DEVELOPMENT OF A FLIPPED CLASSROOM MODULE BASED ON PROBLEM-SOLVING OF CULINARY ARTS FOR COMMUNITY COLLEGES

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FACULTY OF EDUCATION
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Field of Study: **INSTRUCTIONAL TECHNOLOGY**

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ABSTRACT

Problem-solving skills is one of the employability skills required by the industry. However, Technical and Vocational Education and Training (TVET) graduates seem to lack problem-solving skills despite having the technical skills. One of the causes to this problem may be due to the insufficient practice in solving real-world problems, even instructors lack the pedagogical skills to teach for problem-solving. Hence, in this study a Problem-Solving Flipped Classroom (PSFC) module was developed for enhancing students' problem-solving skills. A design and developmental research approach with three phases for needs analysis, design and development, and evaluation, was employed. In the first phase, 831 Culinary Arts students from all the 11 Community Colleges offering Certificate in Culinary Arts were surveyed to identify their level of problem-solving skills and their readiness for flipped classroom (FC) implementation. In addition, semi-structured interviews with 10 instructors were to gain insights into their current teaching practices. Findings indicate that students had average levels of problem-solving skills but exhibited high-level of readiness towards FC implementation. Instructors' seem to follow the traditional culinary pedagogical model which did not seem to develop problem-solving skills. Thus, there was a need for a module to develop problem-solving skills and the FC approach could be used. In the design phase, the elements appropriate for the PSFC module were determined using the Fuzzy Delphi (FD) method. Firstly, semi-structured interviews with six experts was conducted and the data was analysed into themes to design the FD Instrument. The instrument was distributed to a panel of 19 experts for consensus on the elements in the module. The consensus was achieved for elements of instruction in nine lessons for real-world problems related to Standards of Professionalism, Food Safety, Kitchen Safety and Kitchen Fundamentals. The PSFC module developed was reviewed by six experts and improved before implementation. In the module, lessons were facilitated by instructors using *Telegram*, while the instructional materials and resources were hosted on *Schoology*. The PSFC module was implemented among 30 students in a Community College in the evaluation phase using a single-group experiment. In addition, surveys on students' perception of the module and interviews with the participating instructor were done to determine the module's usability. The t-test analysis indicates a significant difference in pre-test and post-test scores for learning, $t(29) = 12.458$, $p < .05$ and for problem-solving, $t(29) = 17.943$, $p < .05$. Students also had positive perception towards their learning experience and the instructor found the module pedagogically and technically usable. The findings show that the module is effective in improving students' problem-solving skills and learning. The module enables instructors to teach problem-solving using authentic tasks and resources in teaching Culinary Arts. It is recommended that the module could be implemented in other Culinary Arts classrooms to improve students' problem-solving skills.

Keywords: Flipped Classroom, Problem solving, Culinary Arts, First Principles of Instruction, Cognitive Apprenticeship

PEMBANGUNAN MODUL BILIK DARJAH BERBALIK BERASASKAN PENYELESAIAN MASALAH DALAM SENI KULINARI UNTUK KOLEJ KOMUNITI

ABSTRAK

Kemahiran penyelesaian masalah merupakan satu kemahiran kebolehkerjaan yang diperlukan oleh industri. Walaubagaimanapun, didapati graduan Institusi Pendidikan dan Latihan Teknik dan Vokasional (TVET) masih kurang menguasai kemahiran penyelesaian masalah meskipun mempunyai kemahiran teknikal. Salah satu punca kepada masalah ini ialah kurang–latihan menyelesaikan masalah dalam situasi dunia sebenar, malah pengajar masih kurang kemahiran pedagogi untuk mengajar penyelesaian masalah. Justeru, dalam kajian ini sebuah modul Bilik Darjah Berbalik Berasaskan Penyelesaian Masalah(PSFC) telah dibangunkan untuk meningkatkan kemahiran penyelesaian masalah dalam kalangan pelajar. Pendekatan kajian Reka Bentuk dan Pembangunan yang melibatkan tiga fasa iaitu analisis keperluan, reka bentuk dan pembangunan, serta penilaian telah digunakan. Pada fasa pertama, seramai 831 pelajar Seni Kulinari dari kesemua 11 Kolej Komuniti yang menawarkan Sijil Seni Kulinari telah ditinjau untuk mengenal pasti tahap kemahiran penyelesaian masalah mereka dan kesediaan mereka untuk mengikuti pendekatan kelas berbalik. Di samping itu, temu bual separa berstruktur telah dijalankan dengan 10 orang pengajar untuk mengenal pasti amalan pengajaran semasa. Dapatan kaji selidik pula menunjukkan bahawa pelajar mempunyai tahap kemahiran menyelesaikan masalah yang sederhana, namun mereka menunjukkan tahap kesediaan yang tinggi terhadap pelaksanaan bilik darjah berbalik. Selain itu, didapati pengajar pula mengikuti model pedagogi kulinari tradisional yang kurang memberikan penekanan terhadap pembangunan kemahiran menyelesaikan masalah dalam kalangan pelajar. Oleh itu, wujudnya keperluan untuk membangunkan sebuah modul yang bertujuan untuk membangunkan kemahiran penyelesaian masalah dengan menggunakan pendekatan bilik darjah berbalik. Sewaktu fasa reka bentuk, unsur-unsur yang sesuai untuk modul PSFC telah ditentukan menggunakan teknik *Fuzzy Delphi* (FD). Pertama, temu bual separa berstruktur telah dijalankan dengan enam pakar dan data dianalisis secara tematik untuk mereka bentuk instrumen FD. Instrumen tersebut diedarkan kepada panel yang terdiri daripada 19 orang pakar untuk mendapatkan konsensus mereka mengenai elemen-elemen dalam modul ini. Konsensus mengenai elemen-elemen pengajaran telah dicapai bagi sembilan pelajaran berkenaan masalah dunia sebenar berkaitan Standard Profesionalisme, Keselamatan Makanan, Keselamatan Dapur dan Asas Dapur. Modul yang dibangunkan telah disemak semula oleh enam pakar dan dimurnikan sebelum pelaksanaan. Dalam modul ini, pengajar sebagai fasilitator telah menyampaikan pengajaran melalui *Telegram*, manakala bahan pengajaran dan sumber dihoskan melalui *Schoology*. Bagi menilai keberkesanan modul ini, kaedah eksperimen satu kumpulan telah digunakan. Seramai 30 pelajar dari sebuah Kolej Komuniti telah dipilih sebagai kumpulan eksperimen dan didedahkan dengan modul PSFC. Bagi menyokong dapatan, satu kaji selidik persepsi pelajar tentang modul dan temu bual dengan pengajar yang terlibat telah dilaksanakan untuk menentukan kebolehgunaan modul. Dapatan analisis ujian-*t* menunjukkan perbezaan yang signifikan dalam skor pra-ujian dan pasca ujian untuk pembelajaran, $t\ (29) = 12.458$, $p < .05$ dan kemahiran penyelesaian masalah, $t\ (29) = 17.943$, $p < .05$. Hasil penilaian kepenggunaan modul mendapati pelajar mempunyai persepsi positif terhadap pengalaman pembelajaran mereka, manakala pengajar mendapati modul ini mempunyai kebolehgunaan pedagogi dan teknikal. Dapatan menunjukkan bahawa modul ini berkesan dalam meningkatkan kemahiran menyelesaikan masalah dalam kalangan pelajar dan mampu meningkatkan pembelajaran. Modul ini telah membolehkan para pengajar mengajar penyelesaian masalah dengan menggunakan tugasan dan sumber yang autentik dalam mengajar Seni Kulinari. Modul ini disyorkan agar diguna pakai di bilik darjah Seni Kulinari lain bagi meningkatkan kemahiran penyelesaian masalah pelajar.

Kata kunci: Kelas berbalik, penyelesaian masalah, seni kulinari, *First Principles of Instruction, Cognitive Apprenticeship*

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List of Abbreviations

CTE	Career and Technical Education
CTML	Cognitive Theory of Multimedia Learning
DCCE	Department of Community College Education
DDR	Design and Developmental Research
DPE	Department of Polytechnic Education
FC	Flipped Classroom
FDM	Fuzzy Delphi Method
HACCP	Hazard Analysis and Critical Control Points
HEI	Higher Education Institution
ICT	Information and Communications Technology
IDT	Instructional Design and Technology
IIEP	International Institute for Education Planning
ILO	International Labour Organisation
IVLP	Interactive Video Learning Platforms
KTAR	Kolej Tunku Abdul Rahman
LMS	Learning Management System
MARA	Majlis Amanah Rakyat
MOE	Ministry of Education
MOHE	Ministry of Higher Education
MQA	Malaysian Qualifications Agency
MQF	Malaysian Qualifications Framework
NKEA	National Key Economic Areas
NOSS	National Occupational Skills Standard
OECD	Organisation for Economic Co-operation and Development
PS	Problem-solving
PSFC	Problem-solving Flipped Classroom
PSPFCR	Problem Solving Practices and Flipped Classroom Readiness
SCANS	Secretary's Commission on Achieving Necessary Skills
SPIQ	Student Perception of Instruction Questionnaire
SPM	Sijil Pelajaran Malaysia
SPSS	Statistical Packages for the Social Sciences
TVET	Technical and Vocational Education and Training
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VET	Vocational Education and Training
VTE	Vocational and Technical Education
VTET	Vocational and Technical Education and Training

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CHAPTER 1

INTRODUCTION

Background of the Study

Traditionally, Technical and Vocational Education and Training (TVET) is related to attaining knowledge and skills for employment. The 2001 United Nations Educational, Scientific and Cultural Organisation (UNESCO) and International Labour Organization (ILO) Revised Recommendations concerning Technical and Vocational Education and Training (TVET hereafter) defined TVET as "those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupation in various sectors of economic life" (UNESCO, 2011, p. 7). The concept of TVET used in Malaysia is consistent with the concept of technical and vocational education used by UNESCO (Maizam Alias & Hassan, 2012).

The Malaysian government places great emphasis on developing TVET programmes in the country. For example, the Tenth Malaysia Plan (2011-2015) emphasised that TVET education is required to produce more skilled and knowledge workers (k-workers) which are at par with developed countries such as the USA, Japan, Germany and South Korea. Various ministries and government bodies offer TVET programmes in Malaysia, namely the Ministry of Education, Ministry of Human Resources and the Ministry of Rural and Regional Development (Mohamad Sattar Rasul, Zool Hilmi Mohamed Ashari, Norzaini Azman, & Rauf, 2015). The Ministry of Education in its Malaysia Education Blueprint 2015 to 2025 (Higher Education) report outlined that Community Colleges, together with polytechnics and vocational colleges are the premier higher education TVET providers to develop talented skills to supply skilled TVET workers by 2020 (Ministry of Education Malaysia, 2015). Due to the need to target 60% of 1.5 million new jobs by 2020 for workers with TVET skills, the Budget 2016 Speech by the Prime Minister and Finance Minister, Datuk Seri Najib Tun Razak outlined that RM4.8 billion is allocated to 545 TVET institutions (Ministry of Finance Malaysia, 2016). As part of its measure to empower human capital, some RM585 million has been allocated for TVET training equipment at Polytechnics, Community Colleges and other TVET institutions (Ministry of Finance Malaysia, 2016). These efforts resulted in the increase in numbers of SPM leavers pursuing TVET from 25% in 2010 to 36% in 2013 (Mustapha, 2017).

This study focuses on Community Colleges, which are TVET institutions under the purview of the Department of Community College Education (DCCE), under the Ministry of Higher Education of Malaysia. The history of establishing Community Colleges started with the Malaysian Cabinet's approval of Memorandum No. 398/2225/00 submitted by the Minister of Education on 5th of July 2000 (Idris, 2011; Sipon, 2013). In 2001, there were only 12 Community Colleges operating. Currently, there are 94 Community Colleges operating across all states in Malaysia except Federal Territories (i.e., Kuala Lumpur, Putrajaya, and Labuan) that have no Community Colleges operating. The current total enrolment of Community Colleges is 21,468 students (Ministry of Education Malaysia, 2014).

The establishment of Community Colleges in Malaysia was brought by the success of similar colleges set up in Canada and the United States (Idris, 2011). Just like their foreign counterparts, Community Colleges in Malaysia cater to school leavers, especially those who are unable to pursue their studies at other institution due to the stringent academic entry requirements. According to the Department of

Community College Education (DCCE hereafter), the vision of Community Colleges is to be a “lifelong learning centre, with the commitment to building a knowledgeable and skilled community, in line with the National Education Philosophy” (Department of Community College Education, 2014). Meanwhile, the mission of establishing Community Colleges is “leveraging on Technical and Vocational Education and Training, and Lifelong Learning as a means to transform local communities to become knowledgeable and trained workforce to fulfil the demands of the world of work” (Department of Community College Education, 2014). Thus, Community Colleges provide a platform for rural communities to gain skills training through short courses as well as providing access to post-secondary education (Mustapha, 2017) to upgrade their knowledge, skills and socioeconomic status (Mohamed, Omar, & Romli, 2011).

The National Occupational Skills Standards (NOSS) document prepared by the Department of Skills Development, under the Ministry of Human Resources of Malaysia outlines the required competency level expected of a skilled employee; the level of employment and the path required to achieve the stated competency level (Department of Skills Development, 2015). The tourism and hospitality industry is one of the skills-based industries listed in the National Occupational Skill Standards (NOSS) directory relating to TVET and offered at Malaysian Community Colleges.

As the growth of the tourism and hospitality industries persists, the demand for quality human capital rises (Chau & Cheung, 2017). As Malaysia continues to receive a growing number of tourists, guests and consumers that seek culinary pleasures, the key players in the tourism and hospitality industry need to provide competent and highly skilled graduates in hospitality-related fields such as hotel, catering, food and beverages services and food manufacturing. The Culinary Arts industry is one important niche area in the tourism and hospitality industry as it plays an important role in attracting tourists (Fuziah Ibrahim & Jamaluddin, 2007; Nornazira Suhairom, Aede Hatib Musta'amal, Nor Fadila Mohd Amin, & Noor Khairul Anuar Johari, 2014; Zahari, Jalis, Zulfifly, Radzi, & Othman, 2009). With the growth in the Malaysian culinary industry and some estimated additional culinary related jobs by 2020, the field of Culinary Arts Education seeks better quality graduates. This means students need to be trained based on the realities of the job (Ko & Chung, 2015; Pratten, 2003; Pratten & O'Leary, 2007) according to the expectations of the culinary industry by the culinary instructors (Ko & Chung, 2015). This is so that students will be able to meet employers' expectations when they enter the industry (Brown, Thomas, & Bosselman, 2015).

The Western Cuisine (*Masakan Barat)* course is a fundamental course for the Certificate in Culinary Arts programme at Community Colleges. The Western Cuisine (*Masakan Barat)* course has four modular units consisting of SKU1103: Fundamental of Basic Cookery (knife skills, hygiene and sanitation, kitchen safety, SKU1202: Breakfast, SKU 1303: Appetizer (salads and dressing, stocks, soups, sauces) and SKU1403: Main Course (pasta and starches, poultry, meat, fish and shellfish). The curriculum is mapped to the roots of formal culinary education which is the seminal professional cookbook by George Auguste Escoffier: Le Guide Culinaire (2011/1903) (Miller & Deutsch, 2016). The main focus of the course is to equip students with knowledge and skills related to (i) hygiene, sanitation and safety practices at the workplace, (ii) introduction to the tools, equipment, and basic kitchen operations; (iii) perform technique and cooking methods that fulfil industry standards, (iv) assess the taste, look, texture and preparation time of end product, (v) preparation, garnishing and serving process, and (vi) working individually and in groups. At the end of the Basic Western course, students should be able to (i) identify western cuisine concepts and its importance in the industry; (ii) identify, explain and practice basic kitchen operations; (iii) adhere to kitchen safety, hygiene and sanitation practices; and (iv) identify, explain and replicate basic commodity cutting and cooking method.

The Western Cuisine module offered in the first-semester of the Certificate in Culinary Arts programme at Malaysian Community Colleges is consistent with Escoffier's outline as mentioned before. Based on the aspiration to develop a knowledgeable and skilled Culinary Arts graduate, there must be an emphasis on training students to apply knowledge to solve problems instead of solely focusing on technical skills specific to their area of specialization, i.e., developing students' skill-based cooking. This was highlighted in a study on the effectiveness of the Western Cuisine module towards students' practical performance of manual (psychomotor) skills study conducted in the Community College Culinary arts classroom by Reezlin Abdul Rahman, Mohamad Amer Hasbullah, and Zahari (2011). They found that instructors emphasised on developing skill-based cooking skills, and students lacked the knowledge to solve related problems due to the lack of emphasis on theory. The Culinary Arts course offered at Community Colleges follows the traditional culinary arts instruction based upon the master-apprentice framework and the kitchen hierarchy structure developed by Escoffier in the early 20th century (Deutsch, 2014; Woodhouse, 2016). The recipe-based pedagogy is limited to the following: the chef-instructor demonstrates the recipe, then the students diligently replicate the demonstration, and the chef-instructor provides feedback based on the outcome (Brown, Mao, & Chesser, 2013; Deutsch, 2014; Noe, 2005).

In foundational culinary arts courses, the traditional techniques and repeated training (i.e., lecture and demonstration) are the norms (Hu, Horng, & Teng, 2016). Instructors seem to focus more on transmitting technical skills and repeated training, rather than keeping students engaged with creative problem-solving opportunities (Brown, Collins, & Duguid, 1989; Hannafin & Land, 1997; Wang, 2015). The main disadvantage of repeated training with familiar situations is that they seem to be useful when solving simple, well-structured problems, but, when procedures fail to work or when facing an unfamiliar situation, students are at a loss on what to do (Jonassen, 2004); for example, when facing unexpected incidents in the food service industry such as a missing delivery when receiving items, having many more guests than anticipated or a power supply disruption (Deutsch, 2016). Owing to this, Abdul Rahman (2011) suggests a reform to the current instructional approach such that instructors pay attention to creating a balance between theoretical knowledge and applied knowledge so that students can solve related problems, instead of focusing solely on developing technical skills in Culinary Arts.

A call for reform of the traditional pedagogical model in Culinary Arts education is also happening at the global level as scholars have advocated for changes to the way of teaching hospitality and culinary-related skills education (Herrington & Oliver, 2000; Lewis & Beach, 2011; Lin & Cherng, 2006; Marsick, Watkins, & O'Connor, 2010; Pratten & O'Leary, 2007). It has been proposed that hospitality and culinary arts students are to be prepared to face an increasingly challenging workplace environment (Barron & Maxwell, 1993; Bourdain, 2013; Ko, 2015; Nornazira Suhairom et al., 2014; Riggs & Hughey, 2011; Zahari et al., 2009).

Culinary Arts students are expected to become trained cooks especially on their first job (Ko, 2012) and should be able to gain employment in professional kitchens such as restaurants, canteens, and cafes (Pratten & O'Leary, 2007; Steno & Friche, 2015). However, industry key players are voicing out their dissatisfaction with hospitality and culinary students. It was revealed that hospitality and culinary students were lacking basic skills required for them to function effectively in the workplace (Hegarty, 2004; Hertzman & Maas, 2012; Hertzman & Stefanelli, 2008; Ko, 2015; Lin & Cherng, 2006; Müller, VanLeeuwen, Mandabach, & Harrington, 2009; Riggs & Hughey, 2011). Similarly, many culinary graduates also have expressed their dissatisfaction at being unable to apply what they have learnt at culinary schools when they join the workforce (Ko, 2015; Müller et al., 2009; Yao-Fen & Chen-Tsang, 2014). Culinary graduates lamented that what they have learnt previously may not be connected to what practitioners perform at the workplace (de Bruijn & Leeman, 2011; Herrington & Oliver, 1995). This often results in many graduates leaving the industry after realizing a mismatch exists between actuality and expectation (Brown et al., 2015; Ko, 2015; Kusluvan & Kusluvan, 2000; Müller et al., 2009; Pratten & O'Leary, 2007; Steno & Friche, 2015). Thus, to meet industry expectations, there is a need to find out the crucial content elements to learn according to perceived importance by industry practitioners (Kilbrink, Bjurulf, Olin-Scheller, & Tengberg, 2014; Min, Swanger, & Gursoy, 2016).

The issue of local graduate employability was put as a priority on the Malaysian government's agenda to better respond to the needs to produce relevant human capital. In an effort to address this issue, not only current trends in employers' demands for particular skills should be studied, but proactive steps must be taken to develop these skills among graduates. According to the Malaysia Education Blueprint for Higher Education (2015-2025), this can be achieved by enabling the industry to lead curriculum design and delivery. Hence, curriculum planning should involve the participation of industry representatives and experts to reflect the most recent trends (Lin & Cherng, 2006; Maier & Thomas, 2013; Spowart, 2011; Zhong, Couch, & Blum, 2013). Thus, in the study, the consensus from industry and expert practitioners are sought to design and develop the Problem-solving Flipped Classroom (PSFC hereafter) module.

