingham.ac.uk

Supervisor's Name: Professor Sarah Speight (Sarah.Speight@nottingham.ac.uk)
Supervisor's Name: Professor Howard Stevenson (Howard.Stevenson@nottingham.ac.uk)

The contact details of the Research Ethics Coordinator should participants wish to make a complaint on ethical grounds are: educationresearchethics@nottingham.ac.uk

## Appendix 3.3: Semi-structured research interview's question set

1. Would you please briefly share with me your professional experience?
2. What are the factors to motivate you to take up the teaching profession after years of service in the IT industry?
3. How do you view the value of "industry learning as part of the university education" for students on IT Programmes?
4. Based on your experience in the industry and now in the academic field, how do you see the relationship between "student learning in university" and "graduates' employment and professional development after graduation"?
5. Can you tell me how you draw on your professional experience in your teaching to inform the educational experience on students? Please give me some examples.
6. In what ways do you monitor the learning progress of your students in acquiring the professional skills and understanding in your course(s)?
7. Based on your observations and understanding, do you think your students who are able to learn and understand fully in what you taught to them? Please share with me your experience.
8. How do you perceive your students in understanding the importance of acquiring professional skills and knowledge when studying IT programmes? Please elaborate.
9. Do you encounter any challenges during the process in drawing on your professional knowledge and industry practice to inform the educational experience on students? Please give me some examples.
10. What do you consider to be the minimum set of industry skills and experience that IT graduates should learn in university? Please share with me your thought.
11. What do you consider to be the most difficult set of industry skills and experience for IT graduates to learn in university? Please elaborate.
12. From your perspective, in achieving the practical transfer from professional experience to educational experience on students, what do you think are the success factors contributed from the areas, such as university, department, programme, teacher, student and so on?

## Appendix 3.4: Student survey's question set

**IT Course Design**

*(Scale 1 to 5, where 1 = Strongly Disagree and 5 = Strongly Agree)*

1 The aims and objectives of the course were made very clear.

2 The course content covered both technical skills and industry knowledge in IT field.

3 Please rate the following course items in according to the level of usefulness to you?
*(Scale 1 to 5, where 1 = Not Useful and 5 = Very Useful)*
_____ Understanding of the course subject in the field of study
_____ Technical aspects like programming skills, lab exercises & etc.
_____ Experience sharing of industry practices and real-life examples
_____ Class exercises, assignments & projects
_____ Others, such as company visits & etc.

4a Course assignments & projects were effective to help me practising what I learned in the course.

4b *The areas that you had practised were:*

*Ans:* _____

5a Course assessments were consistently used for assessing my understanding in the course.

5b *The course assessments that I had taken in the course were:*

*Ans:* _____

6 I usually had a clear idea of where I was going and what was expected of me in the course.

**Student Learning Experience**

*(Scale 1 to 5, where 1 = Strongly Disagree and 5 = Strongly Agree)*

7 Course materials were comprised of theories and applications in IT industry.

8 The study materials covered relevant case studies and industry practices in IT field.

9a It was made clear what resources were available to help me learn.

9b *The relevant resources available to help my learning were:*

*Ans:* _____

10 I learned to express ideas confidently with teacher and classmates.

11 The teaching staff was very experienced in making the course more practical and interesting.

12 How useful to you is, if teaching staff possess the experience from working in IT or related industries?

*Ans:* _____

13a The teaching staff made a real effort to understand difficulties I might be having with my work.

13b If any, what had the teaching staff done to understand your difficulties in the course? Please give examples.

*Ans:* _____

14 The teaching staff always encouraged me to understand the subjects from different angles.

**Student Learning Outcomes**

*(Scale 1 to 5, where 1 = Strongly Disagree and 5 = Strongly Agree)*

15 The course helped me to develop IT technical skills.
16 The course sharpened my problem-solving skills to handle IT tasks in the future.
17 The course prepared me to work as a good team member in IT projects in the future.
18 As a result of the course I feel confident about tackling unfamiliar problems in my job.
19 The course provided me with a broad overview of IT field of knowledge.
20 I learned to apply principles from the course to new situations.
21 The course developed my confidence to investigate new ideas.
22a I consider what I learned valuable for my future.
22b Please elaborate how this course is valuable to your future:
*Ans:* _____
23 The course has stimulated my interest in the study of IT field.
24 The course developed my ability to do self-reflection on what I learned.
25 The course has inspired me to pursue job in IT field after graduation.

26 ***Overall, I was satisfied with the quality of this course.***

**Open-ended Questions:**

Q.1 What do you think to be the most difficult topic(s) that you learned in this course? Please give example(s).

_____
_____

Q.2 What do you think to be the most practical skills that you developed in this course? Please give example(s).