More advanced problem-solving skills are needed than ever before for today's ill-structured nature of work (Bereiter & Scardamalia, 1993; Jonassen, 1997; Lohman, 2004; Mohamed et al., 2011; Muhd Khaizer Omar, Ab. Rahim Bakar, & Abdullah Mat Rashid, 2012). However, the opportunity to gain knowledge and skills based on authentic real-world problems or tasks which are very relevant to TVET education is hardly put into practice (de Bruijn & Leeman, 2011) as there are no standardised means of implementation outlined in the curriculum. The situation is that TVET graduates struggle to integrate theoretical knowledge and practical experience (Caruso, Cattaneo, & Gurtner, 2016; de Bruijn & Leeman, 2011). Industry practitioners focus on proven practices (Jayawardena, 2001). Some researchers suggest that emphasis must be placed on subject matter content and its application to nurture real-world problem-solving skills (Ko & Chung, 2015). This is because teaching practice without a theoretical base will produce graduates who can only follow proven models but are unable to create new ones to deal with unusual situations or real-world applications (Jayawardena, 2001). If students truly understand the principles and concepts behind a theory, they can learn to analyse any problems faced in the real-world (Jayawardena, 2001). To achieve this, a combination of the theoretical foundation of subject-matter knowledge and hands-on practicum learning can be used (Brown, 2005). Even more importantly, Ko (2012) asserted that students would only be able to appreciate the theory learnt if it is brought together through applied learning so that they can understand both "what" and "why" to develop their abilities to solve real-world problems and for meaningful learning to occur.

However, instructors are facing issues to utilise fully the scheduled class time for more meaningful learning to occur (Sams & Bergmann, 2013; Willey & Gardner, 2013). Instructors seem to lack sufficient time to cover both subject matter content knowledge and discuss problem-solving within the stipulated time in class (Brown, 1998; Garton & Cano, 1996; McCallum, 2013). Technology may be a solution as it is a standard part of students' daily lives. Technology can be integrated into TVET via a flexible and blended approach to planning the use of in-classroom time and out-of-classroom time properly (UNESCO, 2013a). The Flipped Classroom (FC hereafter) approach is a blended learning strategy enabling the planning of in-classroom time and out-of-classroom time properly. The out-of-classroom time can be conducted online for students to come prepared with knowledge and comprehension of subject matter, whereas the main face-to-face learning activity during in-classroom time can be designed around tasks or problems. This means, scheduled class time can be utilised for more meaningful learning to occur by conducting problem-solving activities for a deeper understanding of subject matter (Bergmann & Sams, 2012; Bharali, 2014; Hoffman, 2014; O'Flaherty & Phillips, 2015).

Statement of the Problem

TVET graduates should have technical skills as well as be able to solve problems and thinking critically to be able to transfer knowledge in attempting non-routine tasks in a variety of situations (UNESCO, 2014b). This is in line with the National Education Philosophy that stated students and graduates at the higher education level must be able to think critically and innovatively and solve problems (Ministry of Education Malaysia, 2015). Identifying and solving problems are the core of actual professional experience that graduates need to perform in the workplace and society in general (Doornekamp, 2001; Hedges, 1996). Past studies have also shown that TVET graduates need to acquire problem-solving skills as this enables them to transfer the technical skills learnt to new situations (Garton & Cano, 1996; Hämäläinen, Cincinnato, Malin, & De Wever, 2014; Pithers & Soden, 1999; Rasul, Rauf, Mansor, Yasin, & Mahamod, 2013; Soden, 2013; Soden & Pithers, 2001; Sudsomboon, 2011).

However, TVET graduates seem to be performing poorly in problem-solving tasks (Gvaramadze, 2010; Hämäläinen et al., 2014; Hart Research Associates, 2013; Panth, 2013; St. Louis Community College, 2013). This issue was also highlighted in a large-scale international assessment across 11 European countries which found that only a minority of TVET graduates can solve problems in Technology-Rich Environments (TREs) using computers and computer networks at a high level (Hämäläinen et al., 2014). Another shocking trend evident in all countries participating in the study was that TVET graduates were more likely to be at risk or weak performers when compared with graduates with upper secondary education or higher (Hämäläinen et al., 2014). Low-skilled adult workers in Denmark and South Korea are losing their jobs because they lack the problem-solving skills and communication skills that employers require (Gvaramadze, 2010). The Association of American Colleges and Universities surveyed 318 employers where an astounding 90% of employers pointed out that graduates lack problem-solving skills. Therefore, more employers had to train graduates to solve problems and apply knowledge to real-world settings (Hart Research Associates, 2013).

The poor performance on problem-solving tasks by TVET graduates is also a primary concern in the Malaysian context as graduates lack generic student attributes (GSA) which are in demand by the industry. The National Graduate Employability

Blueprint between 2012 to 2017 published by the Ministry of Higher Education (2012) reported that fresh graduates lack the depth of skills related knowledge (23.8%) and are unable to solve problems (25.9%). Similarly, the Malaysia Education Blueprint 2013 to 2025 again depicts employer concerns about the lack of higher order thinking skills including problem-solving and creativity among graduates (MOE, 2012b). Additionally, several local studies on technical-vocational students in Malaysia also have consistently documented that they lack problem-solving skills (Department of Community College Education, 2011; Mimi Mohaffyza Mohamad, Yee Mei Heong, Nurfirdawati Muhammad Hanafi, & Tee Tze Kiong, 2014; Zaliza Hanapi, Mohd Safarin Nordin, & Khamis, 2015). It is concluded that TVET graduates need to master problem-solving skills so that they will be able to apply knowledge and to think critically when facing non-routine situations which are beyond academic contexts.

Malaysia was ranked in the bottom third out of 74 and 65 countries that participated in the PISA 2009 edition and PISA 2012 respectively, and below the Organisation for Economic Co-operation and Development (OECD) average in the mathematics, science and reading literacies (Thien, 2016). The PISA results of Malaysia are below the international and OECD average. These results have suggested the poor levels of problem-solving skills among 15-year olds which have been the subject of intense debate within the education fraternity. A 2014 World Bank Report by Gil Sander et al. (2014) notes that the ‘under-performance’ also appears to worsen over the years. This may be because PISA is an assessment of students’ ability to solve problems focused on real-life applications, which tends to be more difficult for students to master (Clarke, 2016).

Community College graduates seem to lack problem-solving skills and were not innovative, despite having technical skills specific to their area of specialization

(Awang, Ibrahim, Hussain, Ramli, & Lyndon, 2013). In particular, culinary students at Community Colleges were reported unable to transfer their knowledge to new environments or solve related problems (Reezlin, Ishak, Zahari, & Inoormaziah, 2012). The ability to solve problems effectively and efficiently is crucial for Community College culinary students as the culinary arts workplace environment has become increasingly challenging and competitive. This requires graduates to possess skills such as problem-solving to adapt and transfer learning to different situations (Ko, 2015; Müller et al., 2009; Thomas, 1992; Way, Ottenbacher, & Harrington, 2011; Yao-Fen & Chen-Tsang, 2014; Zahari et al., 2009). Thus, foodservice operators and restaurant managers are looking for employees who can identify problems and take the initiative to come up with a workable or creative solution especially when solving on the ground problems (Deutsch, Billingsley, & Azima, 2009). Additionally, employers demand employees who have the ability to be innovative, engage in successful troubleshooting activities, and are able to handle uncertainty (Middleton, 2002).

Without the ability to transfer knowledge and solve problems, culinary arts students are unprepared to participate in the "real-world of restaurant work" (Hegarty, 2004) and unable to meet the workplace standards (Foster, 1965; Hegarty, 2004; Ko & Chung, 2015; Meijers, 2008; Tóth, 2012). It has also been stated that there is a gap between learning at school and the workplace that needs to be bridged (Kilbrink et al., 2014). Hence, to solve the lack of problem-solving skills needed for employability among culinary graduates, students need lessons with more practice in addressing real-world problems using authentic contexts, coupled with instructors' guidance. This can be achieved by adopting a more authentic approach to the problem-solving process itself. To meet these requirements, Culinary Arts students must acquire competencies in being better problem solvers as outlined in the curriculum.

Culinary instructors must play a role in providing guidelines and recommending methods to raise the quality of culinary art education (Hegarty, 2011). They also have a role in providing guidelines and recommending methods to prepare students to be critical thinkers and problem solvers in culinary arts education (Hegarty, 2011; Ko & Chung, 2015). It is stated in the curricular document that at the end of the program, Community College Culinary Arts Certificate course students should be able to solve problems creatively and innovatively. Even the National Occupational Skills Standards (NOSS) document highlights that one of the core abilities in the employability skills outlined is applying problem-solving strategies. However, Zaliza Hanapi et al. (2015) pointed out that despite receiving instruction to integrate elements of employability in their teaching and learning, Community College instructors did not emphasise the importance of employability skills during the teaching and learning processes. Factors found to be influencing this lack of emphasis on employability skills are that instructors are free to embed these skills into their curriculum in ways they deem right without any standardised means of implementation or assessment of its impact (Jennifer Chan Kim Lian, 2011; Parmjit Singh, Roslind Xaviour Thambusamy, & Ramly, 2014). Thus, instructors only choose to emphasise the skills related to teaching and assessment in the curricula such as teamwork and interpersonal skills (Parmjit Singh et al., 2014).

Thus, there is a gap between policy and implementation for instructors to embed problem-solving approaches for students to acquire their competencies in being better problem solvers in the existing practice. It has previously been observed that the emphasis on culinary skills in current teaching practices results in the lack of focus on cultivating problem-solving and response abilities required in the workplace (Hegarty, 2011; Shani, Belhassen, & Soskolne, 2013; Wang, 2015) as the traditional techniques and repeated training (i.e., lecture and demonstration) are the norm (Hu et al., 2016). According to Deutsch (2016), the traditional culinary teaching practices inhibits student ability to think innovatively which is required when they join the workplace environment. With the essential problem-solving skills, students will be able to recognise a problem, apply decision-making strategies and solve problems by applying creative, innovative and practical solutions (Rahmat, Ayub, & Buntat, 2016).

Nevertheless, instructors may be good in the subject matter, but may not have the pedagogical knowledge to incorporate suitable instructional strategies to develop students' problem-solving skills. Instructors need proper guidance to incorporate suitable instructional strategies (Porcaro, Jackson, McLaughlin, & O'Malley, 2016). This was also reflected in the findings of a preliminary study of current problem-solving teaching practices at a Community College; it was found that instructors tend to focus more on technical skills (cooking skills) rather than problem-solving skills (Umawathy Techanamurthy, Norlidah Alias, & Dewitt, 2015). The preliminary study also revealed that instructors usually leave it to students to learn problem-solving skills during their industrial attachment, at the workplace, or when they pursue their studies at higher levels (Umawathy Techanamurthy et al., 2015) which highlight the current teaching practices of problem-solving at Community Colleges. It was found that both the Community College curriculum and the NOSS document for the Kitchen Sector does not provide instructors with instructional guidance or instructional materials such as real-world problems that can be used for a problem-solving approach to instruction.

The problem-solving approach to instruction requires instructors to be trained in teaching with authentic problems using real-world problems (Buttles, 2002). There seems to be a lack of support for instructors to teach authentic real-world problems (de Bruijn & Leeman, 2011). When curriculum materials are not provided, there is the probability of significant variation between what the curriculum specifies that students should learn, what instructors teach, and what students learn. This scenario adds urgency to the search for designing effective instructional strategies and instructional materials and using real-world problems. Besides the issue of shortage of curriculum materials and lack of support for instructors to teach authentic real-world problems, another limitation is the lack of time due to the competing service demands which also poses a big challenge to the instructors (Lin et al., 2017).

The use of Flipped Classroom (FC) which focuses on providing an avenue for problem-solving is still rather limited to the notion that more time is available to teach problem-solving during the scheduled session when content delivery is shifted to "before class" sessions (O'Flaherty & Phillips, 2015). There also seems to be a lack of research on how to design an effective problem-solving environment using the FC approach in the field of Culinary Arts which warrants further research. Thus, instructors need guidance to implement FC which spells the need for an underpinning instructional design framework, along with an understanding of how to use available technologies effectively to successfully flip their classrooms (Karanicolas et al., 2016; Porcaro et al., 2016). There is still a huge void to be filled to account for FC implementation at Community Colleges in Malaysia as most studies focus on other HEIs. To date, FC for culinary arts education within the context of Malaysian Community Colleges also has not been studied. An understanding of how to support the teaching and learning of problem-solving in the FC environment is also limited, and a model to guide implementation has been slow to emerge. Plus, little research work had been conducted on whether incorporating technology in the classroom correlates with increases in knowledge or skills (Molnar, 2017).

This study allows the Department of Community College, Higher Education Sector, Ministry of Education of Malaysia to consider using the FC approach for problem-solving instruction at Malaysian Community Colleges to develop students' problem-solving skills. The findings of the study provide an avenue for problem-solving instruction using the FC approach to be conducted using the designed instructional model as a guide for implementation to instructors who have little idea how to apply them to teaching practice using technology. This study also benefits future employers and foodservice operators who value graduates having the highly sought after real-world problem-solving skills. Culinary students who are knowledgeable and possess problem-solving skills should be able to reduce mistakes, produce more cost-effective solutions, and gain client satisfaction when dealing with workplace problems. This study also benefits curriculum designers at Community Colleges, Polytechnics, and other TVET institutions.

Purpose of the Study

The purpose of this study is to design and develop a Problem Solving Flipped Classroom (PSFC) module for Culinary Arts at Community Colleges. The PSFC module aims to develop students' problem-solving skills and improve their knowledge using problem-solving activities that are transferable to authentic professional problems. I studied the needs of the Culinary Arts students and instructors to investigate the possibility of using the FC approach for problem-solving instruction in a Culinary Arts setting. To date, a module on FC approach for problem-solving instruction at Community Colleges has still not yet been investigated. Thus, developing the PSFC module is timely and useful given the importance of problem-solving skills development among TVET graduates at Community Colleges.

Objectives of the Study

Based on the problem statement, the design and developmental study is employed to develop a PSFC module for Culinary Arts at Community Colleges. This study is divided into three phases: the analysis phase, the design phase, and the evaluation phase. The following are the objectives of the study according to the different phases:

Phase 1: Needs Analysis

1) To identify the needs to develop a Problem-Solving Flipped Classroom (PSFC) module for Culinary Arts at Community Colleges.

Phase 2: Design and Development

1) To identify the appropriate elements for the design of the PSFC module for Culinary Arts according to experts' opinion.

2) To develop the PSFC module for Culinary Arts according to experts' opinion.

Phase 3: Evaluation

1) To evaluate the effectiveness of the PSFC module on Culinary Arts students' cognitive knowledge (learning gains) and problem-solving skills.

2) To evaluate students' perception of their learning experience using the PSFC module.

3) To evaluate the pedagogical and technical usability of the PSFC module.

Research Questions

Based on the problem statement and research objectives, the following are the research questions for this study according to the three phases of the developmental approach of the study.

Phase 1: Needs Analysis Phase

i. What are students' perception of their level of problem-solving skills?

ii. What are students' level of readiness towards adopting the FC approach if it is incorporated into the Culinary Arts course at Community Colleges?

iii. What are the current teaching practices among Culinary Arts instructors at Community Colleges?

Phase 2: Design And Development Phase

i. What are experts' views on the elements that should be incorporated into the PSFC module for Culinary Arts at Community Colleges in terms of objective, content to develop real-world problems, instructional strategies, resources/media, and assessment?

ii. Based on experts' consensus, how should the elements be included in the development of the PSFC module?

Phase 3: Evaluation Phase

i. Is the PSFC module effective for improving students' cognitive knowledge (learning gains)?

ii. Is the PSFC module effective for developing students' problem-solving skills?

iii. What are students' perceptions of their learning experience using the PSFC module?

iv. Is the PSFC module pedagogically and technically usable?

Rationale of the Study

The rationale of this study is to develop TVET graduates who possess not only technical skills according to their area of specialisation, but also possess soft skills that support problem-solving, critical thinking, teamwork, and creativity as required by industry (UNESCO, 2015) by improving the TVET curricula delivery (UNESCO, 2017). According to an OECD report, despite the increase in tertiary enrolment, employers have voiced out their dissatisfaction with the lack of skills required by industry (OECD, 2016). It is also noteworthy that regions that have been historically producing highly skilled workers such as Europe and Central Asia are also facing issues of mismatch between the skills required by the economy and the skills produced by the TVET system (UNESCO, 2015). Past studies by UNESCO have also concluded that current TVET systems poorly support soft skills development (UNESCO, 2013b, 2013c, 2015). Higher Learning Institutions (HLIs) should not just focus on supplying a skilled workforce but ensure that the programmes offered are aligned with the workplace demands which can be achieved by improving industry linkages to expose students to industry and also using real-world problem-based exercises to develop the skills.

The Malaysian government also places great emphasis on developing TVET programmes in the country to be able to produce quality TVET graduates as identified in the fourth pillar in the Blueprint (Ministry of Education Malaysia, 2015). It has been reported that 97.2% of Community College graduates entered the workforce six months upon graduation, compared to 88.6% of Polytechnic graduates and 87.1% of Malaysian Technical University (MTUN) graduates (Ministry of Higher Education, 2016). This statistic clearly shows that there has been an increase in employer demand for local TVET graduates, especially Community College graduates.

However, skills such as advanced problem-solving skills are needed than ever before for today's ill-structured nature of work (Bereiter & Scardamalia, 1993; Jonassen, 1997; Lohman, 2004; Mohamed et al., 2011; Muhd Khaizer Omar et al., 2012). What seems to be the problem is at the foundation level for culinary arts courses such as the ones offered at Community Colleges, where the focus is more on technical knowledge of cooking techniques and hands-on skills, rather than cognitive knowledge (Brown et al., 2013; Kraiger, Ford, & Salas, 1993; Reezlin Abdul Rahman et al., 2011; Reezlin et al., 2012). Thus, the rationale for a focus on Community Colleges is based on the need to improve the quality of teaching and learning at foundational level courses offered at Community Colleges due to the high demand for Community College graduates. This is more pertinent when Community College graduates need to be not only equipped with technical skills, but also possess problem-solving skills aligned with workplace demands. Technical skills such as knife skills and cooking skills emphasised during foundational culinary arts courses are deemed no longer sufficient for survival in the industry (Horng & Lee, 2009; Müller et al., 2009; Rinsky, 2012; Shani et al., 2013). Thus, the Certificate level Culinary Arts Course which is a foundation level Culinary Arts program offered to students at Community Colleges is chosen as the context of the study. The lack of emphasis on teaching problem-solving skills to Culinary Arts students has led to the rationale of freeing up classroom time for Culinary Arts instructors, to test the FC based on problem-solving approach as a possible effective teaching method for instructors to provide problem-solving opportunities for students to enhance their learning and problem-solving skills.

Significance of the Study

This study is significant given the lack of literature related to problem-solving in the FC approach in Culinary Arts education. The findings in this study can potentially lead to significant contributions to the Ministry of Higher Education (MOHE), Department of Community Colleges (DCCE), Community College Culinary Arts instructors, Community College Culinary Arts students and to the body of knowledge. The findings of the study imply that the developmental research of PSFC module for Culinary Arts has also given valuable inputs regarding technology-mediated teaching and learning at Community Colleges.

Firstly, the findings in this study offer empirical proof that the PSFC module can be a possible solution to promote knowledge gains and problem-solving among students, especially Community College students who are mostly low achievers with poor academic results and may struggle with traditional lectures. Using the PSFC module, Culinary Arts students develop their employable skills compared to just developing their technical skills or psychomotor skills which are emphasised in the traditionally taught curriculum. With students fully prepared for the future, our communities will be best positioned to compete successfully in the global economy.

The module in this study can be used for other institutions offering the Culinary Arts programme as the findings in this study provide some important insights on the content, instructional strategies, media and materials, platform/technology and assessment strategies that can be used to design and develop instruction. The involvement and participation of industry representatives and experts are sought to design and develop the PSFC module to reflect the most recent trends in FC, problem-solving, and culinary arts. This study is also aligned with the Malaysia Education Blueprint 2015-2025 for Higher Education (Ministry of Education Malaysia, 2015) which highlights the participation of industry to lead curriculum design and deliver improvement in developing skilled TVET graduates to match industry needs.

Next, this study makes an important contribution to culinary instructors who receive the much-needed support and guidance to implement problem-solving instruction in a FC. For example, on how technologies could be used to link all activities to learning objectives in order to ensure relevance for the students (UNESCO, 2013a) and to confidently integrate ICT and innovative methodologies into their teaching (Hoang, Tong, Hoang, & Nguyen, 2010; Ismail, Bokhare, Azizan, & Azman, 2013; Neal, 2011; UNESCO, 2013d; Yasin, Nur, Ridzwan, Ashikin, & Bekri, 2013).

This study extends past studies by developing problems based on the existing typology of problems outlined by Jonassen (2011). Specifically, this study focuses on problems caused by mistakes in Culinary Arts that seem to be related to troubleshooting, and problems caused by changes in situations that seem to be related to decision-making problems and design problems, which were the least researched problem types according to Jonassen (2010). The problems designed are closely related to the students' needs for future professional development or immediate everyday life (Hung, 2006) and aligned to the suggested problem-solving tasks that can be conducted in a culinary classroom as suggested by Deutsch et al. (2009).

In addition, the usability evaluation of the PSFC module further added value to the study as it made it clear that FC using mobile devices in teaching and learning is feasible for implementation in the context of Malaysian Community Colleges.

Hence, policymakers in the DCCE are able to leverage educational technology use to enhance the development of generic skills among students. The methodology of the study can be adopted by policymakers for developing instructional materials for Community Colleges. The key issues following implementation of FC in Community Colleges can be used as a basis to develop a set of guidelines for policymakers, TVET educators, culinary educators and instructional designers to embed problem-solving approach to instruction.

Limitations of the Study

The following are identified as limitations to the study. Firstly, within the theoretical basis of cognitive skills, many higher cognitive skills go beyond problem-solving, namely, reflective thinking, creative thinking, critical thinking, and metacognition. However, investigating all these types of cognitive thinking may not be feasible. Thus, in determining module elements, the present study is limited to selecting a problem-solving model which has not been explored deeply in the FC area of study.