_____
_____

**IT Degree Programme Level:**

Q.1 Please rate each of the following course items/activities in according to the "level of usefulness"
in your study IT degree programme?
*(Scale 1 to 5, where 1 = Not Useful and 5 = Very Useful)*

_____ Understanding of the subject knowledge in the field of study
_____ Theoretical frameworks and methodologies
_____ Technical aspects like programming skills, database design, network architecture & etc.
_____ Real-life case studies and examples
_____ Experience sharing of industry practices by professors/instructors
_____ Practical lab exercises
_____ Class exercises and assignments
_____ Group projects and presentations
_____ Guest lectures
_____ Industry seminar talks
_____ Company visits
_____ Field trips
_____ Mentorship

_____ Summer internship
_____ Work placement

**Your Graduate Jobs:**

Q.1 Do you think each of the following course items/activities will be helpful to your jobs after graduation?
*(3 options: Yes; Maybe; No)*
_____ Understanding of the subject knowledge in the field of study
_____ Theoretical frameworks and methodologies
_____ Technical aspects like programming skills, database design, network architecture & etc.
_____ Real-life case studies and examples
_____ Experience sharing of industry practices by professors/instructors
_____ Practical lab exercises
_____ Class exercises and assignments
_____ Group projects and presentations
_____ Guest lectures
_____ Industry seminar talks
_____ Company visits
_____ Field trips
_____ Mentorship
_____ Summer internship
_____ Work placement

**Professional Development**

Q.1 Do you know whether there is any IT professional certification related to this course subject?
a. Yes
b. No
c. I have no idea.

Q.2 If there is/are available IT professional certification(s) related to this course subject, will you consider to go for the certification?
a. Yes
b. No
c. Not sure

Q.3 If the IT professional certification would require for taking the public examination, when will you plan to sit for the exam?
a. Yes, I will plan to do it before completing the degree programme.
b. Yes, I will plan to do it after graduation.
c. Yes but not sure which one. I will look for more information first.
d. No. It will not be relevant to me.
e. No. I am not interested in.

Q.4 Please provide the list of IT professional certification(s) that you will be interested to pursue for:
_____
_____

## Appendix 3.5: (Sample) Email invitation to research participants for joining semi-structured interview

Dear XXX,

My Postgraduate Research Study:

How does professional experience (or the professional experience of practice-led instructors & professors) inform the educational experience of university students on IT programmes in Hong Kong?

I am writing to you here because your profile matches with the research participant's requirements as "Practice-led Professors" in my research study. Per your department's website, I learned that you possess both the relevant industry and professional experience in IT and are conducting teaching related to IT subjects in the university. Therefore, I am sincerely to invite you to participate into this research study as your views & sharing are valuable to IT field as well as the education discipline in social science domain.

Hence, I would like to provide you in below with some detailed information as your heads-up. You can take time to consider. It is a semi-structured interview on a set of 12 questions. It will take you about 60-mins for the interview.

If you would like to take part, please reply this email to me to indicate your interest and if possible, please propose to me the 60-mins available time-slot (date & time) from you. I will then send over to you, the Consent Form, and the set of interview questions.

Please also note that online student survey, 5-point Likert scale, is also prepared for the interviewee's taught students. Once again, it's up to you to decide to go for the student survey or not; and do your students. The student survey will take about 15-mins to do it online and is used for collecting feedbacks about their understanding and perception of learning professional experience in the course. The overall survey findings (anonymised on students, teaching staff and universities) will also be shared to the interviewees.

Should you have any questions, please feel free to email me or contact me at XXXX-XXXX. I can offer to come over to your department or office to have a briefing session to you for your clarity. It takes you approximate 15-20mins. I am now preparing for my thesis in full-time mode and thus my time is very flexible to fit into your preferred time-slot.

Thanks for your kind attention.

P.S. Enclosed please see the Information Sheet for your copy.

Remarks: In case you are required to seek for the prior consent from the department head, I can send you an email message (this item is prepared per University of Nottingham's research guideline) for your action. Or I can do it for you if you want to. Otherwise, it is assumed being not required.

Kind Regards,

Ann Chan

EdD Candidate, University of Nottingham

# Appendix 3.6: Fieldwork Schedule

**(A.) Semi-Structured Interviews**

| Interviewees: | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Format: | One-to-One Interview | One-to-One Interview | One-to-One Interview | One-to-One Interview | One-to-One Interview | One-to-One Interview |
| Data Collection: | Audio-recording | Audio-recording | Audio-recording | Audio-recording | Audio-recording | Audio-recording |
| | | | | | | |

**(B.) Student Surveys**

| Format: | | | | Online Student Survey | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| Dates: | | | | May-15<br>Dec-07 | | |
| Data Collection:<br># of Responses: | | | | Online Google Form<br>(19+28) = 47 responses | | |
| | | | | | | |

**(C.) Class Observations**

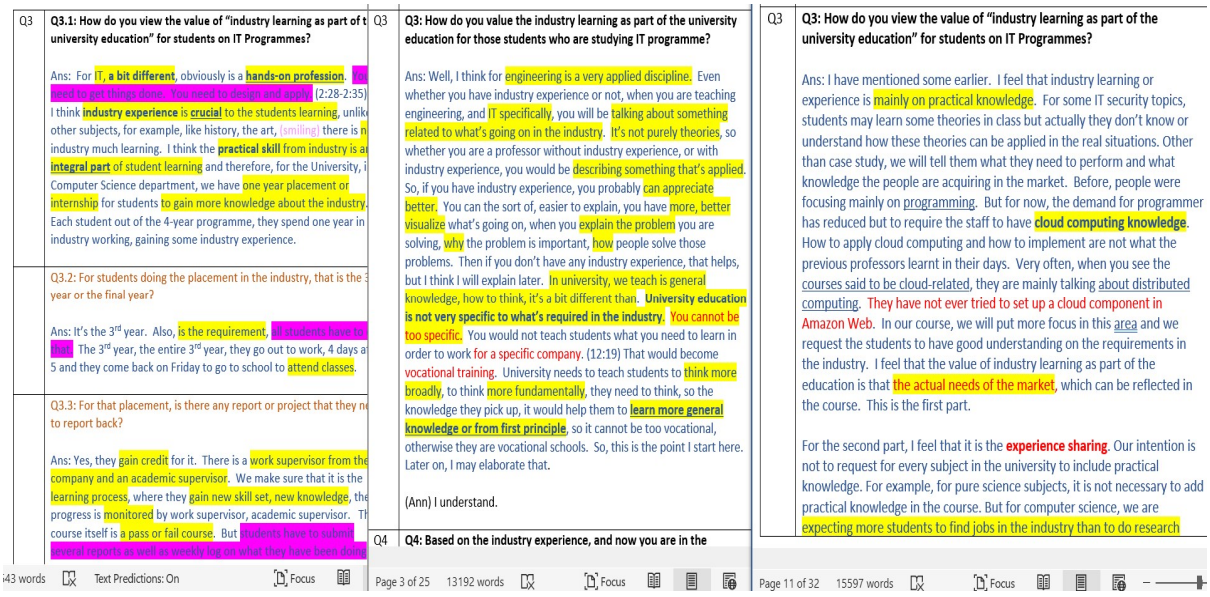
| Interviewees: | 1 | 2 | 3 | 4 | 6 | 5 |
|---|---|---|---|---|---|---|
| Session Format: | | Tutorial | Technical Lab *(4-hour session)* | Technical Lab | Lecture + Tutorial *(2.5 hours per paired session)* | Seminar |
| Activity Types: | | Individual Project Presentations x 16 | Group Project Presentations x 13 | Group Project Presentations x 7 | Group Project Presentations x 12 | Industry Talks x 2 |
| | | | | | | |
| Dates: | | Apr-16<br>Apr-17 | May-03 | Nov-22<br>Nov-29 | Mar 21 - Apr 18 | Nov-24<br>Dec-01 |
| | | | | | | |
| Data Collection: | | Notes-Taking (assisted by audio-taken) | Notes-Taking (assisted by audio-taken) | Notes-Taking | Notes-Taking (assisted by audio-taken) | Notes-Taking |
| | | | | | | |