Next, the study is limited to its participants who are Certificate Level Culinary Arts programme students and instructors at two Malaysian Community Colleges as diploma level students have different needs and requirements. The study was conducted for the Certificate Level Culinary Arts programme offered at Community Colleges because this module contains the fundamentals to culinary arts courses. Hence, the module development was context specific (Richey, Klein, & Nelson, 2004; Wang & Hannafin, 2005) where the data collected from the intervention may not apply to similar interventions in different subjects or courses. Thus, the results may not be generalisable to all certificate level culinary courses for all higher institutions, but it may be generalised to all certificate level culinary students at Malaysian Community Colleges.

This study focuses on developing the PSFC module which follows the developmental research approach. The developmental research approach starts with the analysis phase, followed by the design phase and finally the evaluation phase. In terms of methodology, the PSFC module is developed based on the needs analysis of culinary instructors and culinary students in the Needs Analysis phase. In the development phase, the Fuzzy Delphi Method (FDM) is used to seek experts' opinions which are dependent on the selection of experts and their opinions. In the development phase, 19 experts are involved. Hence, results may vary depending on the variety and the number of experts being sought. Thus, the information found in this study cannot be generalised as the findings are specific to the context.

Conceptual Framework of the Study

The focus of this study is to design and develop a FC module based on problem-solving at Community Colleges and to assess the module effectiveness and usability. The module is designed and developed based on expert consensus to overcome the research problem where students lack problem-solving skills. The conceptual framework in this study shows that the module comprises the integration of the First Principles of Instruction (FPOI) (Merrill, 2007) as the instructional model and Cognitive Apprenticeship Theory (Collins, Brown, & Newman, 1990) as the learning theory based on the FC model using Merrill's First Principles of Instruction (Lo & Hew, 2017). This section highlights the relationship between the FC approach, Merrill's First Principles, and Cognitive Apprenticeship. It also demonstrates how the instructional strategies can be incorporated into a cycle of instruction based on these principles that enhance students’ problem-solving skills. The conceptual framework of the study can be summarised as shown in Figure 1.1.

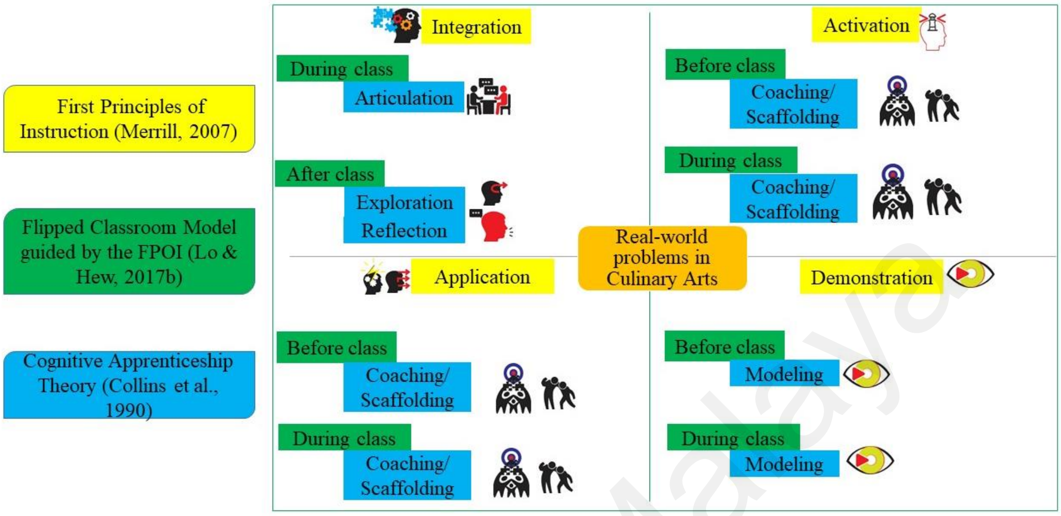


Figure 1.1 Conceptual Framework of the flow of instruction in the PSFC module.

The FC model by Lo and Hew (2017) has distinct in-classroom and out-of-classroom activities guided by the First Principles of Instruction (Merrill, 2007). Merrill’s First Principles focuses on phases based on a real-world problem or task and begins with activation, followed by demonstration, application, and integration. Lo and Hew (2017) suggested that before class activities involving the activation, demonstration and application phase are conducted using video lectures. During class, the suggested strategies are mini-lectures that showed the tasks that students can handle upon completing the mini-lecture [problem-centered: show tasks]. This is followed by the teacher activating students’ prior knowledge by recalling relevant concepts or previously learned knowledge [Activation phase]. Next, the teacher demonstrated new knowledge, strategy, or procedure for solving the problem [Demonstration phase]. After viewing the mini-lectures, it was suggested that students apply knowledge learned by answering mini-quizzes so that they could analyse their responses to the questions [Application phase].

During face-to-face sessions, it was suggested that the activation, application and Integration phase be conducted. In these sessions, the teacher reviews the topics covered in the video lecture to clarify any misunderstandings [Activation phase]. Students then apply the concepts learned by solving simple problems either individually or in pairs [Application phase]. It was also suggested that students apply their knowledge in solving more advanced or real-world problems using group discussion by getting support from the instructor and peers [Integration phase].

This study extends past studies concerning FC designed with Merrill's First Principles by also including the Cognitive Apprenticeship model. The Cognitive Apprenticeship model is used as it fits the Culinary Arts pedagogical model which focuses on both hands-on practicum sessions and theoretical sessions. The Cognitive Apprenticeship model which consists of six methods namely Modeling, coaching, scaffolding, articulation, reflection, and exploration was included in the different phases of instruction. Using the cognitive apprenticeship approach resulted in the instructor becoming a facilitator who models (demonstrates), scaffolds (supports), fades (gradually decreases guidance) and coaches (offers suggestions, feedback and hints to the student)(Kerka, 1997) whereas TVET students in a cognitive apprenticeship are engaged in acts of articulation, reflecting and exploring in the social context. The coaching and scaffolding can be conducted seamlessly before, during and after class. Modeling can occur during the demonstration. Thus, in this study, there was distinct before class, during class and after class activity guided by the Cognitive Apprenticeship theory and Merrill's First Principles in the FC to organise the FC based problem-solving approach. Table 1.1 summarises this section and shows the relationship between the FC approach, Merrill's First Principles and Cognitive Apprenticeship.

Table 1.1

The Conceptual Framework for Organizing Instruction in the PSFC Module

Flipped Classroom	**FPOI**	**Cognitive Apprenticeship**	**Strategies used in the PSFC module**
Before Class	Activation	Coaching and Scaffolding	Ask questions to assess students' prior knowledge (Merrill, 2007)
	Demonstration	Modeling	Have students view video clips on key areas (domain knowledge) (Lo & Hew, 2017)
			Have students complete assigned reading (Hsieh, 2017)
	Application	-	Have students complete quiz ((Lo & Hew, 2017)
During class	Problem-centered		Base learning activities around problem-solving
			Have students to participate in small group discussion of problems from simple to more complex (Lo & Hew, 2017)
	Activation	Coaching and Scaffolding	Review topic (Lo & Hew, 2017)
	Demonstration	Modeling	Students view Modeling of expert performance/processes in the world (Collins et al., 1990)
	Application	Coaching and Scaffolding	Have students use critical thinking to solve content-related problems (Gardner & Belland, 2011)
			Instructor provides corrective feedback and hints to students (Collins et al., 1990)
			Instructor presents new supportive information for tasks
			Students complete task, scaffolding slowly removed as learners improve (Collins et al., 1990)
	Integration	Articulation	Student presentation on learning process (Collins et al., 1990)
After class	Integration	Exploration	Have students complete more complex task
		Reflection	Students reflect on their learning (Collins et al., 1990)

Operational Definitions

Chef practitioners. Culinary industry chefs, also known as chef practitioners are chefs working in the industry

Community colleges in Malaysia. Community Colleges are higher education institutions (HEIs) under the purview of the Department of Community College Education (DCCE hereafter), under the Ministry of Higher Education of Malaysia (MOHE hereafter). Community Colleges are higher education TVET providers to develop not only knowledge workers but talented skills to supply skilled TVET workers. To date, there are 94 Community Colleges in Malaysia offering both Certificate and Diploma courses in tourism and hospitality, computer, fashion, automotive, pastry and confectionary and others.

Culinary instructors. Chefs working in the field of culinary education, or culinary educators, who have left the industry to shift their focus toward training the next generation of chefs by teaching culinary arts.

Culinary arts. Culinary arts refer to the art of preparing, combining cooking techniques, and the aesthetics of displaying and serving meals (Ko, 2015; Mack, 2012). A culinarian working in a kitchen is commonly referred to as a cook or a chef. In this study, culinary arts refer to the study of cooking techniques, food preparation, display, and serving.

Effectiveness. Wojtczak (2002) defined effectiveness as a measure of the extent to which a specific intervention, procedure or service, when deployed in routine circumstances, does what it is intended to do. (Erlendsson, 2002) defined effectiveness as the extent to which objectives are achieved or “doing the right things”. In this study, the findings determine whether the PSFC module is effective or not in increasing students’ learning gains and problem-solving skills**.**

Flipped classroom. Bishop and Verleger (2013a) define the Flipped Classroom (FC) as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. In this study, the before class session included activities that enabled students to link between online and face-to-face sessions and also promote learners' motivation to come to class prepared. The instructor engaged students during the "before class" session by using online polls, sharing images, audio clips and instructional videos. During the face-to-face setting, students worked on real-world applications of the concepts they had covered before class. Students worked in groups and received coaching from instructors throughout the lessons. They were required to articulate their problem-solving strategies and the processes. The real-world problems were arranged from simpler to more complex and were relevant to the workplace settings in the local context. After lessons were delivered, students were encouraged to reflect on the problem-solving process and the link between what was covered before and during class.

Flipped Classroom readiness. Mohammed Amin Embi, Supyan Hussin, and Panah (2014) identified different Flipped Classroom readiness factors such as technology access, online skills, motivation, ability to use online audios/videos, Internet discussions, and importance to success. In this study, students answer a questionnaire which contains the same items on FC readiness as used by Mohammed Amin Embi et al. (2014).

Learning Management System (LMS). A Learning Management System (LMS) is a course management and delivery system which provides web-based access to course content materials, communication tools, and evaluations and assessment tools to support classroom instruction, blended and online course delivery (Araño-

Ocuaman, 2010). In this study, the LMS used was *Schoology*, which is available free of charge and contains various functionalities to manage content materials and assessments. In this study, students access the LMS using the app version on their smartphones. Each lesson folder in the LMS is divided into three subfolders, namely "Before Class" session, "During Class" session and "After Class" session. Each folder is further subdivided according to instructional materials for the different phases of instruction, namely: Activation, Demonstration/Modeling, Application, and Integration. Following Maddux and Cummings (2007), the *Schoology* platform in the study "could be described more accurately as a lesson plan format" (p. 120). Thus, in this study, the *Schoology* platform is used by the instructor to access instructions and materials systematically according to the seven major phases of instruction of the PSFC model: Activation (*Fasa Pengaktifan*), Demonstration (*Fasa Demonstrasi/Pemodelan*), Application (*Fasa Aplikasi*), Integration: Articulation (*Fasa Integrasi: Artikulasi*), Integration: Exploration (*Fasa Integrasi: Eksplorasi*), Integration: Reflection (*Fasa Integrasi: Refleksi*), and Coaching and Scaffolding (*Bimbingan dan Maklum balas*).

Module. Russell (1974) defined a module as an instructional package that has a single conceptual unit of subject matter that can be used by individuals or small groups of students independently in different situations. A module also incorporates multimedia learning experiences so that the learners can hear or see the content and proceed or repeat the materials based on their rate of learning (Russell, 1974). Goldschmid and Goldschmid (1972) defined a module as "a self-contained, independent unit of a planned series of learning activities designed to help the student accomplish certain well-defined objectives". The PSFC module in this study is delivered through *Schoology* app which students accessed on their mobile devices.

Perception of learning experiences. In this study, the measurement of students' level of perception of their learning experience using the PSFC module involved content delivery, use of communication and collaboration tools, assessment and evaluation tools, and student learning experiences measured using a survey instrument administered to measure the students based on their personal learning experiences (Araño-Ocuaman, 2010).

Problem-solving. The ability to solve problems has long been an important skill in education. Problem-solving ability is being able to find out solutions to a problem using an organised thought process. For example, the process of solving problems can be done by understanding them, then planning, carrying out and evaluating plans to solve them (Gagné, 1985; Polya, 1981). Problem-solving is the ability to combine previously learned principles, procedures, declarative knowledge and cognitive strategies in a unique way within a domain of content to solve unfamiliar or non-routine problems (Smith & Ragan, 2005). Specifically, this study follows the components for teaching to solve real-world problems based on Merrill's First Principles and the seven stages of problem-solving processes (Barrows, 1996; Jonassen, 1997; Lohman, 2004) as a scaffold.

Problem-solving skills. Problem-solving skills are the activities students use when solving problems. In the context of this study, the problem-solving activities are the following problem-solving processes: (1) problem identification, (2) goal selection, (3) generation of alternative solutions, (4) consideration of consequences associated with alternative solutions, (5) approach to decision making, (6) implementation of solutions, and (7) evaluation of solutions which are used to develop their problem-solving skills.

Real-world problems. An authentic task has the natural complexity of the real-world (Brown et al., 1989; Herrington & Oliver, 1995). It involves the way knowledge can be used in the real-world daily and in the professional context which is closer to something that a professional in the field would do (Jonassen, 2004) and relates knowledge from more than one discipline (Francom, Bybee, Wolfersberger, & Merrill, 2009). In this study, authentic problems/tasks are defined as meaningful learning exercises that are obviously pertinent to the learners at the time of the study and may be helpful to them in their field of work or in life (Frick, Chadha, Watson, & Zlatkovska, 2010). The rationale for putting tasks on the basis of a learning environment is to promote knowledge application and skills transfer to practice (Dankbaar et al., 2017; Francom & Gardner, 2014)

Usability. Technical usability refers to how a technology-based application is convenient, practical, and usable for the user (Lavonen, Krzwacki, Koistinen, Welzel-Breuer, & Erb, 2012; Nielsen, 1999). Pedagogical usability refers to how the technology-based application system facilitates the learning of the material delivered (Nokelainen, 2006). In this study, both technical and pedagogical usability are considered. The technical usability evaluated are ease-of-use, efficiency, technical design and accessibility and navigability (Hadjerrouit, 2012; Nielsen, 1999). The pedagogical usability which supports the teaching and learning processes are user control, learner activity, collaborative learning, added value, motivation, flexibility and feedback (Hadjerrouit, 2012; Nokelainen, 2006).

Organisation of the Study

Chapter 1 is an introduction to the study. It includes the background of the study, problem statement, purpose and objectives, research questions, rationale and significance of the study, the limitation and the operational definitions. Chapter 2 is a review of the literature. It covers the areas of development of TVET education and culinary education in Malaysia, the need to teach problem-solving to students at Community Colleges, the need to integrate real-world problem-solving in TVET education, the current teaching practices in Culinary Arts education, development of FC and past studies related to the concept of Culinary Arts, Problem-solving and FC, and the theoretical foundations of this study. Chapter 3 details the methodology used for this study. It explains the methods and procedures used to collect, organise, and analyse the data. The results of this study are elaborated on in chapters 4, 5, and 6, wherein each separate chapter the results concerning a research question are described. Finally, in Chapter 7 conclusions are drawn, and the findings are discussed in the light of the literature.

CHAPTER 2

LITERATURE REVIEW

Introduction

This chapter begins with a description of Technical and Vocational Education and Training (TVET) globally, followed by a chronological description of TVET development in Malaysia. This is then followed by descriptions of the growth of Hospitality, Tourism and Culinary Arts Education, Issues in Culinary Arts Education, teaching problem-solving in the context of TVET, a review on the Flipped Classroom (FC) model, past studies in the context of Culinary Arts, Problem-solving, and FC, and the theoretical foundations which are used as a framework for the study.

Technical and Vocational Education and Training (TVET)

Different countries use different terms for TVET. The various terms that have been used are Apprenticeship Training, Industrial Arts, Vocational Education, Technical Education, Technological-Vocational Education (TVE), Occupational Education (OE), Career and Technical Education (CTE), Vocational Education and Training (VET), Professional and Vocational Education (PVE) and Workforce Education (WE), or Workplace Education (WE) (Ab. Rahim Bakar, 2011; Maclean, Jagannathan, & Sarvi, 2013b; UNEVOC, 2015). A consensus was reached during the second International Congress on Technical and Vocational Education, held in Korea in 1999, to use the widespread term of TVET by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and International Labour Organisation (ILO) together with member states and relevant agencies (Maclean, Jagannathan, & Sarvi, 2013a). The 2001 UNESCO and International Labour

Organisation (ILO) Revised Recommendation states that TVET is an array of learning experiences related to the study of a career in terms of its science and technological aspects, in addition to the required knowledge, skills, and attitudes. The concept of TVET used in Malaysia is consistent with the concept of TVET used by UNESCO (Maizam Alias & Hassan, 2012) and will be used in this study. In this study, the concept of TVET is the array of learning experiences related to the industry, which is Culinary Arts, and will focus on Community Colleges.

Considerable research has also been conducted on TVET pointing out that many countries across the globe have gained economic success by developing vocational education (Kebonang, 2014; Song Seng, 2007, 2011). This is because TVET plays a critical role in preparing human capital for fulfilling industry needs by providing the skills required at the workplace (Bakar & Hanafi, 2007; Inayat, Inayat, & Salim, 2013; Maclean & Pavlova, 2013). The skills required at the workplace are not only work-related knowledge (MacKenzie & Polvere, 2009), but also employability skills, such as self-awareness, self-esteem, interpersonal skills, citizenship, communication skills and entrepreneurship (Inayat, ul Amin, Inayat, & Badshah, 2013; 2008). Based on these critical roles that TVET has to offer, more effort has been taken to elevate the position of TVET in both developed and less developed countries by developing national policies and strategies for TVET.

During the last decade, the critical role of TVET in developing a highly skilled workforce for the nation has been at the centre of much attention. Various ministries and agencies are working toward ensuring Malaysia achieve the objective of having three million skilled workers by 2020. This includes the Ministry of Human Resources, MARA, Ministry of Youth and Sports, Ministry of Agriculture and Agro-Based Industry, Ministry of Education, Ministry of Higher Education, Ministry of

Defence, State agencies and the private sector (Ab. Rahim Bakar, 2011; Mohamad Sattar Rasul et al., 2015). The Malaysia Education Blueprint 2015 to 2025 (Higher Education) report outlined that Community Colleges, together with polytechnics and vocational colleges are the premier higher education TVET providers to develop talented skills to supply skilled TVET workers by 2020 (Ministry of Education Malaysia, 2015). The TVET system is believed to play a crucial role in developing a skillful workforce so that Malaysia as a nation can climb the value chain to become a High Income Nation (Pang, 2011).

Development of TVET in Malaysia. The history of skills development and training in Malaysia began in the late 1890s when local youths were trained at trade schools to work as mechanics and fitters in the national railways (Pang, Narunan Rajamorganan, & Simon, 2010). In 1906, Treacher Technical School, named after Sir William Treacher, the Resident-General during that time, began its operation at Weld Road, now known as Jalan Raja Chulan (Universiti Teknologi Malaysia, 2015). Treacher Technical School trained technical assistants for the Federated Malay States Departments of Railways, Survey and Public Works (Pang et al., 2010). In 1919, a committee was set up to review the needs for technical and industrial education. The committee decided to establish an agricultural school and provide training facilities for the Forest Department (Loh, 1975; Pang et al., 2010). Then, in 1926, the Federal Trade School (*Sekolah Ketukangan*) established in Kuala Lumpur provided full-time three-year courses to train mechanics, fitters, machine workers and other technicians (Ahmad, 2003; Loh, 1975; Pang et al., 2010). In 1931, the Education Department took over the Federal Trade School and focused on the need to train skilled workers in the technical fields, both in the public and private sector (Pang et al., 2010). Following that, three other trade schools were built in Penang, Ipoh and Singapore (part of Malaya at that time) to prepare apprentices as artisans in trades such as mechanics, plumbers, fitters, electricians and blacksmiths (Mohamad Sattar Rasul et al., 2015; Pang et al., 2010). These developments showed the growth of the institutionalised vocational training in Malaya to meet the economic needs of the public and private sectors for trained manpower during pre-independence.

In 1955, two years before Malaya gained her independence from the British, the government set up an Education Committee to review the existing education system and to devise a new system for post-independence Malaya (Pang et al., 2010). Through three policy recommendations, vocational training became a major component of the educational system. The committee published the Razak Report in 1956 which promoted the policy of establishing a vocational stream alongside the general secondary school system (Francis & Ee Tiang Hong, 1975; Pang et al., 2010). In 1960, the results of the Rahman Talib Report supported the Razak Report to segregate the secondary school system into academic and vocational streams (MOE, 2012a). Following this, upper-secondary vocational schools were established to supply semi-skilled workers needed by the agricultural, industrial and commercial sectors in the economy during the First Malaysia Plan era (1965-1970) (Mohamad Sattar Rasul et al., 2015). In 1969, the first polytechnic in Malaysia, Ungku Omar Polytechnic, was set up in Ipoh under the United Nations Development Plan (Majumdar, 2011).

The major findings and recommendations of the Cabinet Committee (Mahathir) Report submitted in 1979 reiterated the need for upper secondary education to be divided into academic and vocational streams. The Report also covered the expansion of facilities and the upgrading of TVET personnel (Pillai & Othman, 1994). Following this Report, the country's national policy for TVET was outlined in the first National Industrial Master Plan (IMP) 1986-1995 and the comprehensive report on the

Cabinet Committee on Training was submitted to Parliament in 1991 (Pillai & Othman, 1994). The IMP was prepared for the Malaysian government in collaboration with United Nations Industrial Development Organisation (UNIDO) and Malaysian Industrial Development Authority (MIDA) which highlighted the need for restructuring secondary and higher education curricula to meet the needs and development of the manufacturing industry (Pillai & Othman, 1994).

Subsequently, secondary vocational schools and polytechnics were set up with more programmes in engineering, commerce and computer technology to raise the number of semi-professionals in these areas (Pillai & Othman, 1994). The course content and curriculum reflected the transition from manual trade toward more cognitive and technological courses to reflect changing trends in TVET (Pillai & Othman, 1994). Currently, there are 34 polytechnics in Malaysia divided into three categories -- premier, conventional and metro -- offering various diploma and advanced diploma programmes in engineering, technology, commerce and hospitality with a total of 99, 551 students (Department of Polytechnic Education, 2014, 2016)). Under the Malaysian Polytechnic Transformation Plan (2010-2015), three polytechnics, which are Politeknik Ungku Omar, Politeknik Sultan Salahuddin Abdul Aziz Shah, and Politeknik Ibrahim Sultan were upgraded from Conventional Polytechnics to Premier Polytechnics (Wahab, Zakaria, & Jasmi, 2010). Under the Malaysian Polytechnic Transformation Plan (2010-2015), Premier Polytechnics have been offering undergraduate degree programs beginning September 2014.

The Transformation of Vocational Education (2011-2020) by the Ministry of Education (MOE) has expanded the number of Vocational Colleges (*Kolej Vokasional* or KV), formerly known as *Sekolah Menengah Teknik* (SMT) from 15 to 72 in 2013. This move has been instrumental in providing more students the opportunity to pursue various vocational fields at the secondary school level. The MOE has also collaborated with various Public and Private Skills Training Institutes (ILKA, ILKS) in sponsoring students to study courses unavailable at KV. Malaysia has more than 400 public skills training institutes and more than 500 private skills training institutes (Ab. Rahim Bakar, 2011). To strengthen the current educational and training delivery system, the government aspires to have high-quality TVET education through its vocational colleges, community colleges and polytechnics (MOE, 2015). Hence, the transformation of TVET education is fundamental to the development of knowledgeable and skilled people for employment.

Community colleges. In 2001, the first 12 Community Colleges were started in Malaysia. Initially, the government had approved to set-up one Community College in each parliamentary constituency nationwide (Muhd Khaizer Omar et al., 2012). However, it was decided during the Cabinet Minister's meeting held on the 8th September 2004 that Community Colleges were to be constructed according to needs and not necessarily in every district or parliamentary constituency (Department of Community College Education, 2013). Hence, currently, there are a total of 94 Community Colleges in all states in Malaysia with the exception of the Federal Territories (Kuala Lumpur, Putrajaya, and Labuan), with a total enrolment of over 500,000 students in 2015 (Department of Community College Education, 2015). Community Colleges are typically open-access, low-cost and serve a highly diverse cross-section of the population. The mission of Community Colleges in Malaysia is to leverage on TVET and learning opportunities throughout life, as a method for preparing local communities for education for the world of work and skills development for employability. Community Colleges provide access to all Malaysian citizens in the local community, as well as post-secondary students and workers from the industry requiring skills upgrade for employability, regardless of their socio-economic background.

Community Colleges in Malaysia offer courses leading to a diploma and certificate qualifications. Currently, there are five programme modes offered in Community Colleges namely Community College Work-Based Learning Diploma Programme, Community College Certificate (Continuous Programme), Community College Certificate (Modular Programme) Community College Certificate (Special Skills), Community College Certificate Preparatory Module, and National Modular Certificate (Department of Community College Education, 2015). Only designated Community Colleges to offer Work-Based Learning Diploma courses in collaboration with industry partners (Department of Community College Education, 2015). Among the Diploma courses offered with industry partners are Games Art, Telecommunication Technology, Mobile Devices, Security Technology, Architectural Technology, Beauty Therapy, Hair Dressing, Patisserie and Customer Service Management programmes (Department of Community College Education, 2015). Other courses offered in the Malaysian Community Colleges are automotive, motorboat, aquaculture, air conditioning, carpentry, building construction, tourism and hospitality (Abdul Rahman, 2011).

Besides imparting knowledge and skills, TVET provides lifelong learning opportunities (Inayat, ul Amin, et al., 2013; Maclean & Pavlova, 2013) and it also keeps potential dropout students within the school system (Maclean & Pavlova, 2013), thus facilitating the transition from school to employment (Bhavani, Sheshadri, & Unnikrishnan, 2010; King & Palmer, 2010). Apart from that, Community Colleges offer a variety of short courses relevant to local community needs. These short courses not only inculcate lifelong learning opportunities but also promote the socio-economic growth of community members. This is parallel to UNESCO’s mandate for TVET to promote equity, poverty alleviation and greater social cohesion (UNESCO, 2014a). The following section will describe the Tourism, Hospitality and Culinary Arts industry which is part of the focus of Malaysian TVET.

Enhancing the quality of teaching and learning in TVET. One method of improving the quality of TVET education is through an innovative teaching and learning process. The concept of quality of education is the core of the Sustainable Development Goals, which were promoted during the United Nations Sustainable Development Summit in September 2015. The fourth goal, known as Education 2030, is to promote quality higher education and lifelong learning opportunities for all (UNESCO, 2016). Technology plays a pivotal role in creating an equitable student-centred digital learning ecosystem relevant for the 21st century. In the past years, blended learning which is a fusion of online and face-to-face contact time between instructors and students has been appealing to a number of HEIs to enhance the quality of teaching and learning.

In blended learning approaches, teaching and learning materials are made available online and offline (Idris, 2011). This is to provide learners the choice of who they learn with, as well as where, when, and what they learn (Neal, 2011). Blended learning may appeal to TVET students as these students have a mixed range of levels and abilities (Catterall, Davis, & Yang, 2013; Lewis & Beach, 2011; Maclean & Pavlova, 2013; Naamani & Taylor, 2012; Neal, 2011). This may be attributed to their mixed educational backgrounds; they live at a distance from colleges and possess different motivation for continuing their studies (Brown, 2008). Given the student diversity, there must be an efficient use of classroom time and a student-centred learning environment so that they can learn at their own pace and time (Enfield, 2013).

By taking advantage of available Internet access outside of classroom time, students can access materials anywhere and anytime (Kiger, Herro, & Prunty, 2012). According to UNESCO (2016), the proliferation of the Internet and mobile platforms provide opportunities for blended learning which is a fusion of online and face-to-face contact time between instructors and students as a means to enhance quality and access to learning opportunities (UNESCO, 2016). During online sessions, teachers and students can interact and share information among themselves. Face-to-face contact time can focus on applying theory in practical and authentic settings for learning and technical skills, that have been recommended based on the increased attention toward inculcation of generic skills among students (Carvalho, 2015; Ko, 2012).

Designing authentic tasks for teaching and learning can offer remarkable potentials for adding value to TVET education. To achieve this, the private sector can play an important part in TVET development by exchange of service, facilities, and knowledge. Thus, this study is also aligned with the Malaysia Education Blueprint 2015-2025 for Higher Education (Ministry of Education Malaysia, 2015) which highlights the participation of industry to lead curriculum design and delivery improvement towards improving the quality of TVET graduates in Malaysia.

Culinary Arts Education and the Growth of the Tourism and Hospitality Industry

The Tourism and Hospitality industry brings in the third largest share of revenue for Malaysia. During the booming tourism industry in the 1990s, many executive chefs and sous-chefs were recruited from overseas (Goldsmith & Zahari, 1994) while locals were performing entry-level jobs at hotels (Nair & Whitelaw, 2008). This was observed by Maier and Thomas (2013) who highlighted the growth of Tourism and Hospitality in Asia in the 1990s. Their work looked at over 700 institutions offering degree programmes. They noted that the number of Tourism and Hospitality education programmes in Malaysia had increased significantly in the past 30 years and the aim was to meet the growing demands of the Tourism and Hospitality industry in the country. With that in mind, the training and education for those in the Tourism and Hospitality programmes were observed to be carried out in both public and private institutions (Goldsmith & Zahari, 1994; Mohd Fadil Mohd Yusof, 2010; Nair & Whitelaw, 2008). Before this, there had been little formal vocational investigations in the Culinary Arts training of Malaysia.

The first Tourism and Hospitality training programme was introduced by the National Productivity Corporation (NPC) in the early 1970s (Goldsmith & Zahari, 1994; Mohd Fadil Mohd Yusof, 2010). The MARA Institute of Technology, currently known as Universiti Teknologi MARA (UiTM) was the first tertiary institution to offer hospitality education when it was established in 1967, offering the Diploma in Hotel and Catering Management course. This was followed by a Certificate in Hotel and Restaurant Service in 1972 (Faculty of Hotel and Tourism Management, 2016). To accommodate more students to build a career in the hospitality industry, other pioneer private colleges began offering hospitality courses in the 1990s, and they include Kolej Damansara Utama, Stamford College, Mahkota College, The Hotel Catering Institutional Management Centre and The Reliance Trading Cooperation. All these institutions offered Certificate and Diploma courses based on the syllabuses adapted from the USA, UK, France, and Switzerland (Goldsmith & Zahari, 1994).

The primary growth factor in the Culinary Arts field is the dominance of the Tourism and Hospitality industry in Malaysia. A number of local researchers (Jalis, Che, & Markwell, 2014; Nornazira Suhairom, Must'amal, Nor Fadila Mohd Amin, &

Johari, 2015; Zahari et al., 2009) have highlighted that the diversity of Malaysia's food caused by the assimilation of multi-ethnic cultures had brought about the rise in Culinary tourism which generates the highest amount of tourism spending per capita (Zakaria, Wahab, & Jasmi, 2010). All these movements, consequently, promoted Malaysia's Culinary tourism which has remained high on the Malaysian government's agenda until today (Jalis et al., 2014). This claim is reflected by the gradual increase of tourist arrivals in Malaysia from 2008 to 2013 as shown in Table 2.1.

Table 2.1

Tourists Arrival and Receipts to Malaysia between 2013 and 2016

Year	Arrival	Receipts (RM)
2016	26.76 million	82.1 billion
2015	25.72 million	69.12 billion
2014	27.44 million	72 billion
2013	25.72 million	65.44 billion

Note. Source: Tourism Malaysia, 2017

Since one of the top three areas that tourists spend on in Malaysia is food and beverage (Tourism Malaysia, 2016), it is important to upgrade the workforce competency in the industry to meet the rising demand (Mohd Fadil Mohd Yusof, 2010; Nornazira Suhairom et al., 2015). This may require improved communication between the industry and institutions so that the most relevant and required skills can be instilled in the students so that by the time they graduate, they can fulfil the tourism industry needs.

Currently, students across the country train to work in the large and expanding field of Food and Beverage which comes under Tourism and Hospitality. Both public and private universities as well as polytechnics, community colleges, and some vocational colleges are offering this programme. Under the Food and Beverage programme is Culinary Arts which is offered at the Certificate and Diploma level, consuming around two to three years of academic pursuit. These programmes and courses are specifically designed for those students seeking a solid foundation in the respective areas of vocation. According to the current education landscape in Malaysia, vocational colleges, Community Colleges, and private culinary schools offer the two-year Certificate Level Culinary Arts programme while polytechnics, UiTM, and a few private universities offer the three-year Diploma programme. Upon completing their foundation in the Culinary Arts, students can choose to further their studies at the Bachelor’s degree and proceed to a postgraduate level course. The undergraduate and postgraduate level programmes are designed to train the candidates at the supervisory level of the Hospitality industry. It is deduced that the goals of such programmes are to fulfil the needs of the Food Research and Development organisations of Malaysia which aim to produce R&D chefs.

As a pioneer in offering Hospitality courses, the Universiti Teknologi MARA (UiTM) offers Culinary Arts from Diploma to the postgraduate level. Other local but private institutions such as the KDU University College, Taylors University College, Berjaya University College of Hospitality (Berjaya UCH) and Sunway Le Cordon Bleu offer the Culinary Arts programme from Certificate to postgraduate level. One interesting observation noted from past studies looking at the Culinary Arts is that they seemed to focus on undergraduate programmes mainly. To date, there is a lack of studies looking at the issues of foundation courses (Khamis Mohammad Nor, 2005).

Culinary Arts courses at Community Colleges. Community Colleges were established as centres of excellence for technology, business and the service industries (Yahya Don, Yaakob Daud, Abd Latif Kasim, Mohd Foad Sakdan, & Mohd Sofian Omar Fauzee, 2014). One of the service industries that Community College students are being prepared for is the Food and Beverage industry namely, Culinary Arts and

Pastry. The Certificate level culinary-related programmes are offered at 11 Community Colleges which are scattered in six regions of Malaysia. The Certificate for Culinary Arts offered by Community Colleges is the most widely offered programme as represented by the huge number of graduates who complete this programme. The current study aims at identifying the issues the instructors face in teaching and learning especially in terms of developing students' problem-solving skills and in return offer a solution to overcome these issues especially in the foundation course of Culinary Arts at Community Colleges. This may help to fill in the research gap.

Research in Culinary Arts Education

The Culinary Arts education has received little attention from academics (Antun & Salazar, 2006; Nur Rasyidah Mohd Nordin, Siti Hamin Stapa, & Darus, 2015; Zopiatis, 2010) for a number of reasons. Hegarty (2004) outlined these under the various categories: (a) the lack of theory in Culinary Arts hence, preventing it from becoming a discipline, (b) the difficulty in separating the transitory nature of the discipline and linking it with physical work. Moreover, the requirement for "work"is based on the accepted criteria of education, i.e. Arts, Science or Theory of Education and (c) the lack of professionals in the Culinary Arts education and a lack of others pursuing it at the doctoral level. These factors underlie the cause which indirectly can be attributed to the shortage of articles about Culinary Arts written in academic journals as well as the shortage of professionals trained in Culinary-related subjects (Zopiatis, Theodosiou, & Constanti, 2014). To address this gap, the results drawn from the Hospitality education research are thus utilised as a foundation to discuss the

Culinary Arts education since Culinary schools are feeders to the Hospitality management programmes (Hertzman & Stefanelli, 2008).

Early studies (Brown, 2005; VanLandingham, 1995) on Culinary education have dealt with the history and development of Culinary Arts programme in America. Considerable research (Brown, 2005; VanLandingham, 1995) have also been undertaken in the Culinary Arts curriculum, but in recent years, studies (Shani et al., 2013) have expanded. They focused on how Culinary ethics is integrated into the curriculum (Shani et al., 2013); how the teaching of convenience product is integrated into the curriculum (Antun & Salazar, 2006); how Arts education philosophy is integrated into the curriculum (Brown, 2006); how attitude toward international internship works (Cullen, 2010); how Culinary Arts and food science are integrated into the curriculum when developing the Culinology ® curriculum (Cheng, Ogbeide, & Hamouz, 2011); and critical thinking and reflective practices among the Culinary Arts instructors (Hegarty, 2011).

The last few years have shown a shift of interest, from just offering the Culinary Arts programme to evaluating the quality of the Culinary Arts curriculum. A growing number of researchers (Hertzman & Ackerman, 2010; Hertzman & Maas, 2012; Hertzman & Stefanelli, 2008; Lin & Cherng, 2006; Müller et al., 2009; Rinsky, 2012) share the view that this is necessary in order for the Culinary Arts curriculum to stay current and relevant to industrial needs. In terms of the teaching contents, aspects such as ethics, social skills, and cross-cultural skills, in the context of the Tourism and Hospitality profession, must assume greater importance (Nicolaides, 2012). Within the hospitality industry, instructors are particularly advised to focus on problem-solving skills so that the students or future practitioners can enhance their daily interactions with customers within the customer-centric Tourism and Hospitality industry

(Nicolaides, 2012). Once students enter the workforce, they may not have the luxury of time or resources to commit ongoing mistakes and learn through trial and error anymore; they would be expected to be quick and efficient when dealing with immediate customer demands (Harteis & Bauer, 2014; Jonasson, 2015).

In their pivotal study, Müller et al. (2009) compared the quality of the current students with the quality of students who had graduated and representatives from the industry by looking at their responses to the educational skills attained from the North American Culinary Arts curriculum. The study reported that all the three groups were satisfied with the traditional culinary skills taught in the programme. However, students who have graduated reported dissatisfaction with their programme; they pointed out the lack of emphasis on computer skills, speaking skills, and writing skills. In comparison, the current students reported less dissatisfaction with computer skills probably because they were unaware of its importance. Another essential finding was that both the students who had graduated and the representatives from the industry reported a higher level of dissatisfaction with the level of problem-solving skills and communication skills in the programme. It was also highlighted that current Culinary Arts courses were giving too little emphasis on problem-solving, communication skills and computer skills which, they noted, are essential to those who are working in the industry.

Similarly, another study conducted by Lin and Cherng (2006) observed that students and employers in Taiwan were not satisfied with the quality of the Culinary Arts education provided. They highlighted the gap existing between the contents taught and current industry requirements. The implication of this study is that instructors should be subject matter experts with up-to-date teaching contents. The five Culinary competency dimensions that require improvement in the teaching contents in the study were: food preparation and cookery, nutrition, sanitation and safety, baking and pastry and equipment and utensils.

In the local context, there are still lack of studies on the gap which might exist between the contents taught and current industry requirements. In this regard, this study strongly recommends that it is necessary to gain an insight to up-to-date contents/knowledge that needs to be covered to bridge the gap between academia and industry from chefs in the local establishments. This can be done by consulting expert practitioners by observing, capturing and interviewing professionals to gather background information, heuristics, real-world insights, and also their identities (Jonassen, 2013; Schön, 1983). This will help to map out relevant content and real-world problems according to industry requirements to be used in the module.

Nevertheless, both the studies done by Müller et al. (2009) and Lin and Cherng (2006) highlight the need for students to acquire up-to-date contents/knowledge and opportunities to develop their problem-solving skills and communication skills while still in Culinary Arts school. This means there is a need for the Culinary Arts graduates to be skilful and competent in cooking is necessary as this also leads to their ability to maintain up-to-date information parallel with industrial needs. These skills and competencies are crucial in meeting the challenges of the rapidly evolving culinary tourism industry (Nornazira Suhairom et al., 2015). Owing to the booming Tourism and Hospitality industry, research on Culinary creativity and innovativeness among chefs have attracted a considerable amount of interest among researchers in Taiwan and the Republic of China. Specifically, past studies have focused on the Culinary creativity of chefs producing new ideas or dishes (Horng & Hu, 2009; Horng & Lin, 2009; Horng & Hu, 2008; Horng & Lee, 2009) and the Culinary innovative competency of chefs (Hu, 2010). More recently, Hu et al. (2016) investigated the effects of innovative culinary competencies in the Culinary Arts curriculum (ICCC) by focusing on improving students' creativity through creative thinking strategies and techniques. This can challenge the existing culinary teaching practices.

Pedagogical Issues in Culinary Arts Education at Community Colleges

As mentioned before, the Culinary Arts education is rooted in the TVET traditionally, and it tends to focus on the mastery of technical competencies (Mandabach, Harrington, VanLeeuwen, & Revelas, 2002; Müller et al., 2009). In a traditional apprenticeship model, a young person who wants to be a chef would be under the guidance of a mentor or master in the Culinary Arts (Brough, 2008). However, with the advancement of years, formal education has replaced the traditional apprenticeship model. The shift insists that the traditional apprenticeship model is less superior since the apprentice learns from the master in the context of the workplace. This has resulted in a "gap" of skills, knowledge, and attitudes required in the workplace (Brough, 2008). The implication is that students are now learning those skills required of a chef from their Culinary instructors minus the authenticity of the workplace. With the rapid development noted in the number of Tourism and Hospitality education providers, issues about programme accountability, credibility and effectiveness should be taken into account by stakeholders (Mohd Fadil Mohd Yusof, 2010; Nair & Whitelaw, 2008). Similarly, with the burgeoning of culinary schools, providing good quality training in the Culinary Arts has become essential. Despite this, there seems to be a lack of effective pedagogy for the Culinary Arts education (Mack, 2012).

Typically, a traditional Culinary Arts instruction follows the recipe-based pedagogy where the chef-instructor demonstrates how a recipe is developed, then the student diligently replicates the demonstration, and the chef-instructor provides feedback based on the outcome (Brown et al., 2013; Deutsch, 2014; Noe, 2005). When procedural learning is given more emphasis than subject matter knowledge, problems arise as it impedes problem-solving performance which most employers seem to value (Deutsch, 2016; Soden & Pithers, 2001). To illustrate, when students face unexpected incidents in the Food Service industry such as a missing delivery, having more guests than anticipated or problem with the gas or electric stove in the kitchen (Deutsch, 2016) they are at a loss in solving the issue. This is because procedural learning seems more useful for solving simple, well-structured problems but when procedures fail to work, learners get stuck, not knowing what to do (Jonassen, 2004).

A study investigating the effectiveness of the basic Western Cuisine module of the Culinary Arts in Malaysian Community Colleges which is expected to enhance students' practical performance of manual (psychomotor) skills was conducted by Reezlin Abdul Rahman et al. (2011). It was found that an imbalance existed between students' theoretical knowledge and their applied knowledge. Reezlin Abdul Rahman et al. (2011) observed that instructors in the traditional foundation level Culinary Arts programme had to teach a large amount of hands-on content which emphasise skill-based cooking knowledge, the basis of the Culinary Arts curriculum but less on the theoretical aspects. Owing to this, Reezlin Abdul Rahman et al. (2011) proposed that at least two hours per week be allocated for instructors to impart the theoretical knowledge, and this can be taught simultaneously with the hands-on content. This implies that the instructional approach should also pay attention to the cascading domain knowledge which can be useful in developing problem-solving skills as well as technical skills in the Culinary Arts.