# Appendix 3.7: Log sheet of the discussion flow during the semi-structured research interviews

| Interviewees: | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | 35mins (3,200 words) | 121mins (12,300 words) | 141mins (15,800 words) | 102mins (7,800 words) | 101mins (6,800 words) | 78mins (9,000 words) |
| **Original Set of Questions 1-12** | | | | | | |
| **[+] Follow-up questions to the previous question** | | | | | | |
| | Q1: Professional experience | Q1: Professional experience | Q1: Professional experience | Q1: Professional experience | Q1: Professional experience | Q1: Professional experience |
| | Q2: Motivation to teaching profession | Q2: Motivation to teaching profession | Q2: Motivation to teaching profession | Q2: Motivation to teaching profession | [+] Industry Seminars | Q2: Motivation to teaching profession |
| | Q3: Value of "industry learning as part of the university education" | Q3: Value of "industry learning as part of the university education" | [+] Course design | [+] Industry experience > teaching experience | Q2: Motivation to teaching profession | Q3: Value of "industry learning as part of the university education" |
| | [+] Placement | Q4: Relationship between "student learning in university" and "graduates' employment | [+] Course design - his role | [+] Career Change | Q3: Value of "industry learning as part of the university education" | Q4: Relationship between "student learning in university" and "graduates' employment |
| | [+] Placement - assessment | Q5: Draw on professional experience to inform educational experience | [+] Course materials | Q3: Value of "industry learning as part of the university education" | Q4: Relationship between "student learning in university" and "graduates' employment | Q5: Draw on professional experience to inform educational experience |
| | [+] Placement <-> Employment | [+] Course design | [+] Undergraduate vs Master course | Q4: Relationship between "student learning in university" and "graduates' employment | [+] Technical / Hard skills | [+] Personal experience |
| | Q4: Relationship between "student learning in university" and "graduates' employment | [+] Company visit | [+] Role in course design | [+] Student's aspiration | [+] Student's career path | [+] Course materials |
| | Q5: Draw on professional experience to inform educational experience | [+] Group presentation | [+] Course design | [+] Experiential learning | [+] Course design | [+] Class assignment |
| | [+] Student projects & assignment | Q6: Monitor the student learning progress | [+] Student understanding | [+] Student qualities | Q5: Draw on professional experience to inform educational experience | [+] Class dynamic |
| | [+] Case studies | Q7: Students who are able to learn and understand fully | [+] Pedagogy | Q5: Draw on professional experience to inform educational experience | Q6: Monitor the student learning progress | [+] Class assignment |
| | [+] Student understanding in case studies | [+] Experience sharing | [+] Course design - his belief | [+] Soft skills | Q7: Students who are able to learn and understand fully | [+] Pedagogy |
| | Q6: Monitor the student learning progress | [+] Student behaviour | [+] Industry certification | Q6: Monitor the student learning progress | Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university | [+] Course design - Role |
| | [+] PILO matrix <-> Student assessment | [+] Industry experience <-> company visits | [+] Industry certification - students | Q7: Students who are able to learn and understand fully | Q9: Encounter any challenge during the process (professional experience > educational experience) | Q6: Monitor the student learning progress |
| | [+] Role in the skills matrix | [+] Student perspective | [+] Industry certification - impact | [+] Course design | [+] Course design | [+] Teaching assessment |
| | [+] Matrix > courses being taught | Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university | Q3: Value of "industry learning as part of the university education" | [+] Student expectation | [+] Role in course design | [+] Student feedback |
| | Q7: Students who are able to learn and understand fully | Q9: Encounter any challenge during the process (professional experience > educational experience) | Q4: Relationship between "student learning in university" and "graduates' employment | Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university | Q11: The most difficult set of industry skills & knowledge | [+] Marking scheme |
| | [+] Student behavior | [+] Programme design | [+] Industry changes > course design | [+] Student learning attitudes | Q10: The minimum set of industry skills & knowledge | Q7: Students who are able to learn and understand fully |
| | [+] Class dynamic | [+] Student role | [+] New industry knowledge > crriculum design | [+] Student <-> Teaching | Q12: Success factors in achieving the practical transfer | [+] Group presentation - Pedagogy |
| | Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university | [+] Final year project | Q5: Draw on professional experience to inform educational experience | Q9: Encounter any challenge during the process (professional experience > educational experience) | Courtesy message after Q12 | [+] Student response |
| | [+] Class size | [+] Final year project | Q6: Monitor the student learning progress | Q10: The minimum set of industry skills & knowledge | | *Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university* |
| | [+] Class size | [+] Course design | [+] Student understanding | Q11: The most difficult set of industry skills & knowledge | | Q9: Encounter any challenge during the process (professional experience > educational experience) |
| | [+] Course structure | [+] Work-Study vs Placement | Q7: Students who are able to learn and understand fully | Q12: Success factors in achieving the practical transfer | | [+] Course design |
| | Q9: Encounter any challenge during the process (professional experience > educational experience) | [+] Student feedback | Q8: Perception on student's understanding about the importance in acquiring professional skills & experience in university | Courtesy message after Q12 | | [+] Final exam |
| | Q10: The minimum set of industry skills & knowledge | Q10: The minimum set of industry skills & knowledge | [+] Student expectation | [+] Industry knowledge and experience | | [+] Exam format |
| | Q11: The most difficult set of industry skills & knowledge | [+] Student employment | Q9: Encounter any challenge during the process (professional experience > educational experience) | [+] Belief > Whole-person development | | [+] Experience sharing |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Q12: Success factors in achieving the practical transfer | [+] Department survey | [+] Lab sessions | | | [+] Experience sharing - Pedagogy |
| | [+] Role in course design | Q11: The most difficult set of industry skills & knowledge | [+] Professional knowledge | | | [+] Course materials |
| | [+] His input to course structure | Q12: Success factors in achieving the practical transfer | Q10: The minimum set of industry skills & knowledge | | | Q10: The minimum set of industry skills & knowledge |
| | Courtesy message after Q12 | [+] Professional experience in teaching | Q11: The most difficult set of industry skills & knowledge | | | Q11: The most difficult set of industry skills & knowledge |
| | [+] Student's employment | [+] His graduates' employability | Q12: Success factors in achieving the practical transfer | | | Q12: Success factors in achieving the practical transfer |
| | [+] Comment on industry trend | Courtesy message after Q12 | [+] Sharing about his thought on new direction + Sharing on case from overseas | | | [+] Staff calibre vs Performance in workplace |
| | | | Courtesy message after Q12 | | | [+] Motivate students |
| | | | | | | [+] Teaching <-> Students |
| | | | | | | Courtesy message after Q12 |
| | | | | | | [+] Professional experience |
| | | | | | | |

# Appendix 3.8: (Example) Highlights of key phases on the interview transcripts



Q3 **Q3.1: How do you view the value of "industry learning as part of t university education" for students on IT Programmes?**

Ans: For IT, **a bit different**, obviously is a **hands-on profession**. You need to get things done. You need to design and apply. (2:28-2:35) I think **industry experience** is **crucial** to the students learning, unlik other subjects, for example, like history, the art, (smiling) there is n industry much learning. I think the **practical skill** from industry is a **integral part** of student learning and therefore, for the University, i Computer Science department, we have one year placement or internship for students to gain more knowledge about the industry. Each student out of the 4-year programme, they spend one year in industry working, gaining some industry experience.

Q3.2: For students doing the placement in the industry, that is the year or the final year?

Ans: It's the 3rd year. Also, is the requirement, all students have to that. The 3rd year, the entire 3rd year, they go out to work, 4 days a 5 and they come back on Friday to go to school to attend classes.

Q3.3: For that placement, is there any report or project that they n to report back?

Ans: Yes, they gain credit for it. There is a work supervisor from the company and an academic supervisor. We make sure that it is the learning process, where they gain new skill set, new knowledge, the progress is monitored by work supervisor, academic supervisor. Th course itself is a pass or fail course. But students have to submit several reports as well as weekly log on what they have been doing

43 words Text Predictions: On Focus

Q3 **Q3: How do you value the industry learning as part of the university education for those students who are studying IT programme?**

Ans: Well, I think for engineering is a very applied discipline. Even whether you have industry experience or not, when you are teaching engineering, and IT specifically, you will be talking about something related to what's going on in the industry. It's not purely theories, so whether you are a professor without industry experience, or with industry experience, you would be describing something that's applied. So, if you have industry experience, you probably can appreciate better. You can the sort of, easier to explain, you have more, better visualize what's going on, when you explain the problem you are solving, why the problem is important, how people solve those problems. Then if you don't have any industry experience, that helps, but I think I will explain later. In university, we teach is general knowledge, how to think, it's a bit different than. **University education is not very specific to what's required in the industry.** You cannot be too specific. You would not teach students what you need to learn in order to work for a specific company. (12:19) That would become vocational training. University needs to teach students to think more broadly, to think more fundamentally, they need to think, so the knowledge they pick up, it would help them to **learn more general knowledge or from first principle**, so it cannot be too vocational, otherwise they are vocational schools. So, this is the point I start here. Later on, I may elaborate that.

(Ann) I understand.

Q4 **Q4: Based on the industry experience, and now you are in the**

Page 3 of 25 13192 words Focus

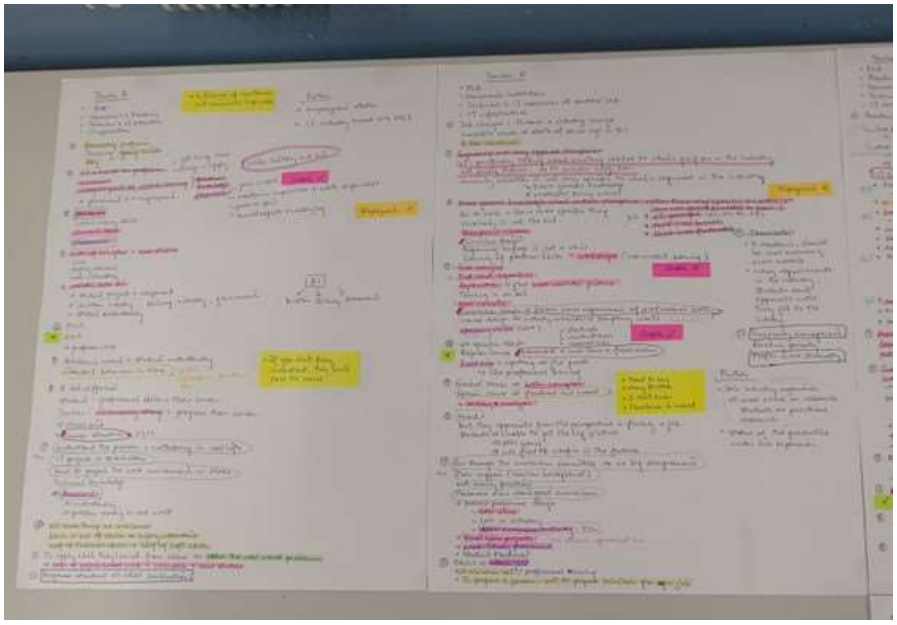
Q3 **Q3: How do you view the value of "industry learning as part of the university education" for students on IT Programmes?**