Another factor noted in the Culinary Arts curriculum is that instructors appear to be placing more emphasis on the technical skills specific to the area of specialisation. In a preliminary study of an urban Community College offering the Culinary Arts (Umawathy Techanamurthy et al., 2015), it was revealed that instructors tend to focus more on developing cooking and technical skills instead of developing students' problem-solving skills. Instructors often choose to teach technical skills because they perceive the teaching of employability skills to be more difficult than technical skills (Jozwiak, 2004). In addition, instructors also lack time to cover both the subject matter content and to discuss some aspects of problem-solving within the stipulated time in class (Brown, 1998; Garton & Cano, 1996; McCallum, 2013). As a result, Community Colleges instructors have resorted to leaving the students to learn the problem-solving skills during their industrial attachment or when they pursue their studies at higher levels (Umawathy Techanamurthy et al., 2015).

In the TVET curriculum, it is best for instructors to provide a variety of situations so that students may learn about the common aspects of issues in different situations and then be able to transfer their gained knowledge. This is endorsed by Brown et al. (2015) who proposed that classroom instruction should include realistic skills related to the careers of those involved in the Hospitality industry. Such skills can enable students to be more streetwise as they enter the real working world that will always be facing problems. This recommendation implies that instructors need to provide a variety of authentic tasks or situations related to the occupations.

Another concern raised by some local studies (Idris, 2011; Mohammad Azli Razali, Farina Nozakiah Tazijan, Suzana Ab. Rahim, Nina Farisha Isa, & Hemdi, 2012; Mustapha, 2017) is that Culinary instructors lack industrial experience. This is quite plausible considering that most instructors were hired directly after having completed their studies based on their academic qualifications. Employers hiring these instructors had not given any emphasis to their industrial work experience (Idris, 2011). In other words, the overemphasis on academic credentials had resulted in this scenario (Ko, 2012) which may reduce the quality of instruction in teaching and learning of the Culinary Arts. Although not always true, it is possible that instructors who lacked the industrial experiences may be unable to integrate theory and practice. This can deprive the learners of opportunity to learn about contents that are most relevant and appropriate to their industrial needs (Ko & Chung, 2015; Lin & Cherng, 2006). Consequently, students are unable to apply complex reasoning skills, work-related attitudes, cooperative skills, job-specific knowledge and knowledge required for the workplace (Brown et al., 2015; Giddens & Stasz, 1999). Past studies (Brown et al., 2015; Hertzman & Stefanelli, 2008; Lin & Cherng, 2006) suggest that it is imperative for instructors to keep abreast of the latest knowledge in the industry (Mustapha, 2017). They noted that current supplementary materials used by current instructors are inadequate because these references do not reflect industry realities. Instructors must also ensure that the content they are teaching is up-to-date with industry needs. This can be achieved by working closely with industry practitioners (Lin & Cherng, 2006). Such measures will ensure that students understand the realities of their proposed careers.

Importance of developing problem-solving skills in TVET and Culinary Arts. The existing body of research (Deutsch, 2014; Müller et al., 2009; Shani et al., 2013; Soden, 2013; Soden & Pithers, 2001; Zahari et al., 2009; Zhong et al., 2013) suggests that Culinary Arts graduates need to have technical knowledge of cooking techniques, hands-on skills as well as practical problem-solving skills. Competency in the skills specific to the specialisation such as knife skills and cooking skills, in

Culinary studies, is no longer sufficient for survival in the industry (Horng & Lee, 2009; Müller et al., 2009; Rinsky, 2012; Shani et al., 2013). Employers today look for people who can do more than repeat well-practised routines and who have a sound grasp of the principles connected with carrying out the tasks (Soden & Pithers, 2001). Of late, foodservice operators and restaurant managers also desire employees who can identify problems and take the initiative in developing practical and creative solutions for solving them (Deutsch et al., 2009). Besides their culinary skills, staff are now expected to know problem-solving, have palate development, teamwork, and communication skills (Deutsch et al., 2009). This expectation reflects the current trend in employment. Culinary students equipped with these essential skills have the edge in becoming part of the workforce. This, therefore, indicates that the curriculum needs to balance between theoretical and applied knowledge (McKinstry, 2012).

Students in the Tourism and Hospitality industry require critical thinking skills and strong analytical skills that can enable them to become innovative, creative and think out of the box when solving problems, thereby adapting to change (Hu et al., 2016; Ring, Dickinger, & Wöber, 2009). For example, when working in a fast food franchise outlet, employees may only need to complete simple and specific tasks, with no room for individual creativity or personal perspective. But if they work in a fine dining restaurant, they are expected to possess a certain level of creativity; chefs are expected to change menus according to festive seasons. In view of this, career progression for chefs or cooks would thus begin with simple and specific tasks before progressing through a series of different workplace settings (Bourdain, 2013). Based on this argument, a successful TVET curriculum must be up-to-date and relevant for students (Buttles, 2002; Finch & Crunkilton, 1999).

Proponents of real-world problem-solving issues have emphasised that real-world problem-solving activities must be consistent (Chi, Glaser, & Rees, 1982; Savery & Duffy, 1995) without the contexts given being simplified (Jonassen, 2011). This recommendation is also supported by other researchers (Buttles, 2002; Ro & Choi, 2011; Soden, 2013). When students are presented with examples drawn from real-world issues, they learn better, applying lessons learnt through mistakes, inferring the solution and then discussing with others in order to reach the best solution (Jonassen, 2011). Therefore, students become more confident when they notice the multiple perspectives used by experts to solve problems. This observation can deepen their domain knowledge (Jonassen & Hernandez-Serrano, 2002). Such an opportunity also encourages students to act as professionals while role-playing can further enhance confidence and self-esteem when seeking solutions (Harris, 2014; Wilson, Fernandez, & Hadaway, 2006).

In the Community College context, there may be opportunities to learn from mistakes as students gain new experiences through the complex work processes (Jonasson, 2015). In this regard, problem-solving can be applied to motivate students to be more enthusiastic about the topic, to break away from the usual routine and to reinforce concepts taught. Another benefit of the problem-solving approach is that students get to seek solutions to problems thereby developing a sense of ownership (Nicolaides, 2012). Undoubtedly, problem-solving skills can increase confidence (Nicolaides, 2012). Hence, instruction in TVET education must provide real-world contexts using real-world problems. However, to prepare students for this kind of task, they need to reflect on the current trend in employment that values the universal nature of solving problems. In this regard, appropriate measures need to be considered (Müller et al., 2009).

Problem and problem-solving. A problem exists when there are unknown elements that prevent a person from reaching a goal to satisfy a specific need (Jonassen, 1997). According to Jonassen (1997), a problem comprises: (a) a problem domain, made up of a content (concepts, rules, and principles) that defines the problem elements; (b) a problem type, which is a combination of concepts, rules, and procedures used to solve the problem; (c) a problem-solving process, which depends on the person's understanding of the problem and expertise in handling this type of problem; and (d) a solution. A good problem should be open-ended, address important concepts, engage students and be related to something students have learnt previously (McIntosh, Jarrett, & Peixotto, 2000). Despite being challenging, the complexity of the problem should be just slightly higher than the student's skill level as claimed by Krashen's (1987) Input hypothesis, but yet solvable (McIntosh et al., 2000).

The structure of a problem tends to fall on a continuum between well-defined (well-structured) problems on one end or ill-defined (ill-structured) problems on the other end (Smith & Ragan, 2005). Well-structured problems have all the elements of a problem with a limited number of rules and principles arranged strictly to get a right answer (Jonassen, 2013). In contrast, ill-structured problems may have many other solutions although loosely defined or they contain unclear goals and constraints which can have more than one solution path and more than one criteria for evaluating solutions (Jonassen, 2013).

Most of the problems encountered in textbooks are well-structured problems whereas most of the problems encountered in everyday life are authentic but ill-structured. Jonassen (2000) categorised problems into eleven types on the continuum of well-structured to ill-structured problems namely: logical, algorithmic, story, rule-using, decision making, troubleshooting, diagnosis-solution, strategic performance, case analysis, design, and dilemma. These problem types can be used to design authentic problems for instructional activities which can develop students' problem-solving skills.

Story problems usually present a set of variables embedded within a shallow story context (Jonassen, 2003) that is common when learning to solve Mathematics and Science problems, usually found at the end of textbook chapters (Jonassen, 2011). An example of a story problem is the mathematical problem documented in words where learners need to identify the key points from a story, select an appropriate procedure, apply the procedure and then check the answers (Sherrill, 1983). The story problem has been criticised as students tend to just employ the "plug and chug" method where they just plug the value into the formula and chug it to the solution. This defeats the process of learning (Jonassen, 2004).

The rule-using problem may use multiple rules to solve the problem, and this may result in multiple solutions using a structured solution process (DeWitt & Alias, 2015). For example, preparing a meal with a limited budget of RM100 for 20 people or calculating the cost of a meal by ensuring a minimum of 33% of the profit will be made.

A decision-making problem requires students to consider the consequence of every alternative solution in order to make a decision. For instance, what should the student do upon seeing a basket of raw food left unattended near chemicals, wastewater lines or any other possible sources of contamination which may jeopardise food safety?

In the middle of the continuum of problems ranging from well-structured (story problems) to ill-structured problems (design problems, dilemma) are troubleshooting problems which are more common in day-to-day situations. Here, one has to diagnose the symptoms and search for the system components producing the discrepancy when part of a system is not functioning properly (Jonassen & Hung, 2006). Troubleshooting problems require not only domain knowledge but also procedural knowledge and troubleshooting strategies. This is why experts are usually better at handling troubleshooting problems (DeWitt & Alias, 2015). For example, what causes a cake to sink in the middle or how to troubleshoot a mixer that does not start.

In strategic performance problems, working under time pressure while maintaining situational awareness is crucial. These ill-structured problems are found in many professional contexts. For example, contestants are required to perform tactical activities while performing complex decision-making in real time during competitions. Here, contestants need to plan specific strategies to overcome problems.

In policy type problems, the problem may have many points of view which are conflicting and complex at the same time. These ill-structured problems can be found in the local newspapers such as those highlighting issues at the national, state or local government level (Jonassen, 2011). For example, should alcoholic beverages be served on board national airlines or not?

Design problems are ill-structured problems requiring both domain and strategic knowledge. In this context, students need to consider many needs and constraints when attempting to solve them. For instance, designing a menu to meet the special dietary requirements for a team of sportsmen or cooking a complete nut-free meal for those allergic to nuts.

Finally, dilemmas are problems without a single best-known solution which may have conflicting perspectives in terms of social, moral, political or economic considerations. For example, should we compromise on the quality and taste of a meal when the standard recipe requires alcohol when catering to a group of people with different religious preferences or restrictions?

Hence, instructors need to provide students with authentic problems to face real-life issues such as those at the workplace. When students learn in the context of solving problems, they will understand and remember better (Jonassen, 2004). In the TVET curriculum, the sources of problems provided for students to solve are authentic tasks taken from the vocational practices such as the procedures and concepts of practical and daily operations (de Bruijn & Leeman, 2011; Thomas, 1992). These problems may be a combination of ill-structured and well-structured problems which require students to use knowledge and other cognitive processes in solving them. Culinary instructors can present different types of problems for students to apply their knowledge and develop problem-solving skills. For instance, problems can be categorised as problems caused by mistakes or problems caused by change in situations (Soden, 2013). Other problems can be those caused by changes in situations or improvising the usage of available ingredients and equipment using basic recipes (platform) to create appropriate concepts. Alternatively, it can be designing a dish for a menu within a set of constraining parameters (Deutsch et al., 2009).

Based on the existing typology of problems outlined by Jonassen (2000), it appears that problems caused by mistakes in the Culinary Arts seemed to be related to troubleshooting, whereas problems caused by changes in situations seemed to be related to decision-making, design problems, and dilemmas. Coincidentally, among the 11 problem types addressed by Jonassen (2000), the least researched problem types are decision-making problems, troubleshooting and design problems (Jonassen, 2010). These least researched problems are similar to the ill-structured problems which are common in the Culinary Arts. Thus, they merit further investigation. Specifically, the current study focuses on problems caused by mistakes committed by students studying Culinary Arts. These problems are related to troubleshooting as well as problems caused by changes in situations, which is related to decision-making issues, design problems, and dilemmas. Therefore, the current study will expand on the findings of past studies by developing a set of Culinary Arts based problems derived from the least research problem mentioned before (Jonassen, 2011).

Problem-solving approaches. Knowledge-based methods can be used to solve ill-structured problems (van Merriënboer, 2013). However, knowledge-based methods require students to understand how things are interrelated in a domain (conceptual models), how things work and affect each other in a domain (causal models) and how things are built or organised in a domain (structural models); it also attempts to find alternate solutions to the problem (van Merriënboer, 2013). Students can recollect their past experiences of cases faced before as an analogy to construct possible solutions (analogical problem-solving) (Jonassen & Hernandez-Serrano, 2002). Otherwise, students could rely on their domain-specific cognitive strategies to enable them to solve certain problems through a system, phase-by-phase, using the rules-of-thumb only (van Merriënboer, 2013). In this regard, knowledge retention is essential for developing problem-solving skills. Activating prior knowledge will enable students to recollect past experiences that can enable them to solve problems better.

According to Jonassen (2011), students can learn to solve problems if they are provided with a combination of case studies, prior experiences, and alternative perspectives. As novices, students need support when learning how to solve problems and Jonassen (2011) suggests that students learn to interpret and solve ill-structured problems. However, they also need cognitive scaffolds such as case studies, prior experiences (based on case-based reasoning), alternative perspectives (based on cognitive flexibility theory) or simulations. Table 2.2 illustrates.

Table 2.2

Case and Scaffold Requirements According to the Types of Problem

Types of problem	Typology	Learner's role	Case components	Cognitive scaffolds
Caused by errors	Troubleshooting	Diagnose symptoms and match to the fault state	Problems, prior experiences	Causal, argumentation, Modeling (scenario construction)
Caused by changes in situations	Decision-making	Decide which course of action to pursue	Problem, case studies, prior experiences, alternative perspectives	Causal, argumentation, Modeling (scenario construction)
	Design problems	Have domain knowledge and strategic knowledge to produce a novel idea, may have multiple solution paths	Problem, prior experiences, alternative perspectives	Causal, argumentation, modeling
	Dilemmas	Solve complex, social solution with conflicting perspectives without a known single best approach	Case studies, alternative perspectives	Argumentation

Note. Adapted from: Jonassen (2011) and Soden (2013)

The data illustrated in Table 2.2 can be used to solve problems caused by errors (i.e., troubleshooting problems and problems caused by changes in situations, i.e., decision-making, design problems, and dilemmas). However, to aid comprehension and transfer, students must understand causal relationships; this understanding can enable them to make predictions and inferences (Jonassen, 2010). When making predictions, students must be able to reason based on the description of a condition, set of conditions or state of an event (Jonassen, 2010). Predictions can also be used to forecast an event and to test hypotheses such as to accept or reject scientific assumptions. An inference is required if the causal agent is unknown for an outcome or state which is usually used in medical diagnoses. A physical inference is made based on symptoms, historical factors and test results of patients; this helps the doctor to make an inference of the causes of the illness (Jonassen, 2010). Argumentation is an essential skill for learning to solve ill-structured problems to justify the solution paths and to offer suggested solutions (Jonassen, 2010). Here, Modeling would require the students to be able to construct mental models of the problem space regarding the components and relationship noted in the problem which will enable them to hypothesise and find solutions (Jonassen, 2010).

Real-life problems such as those faced in the workplace require students to perform a combination of ill-structured and well-structured problem-solving and this includes cognitive processes responsible for the ill-structured problem-solving (i.e., knowledge-based methods) and well-structured problem-solving (i.e., strong methods) (van Merriënboer, 2013). A problem-solving approach to teaching the Culinary Arts' competencies can minimise mistakes and develop the ability to produce a cost-effective solution, thereby maintaining client satisfaction when problems arise (Soden, 2013). When confronted with unexpected changes in situations or resources, the student with prior exposure to problem-solving in training is more likely to produce acceptable solutions (Soden, 2013). The argumentation and analytical skills involved will promote understanding and deep-learning that are prerequisites for long-term knowledge acquisition.

Stages of problem-solving. Students can improve their problem-solving abilities with proper training and guidance. Subsequently, learning activities can be designed to expose students to the systematic method of solving problems. This is crucial for ensuring that students learn to appreciate the usefulness and importance of problem-solving skills so that they are able to use them effectively in everyday situations (Jozwiak, 2004). Many researchers have attempted to develop models of problem-solving processes in order to resolve some of these issues.

In 1926, Wallas formulated four key steps for problem-solving: preparation, incubation, illumination, and verification (Wallas, 1926). In the preparation stage, the problem is investigated, and information that might be relevant to its solution is gathered. During the incubation stage, the problem is sorted out which include putting the problem aside for some time while working on other problems. During the illumination period, potential solutions may appear, and at the verification stage, the proposed solution is tested to determine its correctness.

Similar stages were introduced by a Hungarian mathematician, Polya (1945). The four steps include: (1) understanding the problem or identifying what is being asked; (2) devising a plan or creating a few strategies; (3) carrying out the plan or implementing the selected strategies and (4) looking back or checking and interpreting the results to see if they all fit together. Bransford (1993) endorsed this system by introducing the IDEAL approach. Here, students need to (I)dentify the existence of a problem; (D)efine and represent the problem; (E)xplore possible strategies for the solutions; (A)ct on the strategies chosen and (L)ook back and evaluate the effects of those actions. Through this system, learners became more creative problem solvers.

The emphasis on solution generation seems to be crucial as the problem solver needs to consider different perspectives (Jonassen, 1997). During the solution generation stage, the problem solver needs to gather supporting evidence to support or reject the alternative solutions in order to generate possibilities of reaching an understanding of the situation (Jonassen, 1997). This competence is important for problem-solving as students need to know the skills of formulating some basic lines of self-questioning that have high transfer values. Jonassen (2004) terms this as problem posing. The emphasis on solution generation was also emphasised by Wasik (1994), who outlined seven stages of problem-solving, and others such as Barrows (1996), Jonassen (1997) and Lohman (2004).

Lohman (2004) developed an instrument with items that can comprehensively address the key activities associated with effective ill-structured problem-solving. The key activities outlined encompass (1) problem identification; (2) goal selection; (3) generation of alternative solutions; (4) consideration of consequences associated with solutions; (5) decision-making; (6) implementation of solutions; and (7) evaluation of solutions.

Problem-solving varies from one person to another but to solve a problem and to generate possible solutions; one needs to understand the cause of the problem and how the problem may be solved. Such mental representation is termed as problem space (Ge & Land, 2004; Newell & Simon, 1972). In this regard, the first step in articulating the problem space acts as the basis for the problem solver to decide what to do next in the problem-solving process. In the case of students, however, they may be tempted to start looking for a solution first instead of devoting time and energy in understanding and interpreting the problem (Ge & Land, 2004).

Relating this to the ill-structured problem which is complex in nature, various opinions and perspectives concerning the problem space may occur. Thus, different stakeholders may view the problem differently and have different criteria when assessing the problem. Following the first step, the next step involves identifying and clarifying the alternate perspectives (Jonassen, 1997), and the third step is to generate possible solutions. Since different views may also generate different satisfying solutions, it is the problem solver's task in the third step to generate varying solutions (fourth step) (Jonassen, 1997). The fifth step is a reflective process that occurs throughout the first four steps of the problem-solving process (Jonassen, 1997). During these steps, it is important that learners continuously reflect on what they know and how this affects the problem space and the possible solutions (Jonassen, 1997). In a school-based context, it is not possible to actually implement all the suggested solutions. For this reason, most school-based problem-solving activities go no further than the fifth step (Jonassen, 1997).

There is no single solution that is correct for an ill-structured problem. Therefore, when a solution has been implemented, it is necessary to monitor to see whether it functions as well as it was envisioned. The sixth step thus involves the implementation and monitoring of the solution (Jonassen, 1997). The seventh and final step of the problem-solving process is to adapt the solution (Jonassen, 1997) accordingly.

Designing and developing authentic learning tasks. As mentioned before, authentic learning tasks used for preparing students for real-world experiences have been researched before. They usually involve case studies, personal stories and workplace scenarios which act as contextual information for problem-solving in the everyday context. Nonetheless, such problems may not always have a single solution as they tend to consist of multiple sub-problems (Ferreri & O'Connor, 2013; Jonassen, 2004; Jonassen & Hung, 2006; Jozwiak, 2004). There are benefits to using authentic tasks. Those derived from real-world scenarios enable students to acquire the opportunity and experience to deal with problem-solving first-hand in a safe classroom environment (Ferreri & O'Connor, 2013) before knowledge can be transmitted. Thus, when designing tasks based on real-world performances, the degree of authenticity would depend on the amount of equipment and resources available in the educational setting. To illustrate, an example in the engineering field, Sankar and Raju (2006) used real-world case studies or introductory engineering classes. One practical objective noted from this study is develop multimedia materials to improve the higher-level cognitive-based problem-solving skills of the students. In this regard, the study strongly recommends industry practitioner involvement in developing instructional materials.

Another research that used authentic tasks is The Jasper Woodburry Series project which employed the anchored instruction approach (Cognition and Technology Group at Vanderbilt, 1997; The Cognition Technology Group at Vanderbilt, 1990). Here, students were required to solve authentic mathematical problems in groups after watching videos of stories that were set in authentic contexts. In another example, Choi and Lee (2008) collected stories from teachers for teaching classroom management dilemma problems. These were gathered from interviews with teachers and case books. In this study, real classroom stories focused on dilemma problem types. From the use of authentic tasks, students are learning to solve problems which will serve to scaffold their memory when they experience real problems in future.