Ans: I have mentioned some earlier. I feel that industry learning or experience is mainly on practical knowledge. For some IT security topics, students may learn some theories in class but actually they don't know or understand how these theories can be applied in the real situations. Other than case study, we will tell them what they need to perform and what knowledge the people are acquiring in the market. Before, people were focusing mainly on programming. But for now, the demand for programmer has reduced but to require the staff to have **cloud computing knowledge**. How to apply cloud computing and how to implement are not what the previous professors learnt in their days. Very often, when you see the courses said to be cloud-related, they are mainly talking about distributed computing. They have not ever tried to set up a cloud component in Amazon Web. In our course, we will put more focus in this area and we request the students to have good understanding on the requirements in the industry. I feel that the value of industry learning as part of the education is that the actual needs of the market, which can be reflected in the course. This is the first part.

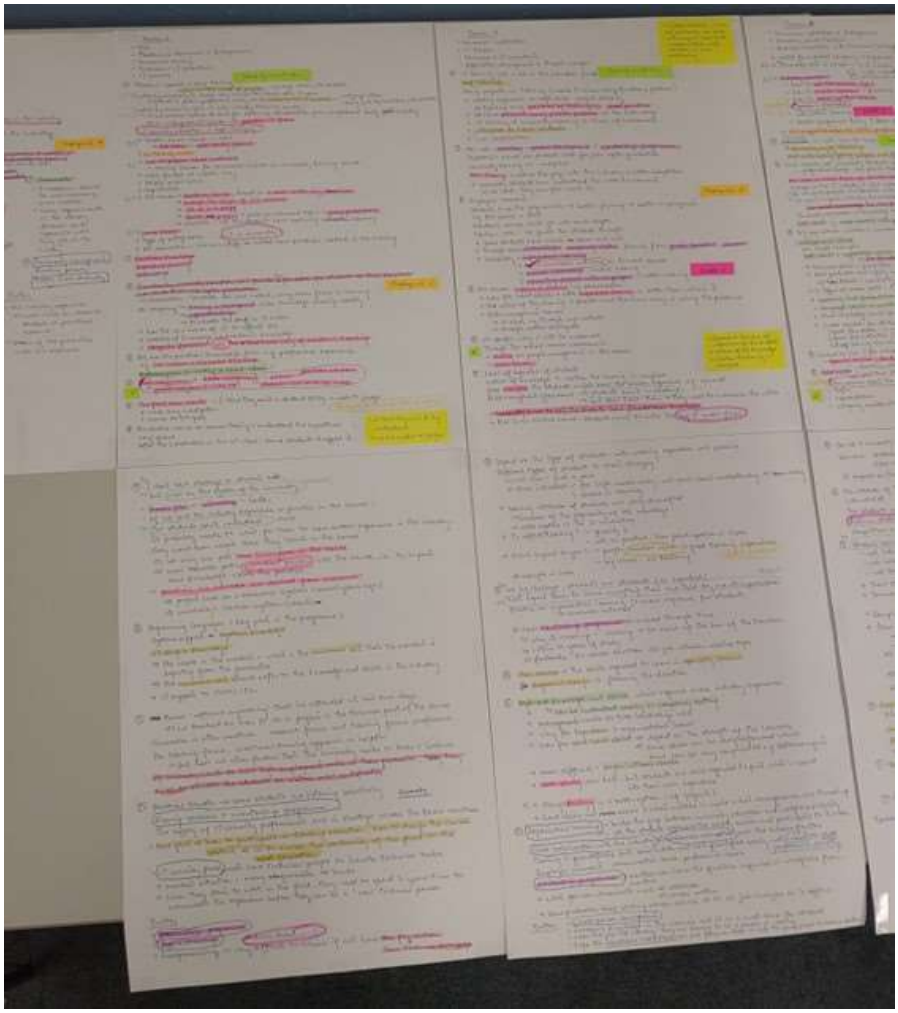
For the second part, I feel that it is the **experience sharing**. Our intention is not to request for every subject in the university to include practical knowledge. For example, for pure science subjects, it is not necessary to add practical knowledge in the course. But for computer science, we are expecting more students to find jobs in the industry than to do research

Page 11 of 32 15597 words Focus

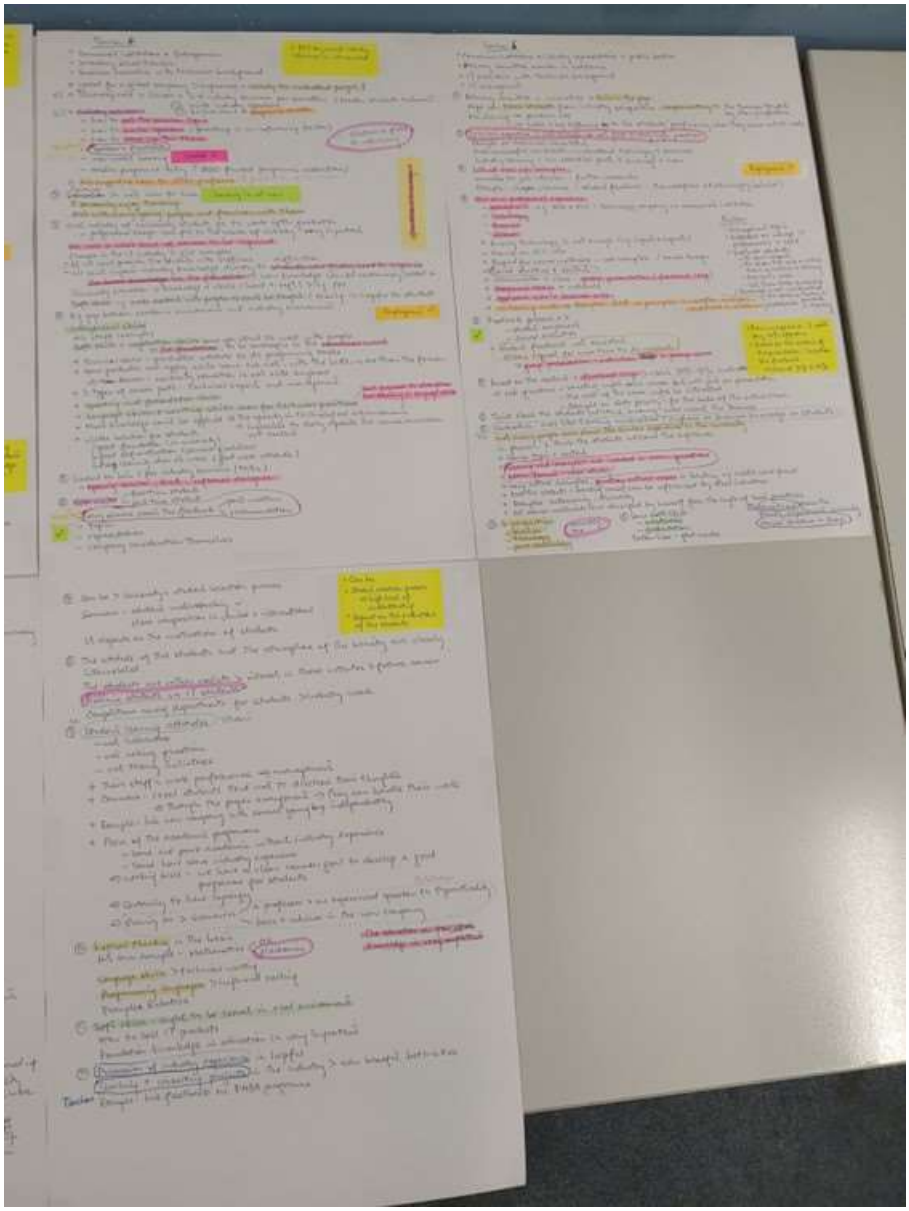
**Appendix 3.9 Extract the key points in each interview question answered by all the 6 practice-led teachers**



(PLT-A and PLT-B)