Likewise, Buttles (2002) developed a set of real-world sample problems by using a three-round Delphi study with a panel of experts from the agricultural biotechnology field. However, this study was limited to only the development of problems based on university level experts. It did not consider the views of secondary school teachers who would be using the list of sample problems in their setting. The study was also limited to the problem design while the set of sample problems provided were not tested for use with instruction. Nevertheless, the study was pivotal as it paved the way for the theoretical framework to be tested in collaboration between subject matter experts and industry practitioners through the Delphi survey approach.

It seems apparent that authentic tasks, when implemented as case studies, are beneficial to students. They serve as platforms for students to become more competent in integrating their knowledge, skills, and attitudes (Kirschner & van Merrienboer, 2008; Merrill, 2002). Authentic tasks reflect the professional context of the students' future occupation (Fitch, 2011; Hämäläinen & Cattaneo, 2015; Jonassen, 2004) thereby, serving as schemata (experiences derived from past experiences) to be used to understand new knowledge (Chang & Chen, 2007) in the future. Undoubtedly, such simulations and collaborative learning can be conducted at Community Colleges (Suriyati Yaapar, Merhayati Sipon, & Daud, 2013).

Cognitive load theory and problem-solving. Past studies (Chandler & Sweller, 1991; Kalyuga & Hanham, 2011; Sweller & Chandler, 1994; van Merrienboer, Kirschner, & Kester, 2003; Zheng, McAlack, Wilmes, Kohler-Evans, & Williamson, 2009) show that problem-solving can be cognitively challenging to learners. According to the Cognitive Load theory (Chandler & Sweller, 1991; Sweller, 1988), every instructional condition imposes a load on working memory. There are three types of cognitive load: (1) intrinsic cognitive load; (2) extraneous cognitive load; and (3) germane cognitive load.

The amount of intrinsic load imposed on the brain depends on the number of elements which need to be processed simultaneously for the information to be learned. Beginning with germane cognitive load, this type of cognitive load refers to the active cognitive processes which contribute to the construction of mental representations or background knowledge/stored information (i.e., schemas). The next type, extraneous cognitive load, does not contribute to learning, and if working memory capacity is entirely occupied by intrinsic and extraneous processing, no cognitive resources will be available to enact germane processes. In such cases, although learners may successfully complete a learning task, they will be unable to construct and automate schemas; thus, little learning occurs. Mayer and Moreno (2003) suggest that effective learning can only occur when learners focus their resources on essential processing (similar to intrinsic load). Therefore, necessary measures that can properly manage cognitive load during the problem-solving process should be considered.

Some studies (van Merriënboer & Sweller, 2005) have noted that instructional methods can decrease extraneous cognitive load so that existing resources can be devoted to learning. Studying sixth-grade students who participated in a rocket project, Petrosino (1998) found that by simply engaging students with hands-on activities, no satisfactory learning outcomes were accomplished. Barron et al. (1998) then speculated that these inadequate learning outcomes could be due to a lack of facilitation in directing the learning process such as providing a driving question. Following this, the use of scaffolding was applied to assist students in acquiring the skills they require. As students develop the domain-related schemas, the scaffolding can be phased out.

Scaffolding can be accomplished in numerous ways, for example by including prompts, hints, comments, explanations, questions, counter-examples and suggestions (Hung, Tan, Cheung, & Hu, 2004). A common practice of the scaffolding support is the instructor providing the necessary support or assistance to students to finish a task. Through scaffolding, the teacher models problem-solving behaviour so that students can internalise the problem-solving strategies to become independent problem solvers. Cognitive load theorists (Renkl & Atkinson, 2003; Renkl, Atkinson, & Maier, 2000; Sweller, 1988; Sweller & Cooper, 1985) have suggested using examples that worked before as a means to promote schema acquisition instead of allowing learners to learn through problem-solving alone. As students gain the expertise, this scaffolding support is phased out with partially-completed problems so that they eventually practice solving the entire problem which also facilitates their skill automation.

Another suggestion made by previous studies (van Merrienboer et al., 2003) is to use the simple-to-complex sequencing of materials. Complex learning is broken and chunked into simple parts that are acquired and combined into a larger sequence. This procedure minimises the cognitive load, and the outcome is beneficial as students can focus their cognitive resources on the learning task at hand. Chunking also allows students to better process, retain and review the information received.

To reduce the cognitive load and to aid learners' problem-solving abilities, one can resort to multimedia resources (Lee, Plass, & Homer, 2006; van Merriënboer & Sweller, 2005) since today's technology has become so advanced. The FC can be considered. It incorporates a range of "experts" or "specialists" into the classroom environment by accessing the experts' thinking and performances through videos or digital footage which can serve as specific problem-solving processes. These models are not only cost-effective but also suitable (Herrington & Kervin, 2007). The access to expert thinking can expose students to the professional vocabulary which seems critical for students to acquire in order to survive the changing employment landscape (Levy & Murnane, 2005; Porcaro et al., 2016). The FC also promotes collaborative learning.

Development of the FC Model

In recent years, the FC for teaching courses through technology has gained considerable attention because it seems to improve student learning (Brame, 2012). However, the lecture-based teaching model should not be dismissed entirely; they should run hand in hand with the advances of online access and technology and development in pedagogical theory (Galway, Corbett, Takaro, Tairyan, & Frank, 2014; Pierce & Fox, 2012). This is because there are benefits in face-to-face interactions.

The FC model developed for most pedagogical contexts was initially based on Bloom's (1956) Taxonomy of Learning Model and later on based on the revised version of Bloom's Taxonomy (Krathwohl, 2002). The FC allows students to view the contents individually at their own time while also catering to those with lower-level learning objectives (knowledge and comprehension). Online contents are made available before the class (Gilboy, Heinerichs, & Pazzaglia, 2015; Khalil & Elkhider, 2016) while actual face-to-face classroom time would be used for collaborative work. This combination can enable students to enable students to discover, practice and apply the knowledge learnt (Nederveld & Berge, 2015). Thus, the FC allows instructors to spend more time on higher-level learning objectives (application, analysis, and creation) through interactions (Gilboy et al., 2015; Khalil & Elkhider, 2016; Nederveld & Berge, 2015).

The FC concept became popular in recent years as a result of Jon Bergmann and Aaron Sams (2012), two high school Chemistry teachers from the USA (Hamdan, McKnight, McKnight, & Arfstrom, 2013). They initiated the FC methodology with the aim of solving the problem of student-athletes who were missing their classes (Bergmann & Sams, 2012). Nevertheless, the FC model is not a novel idea. As early as 2000, (Baker, 2000) had presented the 'inverted classroom' concept at the 11th International Conference on College Teaching and Learning in Florida. In the same year, Lage, Platt, and Treglia (2000) used the term "inverted classrooms" to implement outside the classroom activities that conventionally take place in the classroom and vice versa (Talbert, 2012, 2014). This concept served as the guiding principle of the FC. Focusing on student learning styles, Lage et al. (2000) designed materials according to different modalities to suit their students' varied learning styles; but in 2001, Eric Mazur and Catherine Crouch employed a model called the Peer Instruction (PI) model in their classroom. It was a modified form of FC that focused on cooperative learning, and is aimed at increasing student engagement and understanding of an introductory physics course (Dewitt, 2014).

The FC has specific characteristics. The key characteristic is that students are required to complete pre-class assignments before participating in the face-to-face discussions which occur at a deeper level during class time. The other five key characteristics of a FC are as follows: (i) students transform from being passive receivers of information to active learners because they need to participate in active learning activities, (ii) technology is used widely to deliver instructional materials, (iii) assignments are completed beforehand and this results in the inverting of class time and traditional homework time; (iv) contents are given in the real-world context; and (v) face-to-face classroom activities engage students in problem-solving activities that can enable them to understand difficult concepts (Albert & Beatty, 2014).

During the FC, the instructor's role changes. Instead of focusing on delivering information, the instructor can now focus on the significant gaps that students may have in their understanding. Thus, instructors can use the subject matter and their pedagogical expertise to assist students in making meaning out of the information they had gathered prior to class. Here, the instructor helps the students to create connections between new and prior knowledge. This is usually done by giving students more complex assignments in class, much like the kind of exercise that traditionally would have been given as homework. Hence, what is usually seen as homework is now classwork while the traditional classwork is now done as homework. It appears that doing the homework in class gives the instructor a better insight into the difficulties that students face in their particular learning and also what the students' learning styles are like so that these can be addressed and matched respectively (Fulton, 2012; Wilson, 2013).

Research looking at the FC has focused on various subject areas such as Science, Technology, Engineering and Mathematics (STEM) and courses related to medicine and allied health sciences (McLean, Attardi, Faden, & Goldszmidt, 2016; Porcaro et al., 2016), nursing (Critz & Knight, 2013; McGowan, Balmer, & Chappell, 2014), Chemistry (Bergmann & Sams, 2012; Fautch, 2013, 2015; McCallum, 2013; Schultz, Duffield, Rasmuseen, & Wageman, 2014), engineering (Azemi, 2014; Chao, Chen, & Chuang, 2015; Kim, Patrick, Srivastava, & Law, 2014) and Mathematics (Moroney, 2013; Talbert, 2014). Nevertheless, literature looking at the FC activities of the Social Sciences and Arts such as Business and Management (Findlay-Thompson & Mombourquette, 2013; Toqeer, 2013), English (Lee , Ng , Tan , & Yoon, 2014; Raihanah, 2014), Law (Lemmer, 2013) and Research Methods (Dewitt, 2014; Hoffman, 2014), Sociology (Forsey, Low, & Glance, 2013), History (Murphree, 2014) and Project Management (Jeong, Hae, & Lee, 2015) is also available but limited.

Comparatively, there seems to be the lesser focus given to TVET subjects such as Tourism and Hospitality, Fashion or Commerce and others. In the context of the TVET education, it appears that studies related to FCs have been conducted at TVET institutions, but focus was on Maritime Education (James, Chin, & Williams, 2014), Beauty and Health (Brown, 2008; Naamani & Taylor, 2012), Hospitality (UNESCO, 2013a) and XML programming (Guan et al., 2015). This study suggests that more focus should be given to TVET subjects as well.

Benefits of the FC. The FC holds many promises. For instance, through the FC approach, students are able to catch up with their class lessons either by watching lecture videos prepared by their instructors beforehand or by using screencast software or annotated *PowerPoint* slides which have been uploaded on to *YouTube* (Bergmann, Overmyer, & Wilie, 2012; Bergmann & Sams, 2012). Students can also learn at their own pace as they have the ability to stop, pause, fast-forward or rewind the lecture videos according to their own pace. In the traditional model of instruction, students who arrive late or miss the whole class may receive inconsistent input which subsequently reduces their engagement in class thereby hindering the entire learning experience (Raihanah, 2014). Students who have missed class do not need to depend on their friend's notes or printed handouts anymore (Siti Zuraidah Md Osman, Rozinah Jamaludin, & Mokhtar, 2014). This can minimise the time taken by instructors to repeat the instruction (Blair, Maharaj, & Primus, 2015; Enfield, 2013). The FC model also enables students to move forward with learning by using the learning resources available online should the instructors be absent (Roehl, Reddy, & Shannon, 2013). In this regard, by using lecture materials made available online, students can learn anytime and anywhere at their own pace.

Students in the FC perform better as they seem to have a better understanding of the subject matter based on their academic achievement. This was evidenced through the academic achievement of students who went through the FC approach (Davies, Dean, & Ball, 2013; De Grazia, Falconer, Nicodemus, & Medlin, 2012; Fulton, 2012; Green, 2012; Horn, 2014; Touchton, 2015). Nonetheless, how achievement was measured varied from study to study. Some studies used the difference between pre-test and post-test scores (Kong, 2015; Yong, Levy, & Lape, 2015) and others used the difference between pre-test and post-test scores and the increase in the final exam scores (Pierce & Fox, 2012) and others still merely used the final exam scores (McLaughlin & Rhoney, 2015; Porcaro et al., 2016; Whillier & Lystad, 2015). More recently, Nouri (2016) highlighted that when FCs were used, low achievers significantly reported more accomplishments as compared to high achievers with regard to attitude toward the use of videos as a learning tool, perceived increased learning and perceived effective learning. In a flipped environment, pre-recorded videos might reduce cognitive load as students will be able to play and pause the video especially low-achieving students who may struggle more with managing cognitive load (Talbert, 2017).

Students are more engaged in the Flipped Classroom (Enfield, 2013; Horn, 2014). Here, engagement refers to the depth of interaction students have with the contents whether in-class or outside of class (Butt, 2014). Students noted an increase in engagement due to the redesigning of the face-to-face time (Bormann, 2014). This may be because they are given the opportunity to actively participate in the learning process through active learning strategies (Fulton, 2012; Lemmer, 2013; McLaughlin et al., 2013; McLaughlin et al., 2014; Pierce & Fox, 2012; Roehl et al., 2013). It has been shown that active learning strategies include problem-based and inquiry-based methods such as collaborative work, self-reflection, in-class discussion and case studies stimulate students' engagement (McLaughlin et al., 2014).

The FC also seems to enhance students' motivation in acquiring knowledge and improving their attitude toward the FC approach. Providing quizzes with the video lectures was found to motivate students (Enfield, 2013). Meanwhile Teo, Tan, Yan, Teo, and Yeo (2014) reported that technology and student-centred activities increased student motivation. Students were motivated into completing problem-solving activities when they received facilitation and support from instructors and work in small groups with other students (Kim, Kim, Khera, & Getman, 2014). This claim is often driven by students' perception that in-class time is more engaging when they have an opportunity to work with their peers. This resulted in improved instructor-student relationship and togetherness (Forsey et al., 2013; Lemmer, 2013; Murray, Koziniec, & McGill, 2015). It also developed students' attitude toward liking the subject (De Grazia et al., 2012; Fulton, 2012) many instructors found that it improved attendance (Chen, Wang, Kinshuk, & Chen, 2014; Green, 2012; Lucke, Keyssner, & Dunn, 2013).

Flipped classrooms also provide opportunities for students to apply their acquired knowledge in the professional setting which prepares them for employability. When the FC is applied, instructors get to cover both aspects of learning involving theory and practice. This is because the knowledge acquired through the activities can be applied in real case scenarios thereby reinforcing their act as young professionals in practice. A few studies (Critz & Knight, 2013; Lemmer, 2013; O'Flaherty & Phillips, 2015; Zaid Alsagoff, Baloch, & Hashim, 2014) reported that the FC aided students to work on activities that can prepare them for employability. They achieve this by applying their learnt knowledge to a new context. Through active learning strategies infused through technology via the FC strategies, students may develop higher order thinking skills and creativity. Furthermore, the face-to-face session offered in the FC provides students with more time to solve domain related case scenarios (Fulton, 2012; Sankey & Hunt, 2013; Young, Bailey, Guptill, Thorp, & Thomas, 2014) and from the practice, they learn to mimic what professionals do in the real setting (James et al., 2014; Lemmer, 2013).

All the above mentioned explanations suggest the potential in using FC in TVET to develop vocational careers (Rauner & Maclean, 2008). James et al. (2014)

illustrated that the FC approach could prepare more industry-ready graduates. However, there was a lack of evidence in the increase of problem-solving skills among students after FC implementation. This gap was filled with the outcome of this study.

Limitations of the FC. Despite the benefits of FC, there are concerns. Bergmann and Sams (2012) noted that the first year of the FC practice is likely to be full of challenges and it may take the instructors and students three years to adjust to the practice (Chen et al., 2014).

This is because, firstly, some students still prefer face-to-face lectures (Crouch & Mazur, 2001; Tanner, 2013; Whillier & Lystad, 2015). Students have also reported feeling frustrated following the increase in workload caused by introducing FC (Chen et al., 2014; Missildine, Fountain, Summers, & Gosselin, 2013; Strayer, 2012) as they had to learn the materials independently (Enfield, 2013; Mason, Shuman, & Cook, 2013; Mukherjee & Pillai, 2011; Talbert, 2012). Students who were working part-time or have family commitments at home may be unable to complete their given assignments which serve as mandatory exercises outside classroom time (Nielsen, 2012; Sams, 2013; Stager, 2012; Tanner, 2013). More recently, Ozan and Ozarslan (2016) found that the FC which requires videos to be watched online by students may be ineffective because the length of the video lecture may bore students. Thus, it was suggested that short (less than 10 minutes), and more focused video lectures are used to encourage students further. This crucial measure needs to be taken into consideration as students who are unable to complete their pre-class work may feel lost and fail to interact with the class (Chen et al., 2014; Lee et al., 2014; Mukherjee & Pillai, 2011). Other oppositions raised by students is that the FC lower their motivation since the passive learning habits require less effort (Chen et al., 2014; Whillier & Lystad, 2015).

Linked to that, instructors may be reluctant to abandon the instructor-centered lecture (Missildine et al., 2013; Mok, 2014). As some resort to merely using the same old resources (lecture notes or slides) on a new platform (Harris & Jones, 2014), others may dislike the use of technology for teaching if they are unfamiliar with it. The FC model is not necessarily a solution for effective instruction (Nielsen, 2012; Sams, 2013; Schwartz, 2013; Stager, 2012). This is because students may not be motivated to keep up with poor lecturing or teaching presentations despite the use of technology as a platform. Indirectly, this could attribute to the higher attrition rate concerning online courses Allen and Seaman (2013).

In contrast to technology, it is possible that instructors may not be experienced with the knowledge and skills required to implement the FC thereby hindering its success (Hall & DuFrene, 2015). Clearly, instructors need the right amount of knowledge and skills in planning their FC successfully. There is a concern when the original content of lectures have been pushed outside of the class time as instructors are required to have better plans for their in-class time. This is attributed to the important component of the process which requires high-level engaging questions that can deepen students' thinking besides addressing their misconceptions in the lesson (Danker, 2015).

Flipping a class is not an easy task. A lot of preparation time is required to ensure that the relevant content is covered and that the ''classroom'' activities actually engage higher order thinking skills (Sharma, Lau, Doherty, & Harbutt, 2015). The FC requires materials to be made available ahead of class time (Danker, 2015; Raihanah, 2014). Creating instructional resources such as *PowerPoint* with voice-overs, lecture captures, design of classroom activities and assessment of projects and examinations have to be well planned and executed because they are all very time consuming

(Danker, 2015; Lee et al., 2014; McLaughlin et al., 2014; Mok, 2014; Schlairet, Green, & Benton, 2014; Siti Zuraidah Md Osman et al., 2014). In this regard, instructors should be equipped with basic instructional design skills and knowledge.

Instructors, as subject matter experts, may be unable to implement active learning strategies without receiving guidance on the best practice from experts (Kim, Kim, et al., 2014; Porcaro et al., 2016). Thus, Bishop and Verleger (2013b) and Chen et al. (2014) suggest that the FC activities be designed based on pedagogical practices. The Instructional design models that can be used for presenting information include Gagne's Nine Events of Instruction which is appropriate for direct instruction or Merrill's First Principles which is suitable for a problem-based approach (DeWitt, Alias, & Siraj, 2015; Gagné, 1985; Merrill, 2012). This study suggests that instructors would benefit from a set of instructional strategies that enables them to manage the development of online activities and active learning strategies.

Therefore, before the FC can be implemented, institutions need to invest in the appropriate technological infrastructure. This may incur additional costs as the latest equipment and devices, high-speed connectivity and software are required to support the emerging technologies. In addition, technical support is needed for assisting instructors with any technical concerns when maintaining and updating resources during the FC implementation (Kurup & Hersey, 2013; Missildine et al., 2013). Technical support is also required for the setup of the instructional design (Khanova, McLaughlin, Rhoney, Roth, & Harris, 2015). This idea is related to past issues where the lack of high-speed internet had been a concern when the FC was introduced to local institutions (Lee et al., 2014; Siti Zuraidah Md Osman et al., 2014) particularly in rural areas (Missildine et al., 2013; O'Flaherty & Phillips, 2015).

Of the challenges faced in implementing FC, the biggest challenge noted by past studies is in ensuring that students view online materials in readiness for in-class activities. Ebbeler (2013), for instance, found that majority of the students who appeared in the class were unprepared when they did not complete the extra work required of them before class. Similarly, Kim, Kim, et al. (2014) found that 25% of the students in one of their classes did not access the lectures at home. This ties in with trends of studying time in general. Babcock and Marks (2010) also reported a pronounced decline in the number of hours that full-time college students say they study which decreased from about twenty-four hours a week in 1961 to fourteen hours a week in 2003. Such findings suggest that students today simply may not be interested in doing work outside of the classroom and are, therefore, not equipped for the proactive nature of the FC (Burke & Fedorek, 2017). Nevertheless, the FC is based on the foundation that students arrive in face-to-face class sessions, prepared and ready to learn (Burke & Fedorek, 2017; Roehl et al., 2013). To overcome the said challenge, instructors can use graded online exercises to provide motivation for student accountability (Lo, Hew, & Chen, 2017).

Training and good support are also crucial for instructors. The implementation of FC has implications for teacher training (DeWitt, Alias, & Siraj, 2015). For instance, a systematic teaching plan that outlines the activities, resources, and contents that students need to access is necessary for FC implementation (Flores, del-Arco, & Silva, 2016). Instructors also require training on how to apply existing and emerging technologies in the technology-enabled FC (Roehl et al., 2013). Instructors' training should include training for the use of Information and Communications Technologies (ICT) so that they know how to select and assign resources. The training will also help them to design and develop their own resources (DeWitt & Alias, 2015). Once these resources are prepared, they can be reused for future runs of the course (McLaughlin et al., 2014; Mok, 2014) which makes the FC cost-effective in the long term.