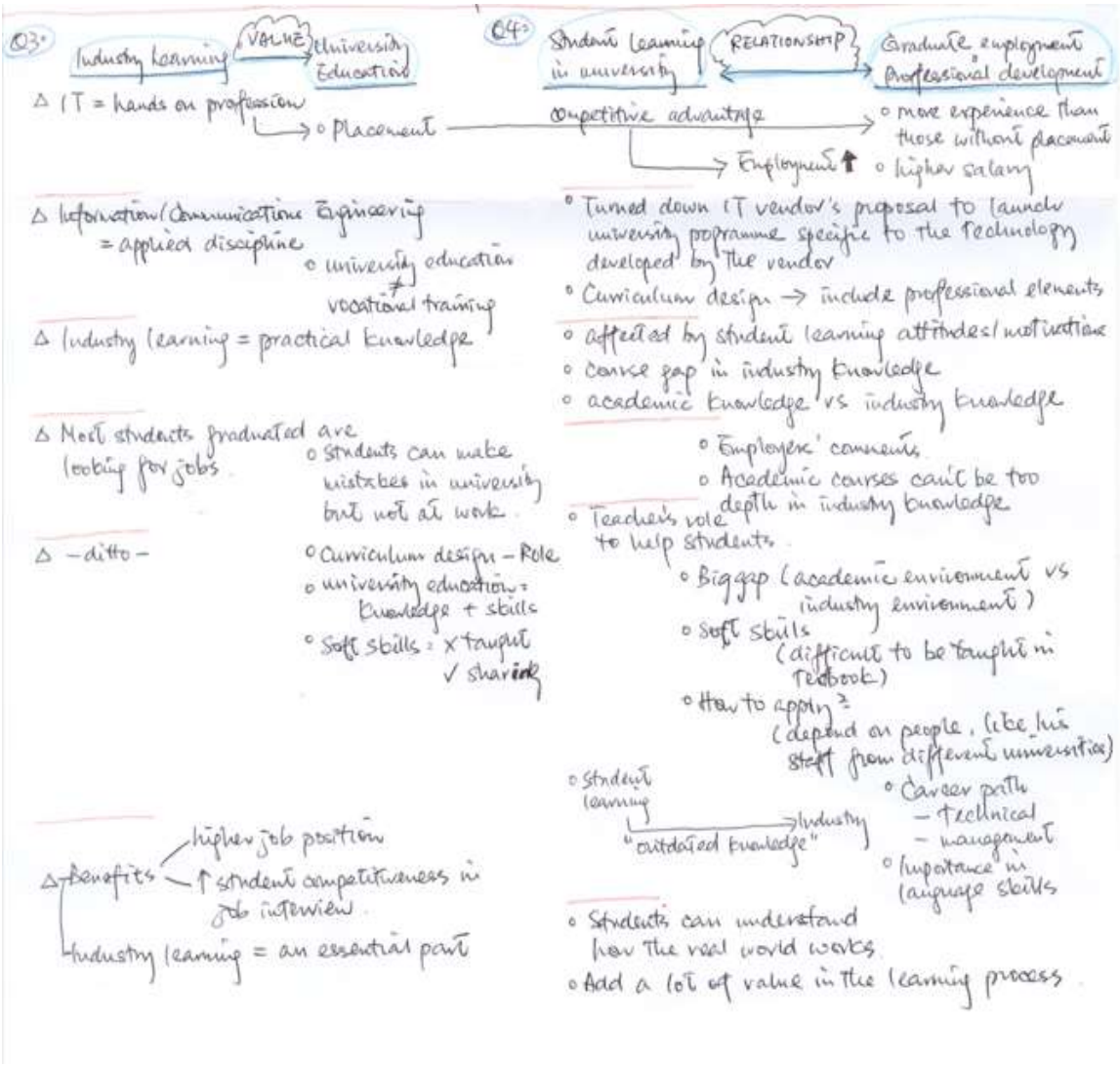


(PLT-C and PLT-D)



(PLT-E and PLT-F)

## Appendix 3.10: (Examples) Drafting of sub-themes based on the interview questions



Q11

Most Difficult set

- Difficult to apply = what learnt in class in real world problems
- Problem-solving = knowing textbook knowledge → application → problem-solving
  * Two different things

Solutions
- lots of project-based works
- lots of examples
- case studies

- Teamwork
  - goal setting in company that all staff to work towards the goal
  - students not necessarily appreciate until they get to the industry
- Project Planning skills
  - Time management
  - Budgeting
- Advanced hard skills
  - Database design
- High-end knowledge & skills
  - Risk management (can understand more easily in company setting)
  - Leadership
  - Organisational issues
    - students not possess the level of maturity to understand (no working experience)
- Negotiation skills
- Presentation skills
  - can be one step ahead of their fellow classmates
    e.g. write a resume to present himself/herself

Soft skills
* Dupnt to learn in real environment
  - price setting
  - product negotiation
  - contract negotiation
* Some even require in ~~some~~ having some foundational knowledge + active to learn + eager to learn
* Environment setting can affect student learning

Solutions
- case study
- Analogy is a better option

Q5: Industry Experience to Inform Educational Experience

- Real-life examples
  - Industry
  - knowing technology not enough (IoE automation)
- Realistic data sets (not to solve toy problems)
- Case studies (industry e.g. aviation)
  - Student understanding ↑ teacher can know
  - real-life scenarios e.g. customer database centralisation
- Student assignments e.g. data breach / data privacy / CIO
- Course Design (Intended)
  - Industry research
  - Group presentation ← teacher feedback + observations
- Student Projects — senior course
- Practical lab sessions
- Work Experience sharing
  - Hard skills
    - project management
  - Soft skills
    - deal with workplace politics
    - how to write client report
- Industry Seminars
  - planning inputs
  - opening sessions
  - Q&A sessions (informal dialogues)
- Company visits / Field trips
  - aims
  - planning
  - students' role / learning
- Discussions with company representatives (senior)
  - Pre-visits ← teachers
  - Post-visits → students + teachers

Curriculum Design
- Industry topics with real-life examples
- Link to some professional ~~for~~ bodies

**Appendix 3.11: (Example) Highlights of the key points shared by all 6 interviewees under the topic of teacher's sharing**