FC Implementation

Many of the past studies (Bishop & Verleger, 2013b; Giannakos, Krogstie, & Aalberg, 2016; Lo & Hew, 2017) had not explained any specific conceptual framework to help instructors to design their FCs. Further, very few previous studies (see, e.g. O'Flaherty & Phillips, 2015) had used the results of their studies to develop and design principles that can be used for developing the FC. Nevertheless, the review of the FC practices and models seem to suggest that implementation requires four critical stages: (1) Orientation before implementation; (2) Weekly pre-class work; (3) In-class work and (4) Post-class work (Porcaro et al., 2016). While these stages are crucial, few studies have highlighted the importance of preparing instructors and students before the FC can be implemented and also the post-class activities that require some attention after implementation. This is traced to the various calls by studies (Bishop & Verleger, 2013b; Kim, Kim, et al., 2014; Lee, Lim, & Kim, 2017; Mohamed Amin Embi & Panah, 2014) for more work to be conducted on designing activities for use inside and outside classrooms.

Most studies highlighted the importance of the in-class and before class activities only. The before class activities focus on delivering contents via online lectures whereas the in-class activities focus on active learning strategies. Despite the hype made about the FC, little has been said about the specifics of the activities used before the flip takes place in a TVET setting. The design of the activities for use in a FC is crucial. Khanova et al. (2015) suggested this because the failure to link the before class materials to the during class activities is related to inadequate class preparation.

This can limit students' ability to construct knowledge during face-to-face learning activities, and ultimately, this contributes to frustration and dissatisfaction with the learning environment among students.

Orientation before the implementation. An orientation to the FC also needs to be conducted to ensure that those involved can accept this approach. In particular, attention is required in the pre-class preparation which facilitates the transition. The orientation should include explaining the rationale, the benefits, types of tasks and establishing the ground rules (Lo et al., 2017). One way to achieve this is to allow instructors to experience the FC as a learner (See & Conry, 2014). When the participants are required to submit a task after watching the pre-workshop video, their understanding of the concept and their acceptance increases. From the pilot study conducted for one study, it was observed that 84% of the participants reported that the exercise increased their understanding of the FC with 88% of the faculty members stating that they would consider flipping one of their classes the following year as the benefits were appreciated (See & Conry, 2014). Instructors can also compile other similar videos concerning the FC best practices available online for other instructors or students to view. For example, after a briefing session to let teachers know about the FC pedagogy and the procedure for conducting the study, Yang (2017) shared a Google Forms link to receive feedback on the level of instructors' understanding of the FC approach. This was accomplished by embedding four readily available *YouTube* videos into the link.

In another study by Gilboy et al. (2015), instructors attended monthly meetings and were given pedagogical resources to help them better understand FC implementation. One of these resources refers to a FC planning template for organising the three components of the FC (before, during and after class activities) (Gilboy et al., 2015). Similarly, Sergis, Vlachopoulos, Sampson, and Pelliccione (2017) used an inquiry-based FC Teaching Model template to organise the class by planning the teaching stage, the learning, and assessment activities that will be used within and beyond the classroom and/or lab. In both studies, instructors used these templates with effectiveness to plan their FC implementation which was emulated in this study.

As discussed earlier, the FC implementation is restricted by time for implementation, training and technological investment all of which may contribute to faculty members' reluctance to adopt the approach. Therefore, when implementing the FC for the first time, it is advisable to convert part of a course, instead of the whole course (Lee et al., 2014; Mok, 2014; Sharma et al., 2015); for instance, by selecting only a few units for students to experience initially (Hao, 2016) or by making incremental implementations (Tsai, Shen, Chiang, & Lin, 2016). This approach is also known as the partial flip approach which has been practiced in a few studies due to instructor resistance (Baker, 2000; James et al., 2014; Strayer, 2012). Another variant of the partial flip approach is to use readily available videos taken online from video repositories such as *YouTube* or *Vimeo* (Talbert, 2012) or from other well-known repositories, library or complementary digital resources provided by publishers of the commercial textbook (Crawford & Senecal, 2017). These are then used as supplements in the in-class lectures and face-to-face discussions (Peters, 2014) thereby avoiding complete and original creations from instructors (Riddell, Sawtelle, & Jhun P., 2016).

Nonetheless, when using available online resources, some factors such as educational fit (content meets the educational goal without being too broad or too deep), credibility (content developed by a credible source such as an institution of higher education, government agency, or reputable foundation/organisation) and availability (has a Creative Commons license or terms of agreement that allows for the content to be used in an educational setting) must be taken into account (Crawford & Senecal, 2017). Another factor to consider when choosing videos is the issue of the fast-paced American accent used in certain *YouTube* and other non-local videos because accents can deter student comprehension (Black et al., 2017; Yang, 2017).

Once the instructors are prepared, the next step is to prepare the students in embracing the FC approach (Albert & Beatty, 2014; Gilboy et al., 2015; Mok, 2014). Those unfamiliar with the FC model must be briefed shortly during the first week of the course. Here, in the first session of the course, instructors can explain to students the reason for the flip and its benefits (Sharma et al., 2015). This will benefit learners so that they know what to expect. Students can then view the introductory video clips such as '*The Flipped Classroom in 60 seconds*' by Julie Schell, a proponent of FC (Porcaro et al., 2016). Another approach is to inform students of the essential elements of the model.

In Schlairet et al. (2014), students received a handout to help them understand the flipped classroom model and the types of learning they would encounter, the activities requiring their participation, the implementation schedule (when/where they would complete activities) and what form of learning they could expect upon completing the activities successfully. For example, group work requires carefully thought-out guidelines and explanation (and indeed reinforcement) (Black et al., 2017). The aversion to group work is often related to prior bad experiences (free riders and/or vague or underwritten guidelines and marking rubrics) (Black et al., 2017). Thus, during the orientation, students were involved in a discussion to identify the attributes that would enable them to contribute positively to group work, and to reflect on team responsibilities (Black et al., 2017).

Besides discussing the syllabus, instructors also need to explain their expectations set for the FC by clearly communicating to students the learning objectives, expectations and grading policy (Khalil & Elkhider, 2016). For successful FC, irrespective of subject areas, students must take the initiative to be self-directed learners and come prepared for class (Alvarez, 2012; Danker, 2015; Davies et al., 2013; Fulton, 2012; Jeong et al., 2015; Mok, 2014; Walling, 2014). Instructors' need to emphasise coming prepared to a class by completing pre-class tasks. They must also stress the importance of time management and accessing the resources available (Black et al., 2017).

Since the FC caters to students with diverse learning styles and preferences (Lage et al., 2000; Mukherjee & Pillai, 2011; See & Conry, 2014), contents can be delivered in a variety of formats – video, audio, text, images – to meet different learning styles. If this is the case, instructors also need to vary the instructional materials prepared to cater for different modalities. Instructional materials used for the FC can be in the form of audio lectures (podcasts) (Naamani & Taylor, 2012; Smith & McDonald, 2013) or video lectures (vodcasts) (Bergmann & Sams, 2012; Pierce & Fox, 2012; Smith & McDonald, 2013). Instead of using lecture notes, students can now review a video clip or podcast as many times as needed to reinforce their own learning (Hall & DuFrene, 2015). Some resources are made available in the form of animated e-books (Johnson, Adams Becker, Estrada, & Freeman, 2014; Kong, 2014; Sazilah Salam, Norasiken Bakar, Halimatussaadiah Mohd Asarani, & Saki, 2014), printed materials or handouts (Lage et al., 2000) as well as mind mapping and brainstorming tools (Kong, 2014). Giving consideration to the types of resources available is necessary so that the curriculum design and instruction could be matched to student characteristics and preferences. In this regard, Hao (2016), for example, developed more videos than audio clips for his students.

Weekly "before class" session. In the traditional model, formal learning time is spent in a static and physical classroom. In the FC environment, pre-set instructions are given to students prior to the start of a class via pre-loaded online modules and content. This encourages students to acquaint themselves with the course content thereby enabling a new set of knowledge to be built from the schema acquired earlier (Hsieh, 2017). The FC model used in Gilboy et al. (2015) involved online lectures, videos from repositories, worksheets, written prompts, textbook readings and supplemental reading materials before class.

Without preparation, students' contribution to the face-to-face session would have been less effective (Long, Cummins, & Waugh, 2016). Student accountability and motivation can, however, be encouraged. Most studies (Chen et al., 2014; Findlay-Thompson & Mombourquette, 2013; Kim, Kim, et al., 2014; Lemmer, 2013; Mok, 2014; Murphree, 2014; Tune, Sturek, & Basile, 2013) mentioned using online quizzes as a method. Others (Ferreri & O'Connor, 2013; Tune et al., 2013) mentioned that quizzes given at the beginning could facilitate classroom discussions. Some studies (Ferreri & O'Connor, 2013; McLaughlin et al., 2014; Schlairet et al., 2014) reported using clickers to gauge student understanding; students reported this as more enjoyable (DeLozier & Rhodes, 2016).

Weekly "during class" session. The focus of the FC is the interaction and the meaningful learning activities that occur during the face-to-face session. Nonetheless, it does not replace the instructor's role (DeWitt, Alias, & Siraj, 2015). This was noted by Ghaznavi (2011) who argues that an instructor's role is more important than ever in the FC setting as the instructor needs to be multi-skilled and assume various responsibilities. For example, the instructor will walk around the class providing support when students are tackling problems or scenarios in groups. After shifting the lectures outside of classroom time, instructors need to come in prepared for what to do during the freed-up time.

Prior to flipping, there was simply not enough processing time between instruction on a concept and higher-level scenario-based application of that principle. There was also insufficient instructional time for students to be given a scenario, enact it and debrief it effectively. Flipping thus provides more instructional time for students to be given a scenario-based application of principles covered before class. In doing so, most of the instructional strategies employed in the FC are thus in-class activities which are used to stimulate higher order thinking skills (Khan, 2012; Lemmer, 2013; Roehl et al., 2013; Sazilah Salam et al., 2014; Zaid Alsagoff et al., 2014). Specifically, most studies in the literature (Bergmann & Sams, 2012; Butt, 2014; Lage et al., 2000; Lucke et al., 2013; McLaughlin et al., 2014) reported on problem-centred instruction with collaborative team-based activities.

Weekly "after class" session. The "after class" session or the post-class component of the FC is to close the learning loop such as to address gaps in knowledge. Some instructors produced shorter versions of screencasts which include commonly asked questions and answers (Porcaro et al., 2016). Others produced short lectures containing information that students could watch to reinforce what they have learnt (Hoffman, 2014). These videos can become final exam review materials for students.

Post-class work can also comprise formative assessments (at the end of the class assignment) or summative assessments (exams or portion of the exam that cover several weeks of content). These assessments should be aligned with the objectives of the pre-class content and the in-class activities (Gilboy et al., 2015). In some studies, (Guan et al., 2015; Kong, 2014), post class work was used to assess performance. Here, students modified their work that was to be uploaded to the LMS for discussion and to learn from each other (Guan et al., 2015; Kong, 2014). Additionally, essay exams (Porcaro et al., 2016), presentations (Siti Zuraidah Md Osman et al., 2014), reflective responses (Chen et al., 2014; Galway et al., 2014; Kong, 2014; Strayer, 2012) or quizzes (Chen et al., 2014; Kong, 2014; Porcaro et al., 2016; Siti Zuraidah Md Osman et al., 2014) may be utilised.

Potential of Mobile Learning in FC implementation

Mobile phones have become inseparable with today's lifestyle, and most Malaysians actually consider mobile phones a necessity. This attitude is reflected in the increase in smartphone ownership and the wider 3G and 4G coverage over recent years. According to a 2016 report by the Malaysian Communications and Multimedia Commission (MCMC), Malaysia has the third largest mobile penetration in Southeast Asia, slightly behind Thailand and Singapore, with an estimated 43.9 million mobile-cellular subscriptions. Mobile phone service providers in Malaysia are continuously seeking to increase their market share by offering highly competitive rates for calls and mobile data plans. This competition has resulted in a high number of prepaid subscriptions consisting of 34.3 million and post-paid subscribers amounting to 9.6 million in 2016 (Malaysian Communications and Multimedia Commission, 2016). Another report stated that the highest percentage of internet users in 2017 involved those between 20 to 24 years old (Malaysian Communications and Multimedia Commission, 2017), thereby reflecting the age range of students at Community Colleges.

Nonetheless, the use of technological advances for TVET pedagogy still lacks (Ng, Lam, Ng, & Lai, 2017) since the TVET programmes tend to attract students of lower academic achievements (Ministry of Education Malaysia, 2015). In that regard, Community College students are comparatively less academically inclined (Idris, 2011). This is reflective of their different backgrounds which could be the cause for their enrolment into TVET programmes in Community Colleges. In one study, Chunxiang (2017) found that students enrolled in TVET colleges had poor academic qualifications, lacked the confidence to re-sit college entrance examinations and so they tend to aim for the lowest level of qualifications such as the Diploma or Certificate only. This implies that these students either lack interest in their studies or that they have very low self-esteem, which can eventually affect their learning outcomes. Based on this, it can be understood why past studies have noted that most TVET instructors complained about classroom management problems involving unattentive, unmotivated as well as passive students (Chunxiang, 2017; Ng et al., 2017).

Nevertheless, to overcome the poor self-study qualities and the lack of interest in studies among TVET students, Chunxiang (2017) suggested that instructors prepare mini-lessons for students to explore knowledge online while the face-to-face settings are used for one-to-one tutoring, discussion, and hands-on activities, as is typical of a FC setting. This recommendation also resonates with the findings of Ng et al. (2017) who mentioned that blending face-to-face teaching with e-learning or mobile learning is the current trend in the TVET teaching and learning process as it helps to accommodate flexible learning space beside enhancing motivation and interactions.

Mobile devices such as smartphones, tablets and future emerging technologies can provide pedagogical advances for FC implementation (Albert & Beatty, 2014; Bogatinoska, 2013; Idrus, 2015; Liao, 2014; Mohammed Amin Embi et al., 2014;

Sams, 2013) especially when other technologies do not work (Hamdan et al., 2013; Nederveld & Berge, 2015). In Malaysia, smartphone remained the most popular means for users to access the Internet (89.4%) making the country a mobile-oriented society (Malaysian Communications and Multimedia Commission, 2017). Today, smartphones and tablets are rapidly becoming essential tools that can be used to acquire small displays of information that can advise learners amid task performance on what to do in order to perform the routine aspects of the task effectively (van Merriënboer, 2013). Through the mobile devices, students can access instructional materials anywhere, anytime and repetitively (Leung, Kumta, Jin, & Yung, 2014; Smith & McDonald, 2013). Since instructional materials can also be updated quickly, the speed can cater to students who have different learning preferences (Smith & McDonald, 2013).

In a few local studies looking at the FC environment (Idrus, 2015; Raihanah, 2014), the mobile messenger app, and *WhatsApp* have been used extensively for delivering small amounts of information to students to read before class (Idrus, 2015; Raihanah, 2014). The instant messaging application has achieved widespread acceptance in society through the pervasiveness of smartphones. However, studies focusing on the use of mobile instant messaging are still limited.

One study conducted by Rambe (2015) in South Africa investigated the potential of *WhatsApp* in promoting student participation in academic activities and in transforming lecturers' teaching practices. Aftab Ahmed Khan, Adel Zia Siddiqui, Syed Fareed Mohsin, M. Mahmoud Al Momani, and Mirza (2017) found that using *WhatsApp* allows for quick dissemination of study materials which was found to increase student engagement for discussing lecture content and also for enhancing learning abilities, thereby making students confident in returning to the classroom with additional knowledge.

Another popular mobile messaging app is *Telegram*, a cloud-based messaging app that enables users to send messages, photos, videos and files of any type (doc, zip, mp3, etc.) to a large group (up to 5000 people) with seamless synchronisation. The application has been on the market since 2013. The distinctive feature of *Telegram* is that it is like the SMS and email combined with an option to create a large group (5000 members), desktop apps and powerful file sharing volumes. The app also supports replies, mentions, and hashtags that help to maintain order especially in a large group. Within Malaysia, very limited studies have looked at the use of *Telegram* in teaching and learning. Ibrahim, Norsaal, Abdullah, Soh, and Othman (2016) studied an Engineering classroom, and they noted that students preferred *Telegram* as a means of accessing course materials and for collaborating with classmates and instructors instantly.

Developing and delivering instructional materials for the FC. Recently, the use of smart technologies via tablets and smartphones has garnered significant momentum, but there is still a lack of research on the systematic use of interactive technologies in the FC (Gannod, 2007; Kim, Kim, et al., 2014; Strayer, 2012). The explanation behind this is that many smartphone users are unaware of the learning potentials offered by portable personal technologies (Woodcock, Middleton, & Nortcliffe, 2012). Ng et al. (2017) proposed using mobile and flexible technologies to enable learning and teaching resources. They suggested that videos and Instant Messaging (Social Media, Group Chat) can serve as complements and supplements to the teaching and learning strategies applied because, when used adequately, these strategies can facilitate self-paced learning. Besides the use of smartphones for communications, mobile devices can also be used by students to answer quizzes or polls. Likewise, instructors can provide real-time feedback via mobile devices thereby transforming their traditional lectures (Giannakos et al., 2016; Zaid Alsagoff et al., 2014).

Next, the plethora of low-priced, easy to use video recording tools available on most computers to capture digital recordings of presentations makes it easier for those involved to develop materials for the FC (Albert & Beatty, 2014; Siti Zuraidah Md Osman et al., 2014). Herreid and Schiller (2013) found that teachers created their instructional materials through software such as *Camtasia*, *PaperShow* and *ShowMe* or applications on the iPad such as *Educreations* and *Explain Everything*. Touchton (2015) used *Explain Everything* and *Camtasia Relay* to create instructional materials although they also suggested using *Microsoft PowerPoint* which allows voiceovers to appear on slideshows. Nederveld and Berge (2015) added that tools such as the *Articulate Studio* or *Storyline*, *Adobe Captivate* or *Presenter*, *Camtasia* or *Lectora* could be used to create interactive videos with quizzes to check students' knowledge and understanding. Other technologies suggested for the FC model include lecture capture tools (*Echo 360*) and online webinar creation tools (*WizIQ*, *Google Hangout*) (Zaid Alsagoff et al., 2014). Additionally, quizzes or polls can be created on web-based interactive technologies such as *Poll Everywhere*, *Google Forms*, *Survey Monkey*, *Socrative*, *Kahoot*, *InfuseLearning*, and *GoSoapBox*.

FC studies in Malaysia

Since online education may not work well in the Malaysian classroom setting as learners may prefer teacher-led activities (Subramaniam, 2008), some studies have focused on learners' perceptions of the FC (Lee et al., 2014; Raihanah, 2014; Siti

Zuraidah Md Osman et al., 2014; Zaid Alsagoff et al., 2014). Others looked at the benefits and challenges of the implementation (Lee et al., 2014; Mukherjee & Pillai, 2011) and some focused on readiness (Mohammed Amin Embi et al., 2014) in addition to investigating resources and developing interactive e-books (Sazilah Salam et al., 2014). The outcome of these studies suggests that students' understanding of subjects such as research methods (Dewitt, 2014), video development (Danker, 2015) and accountancy (Siti Zuraidah Md Osman et al., 2014) can be positively impacted.

The study by Mukherjee and Pillai (2011) found that the FC provided more time for problem-solving activities as compared to the traditional teaching method. It was found that students involved with the FC scored better in their assessments (Siti Zuraidah Md Osman et al., 2014). The explanation behind this is that students in a FC spent more time engaging with their lecturers and peers while solving problems in the classroom. However, despite performing better in the Flipped Classroom, the achievement rate was still low.

A few studies reported on the limitations of FC implementation in the Malaysian context. Lee et al. (2014) conducted a study on the benefits and challenges of FC implementation with 37 pre-service English teachers at a public university in East Malaysia. Among the challenges reported: it was noted that students were not ready to embrace the flipped approach as it was still new and the FC approach required a significant amount of time and effort and better Internet connectivity for implementation (Lee et al., 2014). Siti Zuraidah Md Osman et al. (2014) conducted a study with 61 final Diploma in Accountancy students at a Malaysian polytechnic to find out their perception of using the FC approach. Among the challenges reported is the lack of financial assistance and poor Internet network.

Mukherjee and Pillai (2011) reported low levels of engagement; the lecturers ended up lecturing while the students were not prepared before the class and they preferred to answer factual-based questions instead of participating in open-ended discussions. Their study concurred with that of Zaid Alsagoff et al. (2014) which reported that students did not prepare before the class and 60% still preferred learning through face-to-face lectures. Despite the challenges faced in the local context, practitioners of FC emphasised that the FC approach is feasible with proper training (Danker, 2015). Instructors can prepare learning materials using a plethora of free platforms to save cost and students can view contents off campus before coming to class to overcome limitations of Internet availability on campus (Siti Zuraidah Md Osman et al., 2014).

The novelty of FC in the Malaysian context may have contributed to resistance among instructors and students. Hence, it is imperative that instructors' needs and students' readiness be assessed before FC implementation to ensure success. Assessing the readiness of Malaysian students in adopting the FC model has been conducted among students in Universiti Kebangsaan Malaysia (UKM) by Mohammed Amin Embi et al. (2014). Looking at 352 respondents, it was reported that 89% were undergraduates and the rest were postgraduate students (Mohammed Amin Embi et al., 2014). The survey instrument on the e-learning readiness designed by Watkins, Leigh, and Triner (2004) was used, and the Readiness components include Technology Access, Online Skills, Motivation, Ability to use online audios/videos, Internet Discussions and Importance to Success. It further included items sourced from literature review encompassing FC awareness, respondents' suggestion of face to face versus online activities and preferred content format (Mohammed Amin Embi et al., 2014). An astonishing 64.4% of respondents (consisting of graduate and postgraduate students) were unaware of the FC approach while students had only an acceptable level of readiness for embracing the FC approach (Mohammed Amin Embi et al., 2014). Based on these findings, it is evident that more work needs to be carried out to assess the readiness of Malaysian students for FC implementation, especially in the context of Community Colleges. Without sufficient information to emphasise on the impact and potential success of the FC, it is more challenging for educators and stakeholders to invest their required time and resources in implementing a new pedagogy.

Problem-solving, learning gains, and FC

Much of the benefits of using the FC have been elaborated in the above sections and many studies (Azemi, 2013, 2014; Ferreri & O'Connor, 2013; Gilboy et al., 2015; Kong, 2014; Kurup & Hersey, 2013; Porcaro et al., 2016) acknowledged its usefulness in enabling students to apply problem-solving skills. The only difference that stands out in all the studies is that most did not follow one particular problem-solving model for their problem-centered FC approach. Students need to acquire more than just factual knowledge to deal with problem-solving. Students need to experience and practice the processes and techniques for problem-solving to be better equipped to deal with problem-solving (Dewitt, Alias, Palraj, & Siraj, 2018). For instance, Wolf, Brush, and Saye (2003) found that when the Eisenberg and Berkowitz Information Problem-solving (EBIPS) model was used as a scaffold, students produced articles that were more accurate; they utilised a wider variety of information resources, and their products contained richer details. Backstrom and Cooper (2013) reported that 79% of the students found the legal problem-solving model used in Queensland University of Technology Law School first year units, known as ISAAC ISAACS, is a beneficial scaffold when solving issues in a real-world scenario.

These studies employed collaborative problem-solving strategies during the face-to-face sessions. However, it is unclear whether the problem-centred instruction could be implemented when using the FC approach. O'Flaherty and Phillips (2015) reviewed 28 studies on FC implementations and concluded that the approach could not always determine that students acquire good problem-solving skills. Students have the perception that they have improved their verbal communication skills and their ability to solve unfamiliar problems as a team following the use of patient-assessment scenarios in collaborative problem-solving groups (Ferreri & O'Connor, 2013) but the evidence is not strong.

Nonetheless, there are mixed findings in terms of learning gains. While some reported better exam scores when the FC was implemented (McLaughlin & Rhoney, 2015; Porcaro et al., 2016; Schlairet et al., 2014; Tune et al., 2013; Wilson, 2013; Wong, Ip, Lopes, & Rajagopalan, 2014), others (Blair et al. (2015); McCallum (2013); Whillier and Lystad (2015); Yong et al. (2015) reported no significant difference in terms of exam scores after the intervention. Some studies (Davies et al., 2013; Young et al., 2014) even did not report any measures of improved performance.

It seems apparent that there is still a lack of guidelines on the best practices for eliciting learning gains from students (Talbert, 2017). In subject knowledge learning, Kong (2014), in his FC study of an integrated humanities subject involving a 13-week trial teaching across two academic years, found that the 107 students from four Secondary 1 classes had statistically significant gains in the knowledge domain (in developing information literacy competency and critical thinking skills). Likewise, Ng (2016) noted that FC benefited students' learning when the 74 Higher Diploma students taught by her were able to apply the self-learnt subject knowledge to a real situation. Nevertheless, Guy and Marquis (2016) in their quasi-experimental study involving 433 business-major students noted minimal improvement as there was only 83% of improvement in the FC environment as compared to the Traditional Classroom environment (82%). It can be concluded that there is a possibility that FC could develop problem-solving skills and generate learning gains but more studies are needed to verify these claims.

Problem-solving and Culinary Arts

Problem-solving skills are difficult to teach via traditional lectures. In Culinary Arts they can only be learnt from Master Chefs. To date, just a few studies have been identified in developing problem-solving skills in the Culinary Arts curriculum. Some studies have covered the inculcation of problem-solving skills among instructors (Hegarty, 2011) and students (Chang & Chen, 2007; Wang, 2015) in the Culinary Arts. For instance, Hegarty (2011) insist that instructors be reflective practitioners in order to guide their students to become better problem solvers and to bring Culinary education to a higher level while Chang and Chen (2007) focused on students by integrating the Problem Based Learning(PBL) approach into the theoretical aspect of the Culinary Arts course, "Baking Ingredients". This is because instructors found it challenging to teach a course which emphasised scientific skills. After the intervention, it was observed that students' motivation had increased, but there was no difference in terms of their achievements. The study did not elaborate on the details of how the problems were developed in their study. Nonetheless, it was found that students wanted problems which they could relate to. Indirectly, these problems also increased their motivation and served as an attention-grabbing device. The outcome indicated no change in achievement rates.

Wang (2015) employed the focus group interview technique with six scholars and experts to find out the learning steps that could be deployed for PBL in developing Culinary Arts students' problem-solving skills. The problem-based teaching steps involved 39 boys and 52 girls from two classes -- Chinese Cuisine and Chocolate Making, from a private TVET institution in Central Taiwan (Wang, 2015). The steps adhered to by the instructors include: (1) publish the topics for discussion the week before; (2) students search for solutions in groups; (3) group discussion and first practice; (4) teachers demonstrate or observe each group; (5) demonstrate the results of the second practice and evaluate; and finally (6) teachers offer conclusion, evaluation, and suggestions. These steps were similar to those steps noted in Merrill's First Principles (Merrill, 2007). Nonetheless, their study did not discuss the effectiveness of the PBL method. Apart from this, past studies (Horng & Hu, 2009; Horng & Lin, 2009; Horng & Hu, 2008; Horng & Lee, 2009) have also focused on culinary creativity which involves producing new ideas or innovative culinary competencies of chefs (Hu, 2010). These studies were limited to Wallas's (1926) model of four stages of creativity process (i.e., preparation, incubation, illumination and verification) modified for promoting culinary creativity.

In Hämäläinen and Cattaneo (2015), the instructor guided the problem-solving discussion by beaming pre-selected photos taken at the workplace of the students during the face-to-face class setting. This enabled the students to produce better online learning journals and personal recipe books. This study was found to be significant as it highlighted the potential use of smartphones in capturing photos at the workplace to develop students' online journal and portfolio for a culinary classroom setting. This was deemed to increase the students' culinary skills. Portfolio development provides evidence of skills which students believe they have acquired (Mast Ryan, 2013). These studies imply the potential and importance of developing instructional strategies for instructors in the TVET institutions who can use them as strategies for developing problem-solving activities among Culinary Arts students. To date, the intersection between the FC, problem-solving and Culinary Arts is under-researched, therefore warranting further investigation.

Research Related to Problem-Solving and Blended Learning in Culinary Arts

In the international arena, research on problem-solving and blended learning in the Culinary Arts context has focused on several aspects. The first involves using blended learning in the Culinary Arts classrooms. The second looks at the problem-solving process in the Culinary Arts.

The benefits of blended learning have been discussed in earlier sections, and its relation to collaborative learning activities and hands-on experiences among the Culinary Arts have also been expounded (Glass, 2005; Pea & Cuban, 1998). As mentioned before, the Culinary Arts instructors can integrate technologies to enhance students' culinary skills (Brown et al., 2013; Hämäläinen & Cattaneo, 2015; Schaeffer & Warren, 2013). The use of online cooking videos and various other images can enable students to perform better on team tasks (Brown et al., 2013) thereby enhancing student learning (Schaeffer & Warren, 2013) besides saving costs (Brown et al., 2013; Schaeffer & Warren, 2013).

Studies looking at the concept of problem-solving and the FC in the context of Culinary Arts are rare. Among those that have investigated the Culinary Arts (Khalid, Ismail, Ab Aziz, Azdel, & Kamaruddin, 2014; Mohammad Azli Razali et al., 2012), it was noted that technology use in the Culinary Arts classroom could facilitate student learning. Nonetheless, the primary limitation is that these studies did not consider the employability skills of students by focusing on authentic problem-solving issues and skills.

Based on all that has been discussed before, it can thus be deduced that the FC may be the agent to providing an avenue for problem-solving skills to be developed but only when real-world scenario issues are used to train students' competence. However, since most past studies had overlooked this aspect of the Culinary Arts and since problem-solving competence is of vital importance to the real-world of Culinary Arts, it is possible that the FC implementation at Community Colleges in Malaysia may help to fill the void in the literature.

Module Design and Development

In 1961, Postlethwait supplemented his teaching instruction for a botany course catering to freshmen at Purdue University with audiotaped presentations (Russell, 1974). The system was called a minicourse because it consisted of small units of subject matter with combined objectives, an audio tape, printed study guides, visual aids, and actual biological specimens. Such study mode ensured that students play an active role in their learning since they were required to respond to instructional materials, handle media and equipment and work together with other students and the instructor. This was thus considered a module.

The World Health Organization (1985) defines a module as a self-contained learning package consisting of the instructional materials for learning a specific unit or topic based on specific objectives. It suggests that a module carries several advantages. Firstly, learners can study anytime and anywhere by choosing the module thereby allowing them to learn at their own time and pace. Secondly, a module is cost-effective as it can be used by more people and does not require physical teaching facilities. Thirdly, the learning objectives and activities have been chosen and organised based on the learner's needs and abilities; thus there would be no confusion.

From another perspective, Sidek Mohd. Noah and Jamaludin Ahmad (2005) define a module as an instructional unit that meets a set of objectives. Instructors can use a module to enhance teaching and learning not only to attract students' interest but also to increase understanding of content areas according to the objectives outlined, based on sequenced instructional activities. Sharifah Alwiah Alsagoff (1981) suggests that a module should include characteristics such as meeting user needs; it has related materials according to objectives outlined; it includes a variety of media according to the objectives; easy to use with minimal guidance; contains various instructional strategies or activities; it provides reinforcement and feedback; it provides sufficient practice on concepts and skills, and students are evaluated based on the objectives outlined.

Designing objective. Talbert (2015) suggested that after listing the objectives, these should be rearranged according to increasing cognitive complexity. This is important in a FC environment which may comprise different levels of students (Fulkerth, 2009; Gilboy et al., 2015; Khalil & Elkhider, 2016). Due to the specific phases of instruction expected of the FC, students must know what is to be accomplished before, during, and after class; they must also have regular assessments that can measure their progress and understanding (Hsieh, 2017).

Designing content. The Culinary Arts classrooms act as a bridge between the curriculum and the workplace. To ensure that students can be engaged, the materials taught must be up-to-date and yet be sufficiently general. Undoubtedly, there should also be close cooperation between the Culinary Arts institution and the key industry players so that the input given can be used to prepare students to meet industry expectations. Thus, crucial content elements involving the real-world, as perceived by the industry practitioners, need to be learnt (Kilbrink et al., 2014; Min et al., 2016).

Lin and Cherng (2006) had noted that the key areas to be given focus are: food preparation and cookery, nutrition, sanitation and safety, baking and pastry, equipment, and utensils. Students also require other knowledge of critical food science and technology, cooking methods, aesthetics, business and management practices, accounting, legal requirements as well as customer service (Birdir & Pearson, 2000; Horng & Lee, 2009). Comparing the industry practitioners' rankings of the importance of Hospitality course subjects with the rankings provided in two previous studies (Gursoy, Rahman, & Swanger, 2012; Gursoy & Swanger, 2004) changes in rankings were noted over a 10-year period. Min et al. (2016) found that the highly ranked course subjects had remained the same over the past ten years and the top five most essential course subjects encompass: internship/industry experience, preparation for industry employment, leadership, hospitality management and organisation, and ethics. Taking the cue that these are critical areas to develop in students, the current study then used the key areas of interest noted in the Culinary Arts as a guide to establish the contents that might be reflected in the real-world culinary competencies. (See Chapter 3 for a detailed process description).

Designing assessment. Both the formative and summative evaluation will be critical to the FC educator to identify areas for improvement and also as a measurement of the overall success of the course conducted. The quiz can be utilised to encourage students to complete assignments and as a means of regular formative assessment (Tsai et al., 2016) especially before class when used as student practice and self-checking (Lo et al., 2017). The during class activities require students to apply concepts that they have learned from the pre-class materials (Lo et al., 2017). According to Savin-

Baden and Major (2004), the assessment could measure processes touching on learning outcomes, for example, communication skills, teamwork, researching skills and other professional skills. An assessment that focuses on the knowledge, understanding, and competency when a project is completed is relevant. Such assessments can include group presentations, quizzes, multiple choice test, short answers, practical demonstrations or even poster presentations.

Designing platform. The digital platform is necessary for supporting these self-directed activities as a provision for a seamless learning experience both at home and in school (Chen et al., 2014). Students can access instructional materials through the LMS and a web-based system equipped with file upload, collaborative and communication functionality (Kong, 2014; McLaughlin & Rhoney, 2015). For example, McLaughlin and Rhoney (2015) used *Sakai*, an LMS, as a platform for interactive assessment questions, animations pop-up definitions, the menu for topics and comment boxes to initiate discussion. Instructors can also set up web pages as a platform to manage the delivery of FC materials and resources. In Kong (2014), the web page contained sections for online pre-lesson learning section for viewing lesson goals, brainstorming worksheets, and mind maps tool. The lesson learning section contained e-books and selected websites while the post-learning section contained self-reflection worksheets, post-task quizzes and more references and a discussion forum (Kong, 2014).

Next, instructional materials could also be delivered through the institution's mobile LMS app which students could download for free on their Android or iOS supported mobile devices (Teo et al., 2014). In the local context, platforms such as *Blendspace* (Siti Zuraidah Md Osman et al., 2014), *Schoology* (Lee et al., 2014), *Whatsapp* (Idrus, 2015; Raihanah, 2014) and various LMSs available in public universities were used to manage the teaching and learning process during FC implementation (Dewitt, 2014; Idrus, 2015; Zaid Alsagoff et al., 2014; Zainuddin & Attaran, 2015). Students need online support so that they can rely on these to manage problems which they may encounter during class preparation and to ask questions out of class hours (Inayat, ul Amin, et al., 2013; Lo & Hew, 2017). These studies showed the potential of LMS in managing the teaching and learning materials used in the FC environment.

Assessing the Module Usability

Past literature has provided a set of criteria for use in assessing the usability of technology-based learning materials (Nielsen, 1994; Nokelainen, 2006). The set of criteria focused on technical usability, specifically, on the convenience, ease of use, practicality and the clarity of interaction with the computer or website. Among the usability attributes listed were learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 1990). Nokelainen (2005) lists accessibility, learnability and memorability, user control, support, graphical layout, reliability, consistency, efficiency, memory load and freedom from error as technical usability components. Nokelainen (2006) extended the work of Nielsen by including pedagogical usability which involves the learning context of the learning material; it covers a set of criteria namely, learner control, learner activity, collaborative learning, goal orientation, applicability, prior knowledge, flexibility, and feedback. Hadjerrouit (2010) further expanded Nielsen's (1990) and Nokelainen's (2006) work by adding the pedagogical usability criteria which take into account the learning theories. Hence, the total criteria added would consist of understandability, added value, goal-orientation, time, interactivity, multiple representations of information, motivation, differentiation, flexibility, autonomy, collaboration, and variation. Lavonen et al. (2012) expanded the criteria of pedagogical usability by emphasising not only the type of learning but also elements of motivation in using the digital learning materials. In Lavonen et al. (2012), the motivation criteria in pedagogical usability followed autonomy, competence, and relatedness as suggested by Deci and Ryan (2002).

Theoretical Foundations of This Study

As mentioned before, most studies conducted in the past (Bishop & Verleger, 2013b; Giannakos et al., 2016; Lo & Hew, 2017; O'Flaherty & Phillips, 2015) did not explain any specific conceptual framework that could help instructors to design their FCs. Since the FC is meant to serve as an aid to learning, particularly in promoting student motivation and enable students to acquire a schema before attending the face-to-face session, a number of fulfilments need to be accomplished. For instance, instructors and students need to understand learning theories; they need to be aware of the things that need to be done which can enhance learning (instructional-design theory). All these need to be developed prior to module design. In the context of this study, such elements would be reflected in the theoretical framework outlined. For instance, the current study employed two types of theories as its theoretical framework: (1) the instructional design theory to develop real-world problem-centred teaching using technology in TVET and (2) the learning theory that describes and supports the learning process in a FC.

First principles of instruction: a synthesis of instructional design theory. Merrill (2002) had noted that most instructional design theories and models share similar principles. Calling them the First Principles of Instruction, he stated that they are relevant to the learning of authentic, real-world and whole tasks (Frick et al., 2010).

Based on the syntheses of instructional design theories, Merrill (2002, p. 43) proposed that learning is promoted during instruction when the following occurs:

- When learners are engaged in solving real-world problems.
- When existing knowledge is activated as a foundation for new knowledge.
- When new knowledge is demonstrated to the learner.
- When new knowledge is applied by the learner.

The effectiveness of the Merrill's First Principles had been examined in a study undertaken by Thomson/Netg, a company that offers learning solutions for individuals, businesses, and institutions (Thomson, 2002). Using a three-group experimental design, the investigators found that the group which received the instruction developed from the "First Principles" scored the highest. All differences were statistically significant. Further, the "First Principles" group managed to complete three-course activities in the shortest time (29 minutes), compared to the team that received the existing commercial version of the company's course (49 minutes) while most of the control group failed to finish the tasks. Frick et al. (2010) have also suggested that using Merrill's First Principles can improve students' motivation and learning.

Using Merrill's First Principles, a problem-centred learning flow of instruction can be designed as applied in this study. According to Merrill (2007), in the first phase of the learning cycle, the Activation phase, learners must be able to search for their relevant past experience which can be used as a basis to solve the problem. This also means that starting a task with some prior knowledge or familiar activities enables students to use it as a scaffold for the task unfamiliar to them (Brown et al., 1989). In the next phase, the Demonstration phase, the new knowledge is demonstrated as specific cases of applications to a single situation (Merrill, 2007). Following that, in the third phase, the Application phase, learners are required to apply the knowledge by using the existing information to solve the specific problems or by completing the whole task. Finally, at the end of the learning cycle, the Integration phase, learners should be able to integrate new ways to use their knowledge to new specific situations (Merrill, 2007). According to Wang (2017), the Merrill's First Principles are easy to understand, and they are practical for instructors to use for the FC. Figure 2.1 shows the synthesis of the First Principles of Instructions (Merrill, 2007).

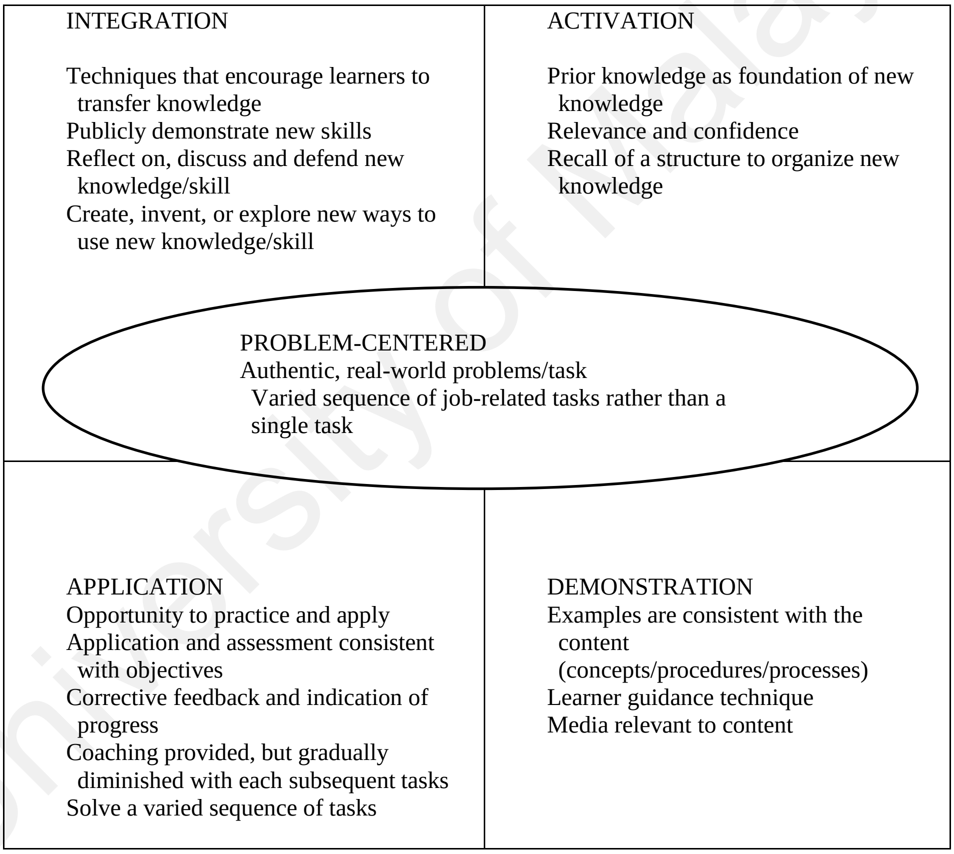


Figure 2.1 Synthesis of First Principles (Merrill, 2007)

FC Model by Lo and Hew (2017). Bishop and Verleger (2013a) define the FC as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. Before class, the teacher recalls relevant knowledge previously learned for students [Activation phase] and the teacher demonstrates new knowledge for problem-solving by using revision videos [Demonstration phase] (Lo & Hew, 2017). Students are required to apply what they have learned from video lectures by completing online exercises before class [Application phase] (Lo & Hew, 2017).

In Lo and Hew's (2017) study, the face-to-face activities inside the classroom focused on applying the concepts and knowledge learned to solve the given problems which were arranged from simple problems during the Application phase to more advanced problems during the Integration phase; this was applied with the support of the teachers and peers. In Lo and Hew's (2017) model, group discussions were used to deepen student understanding and to assist in integrating the new knowledge into real-world contexts. The study emphasised the Cognitive Theory of Multimedia Learning (CTML) principles namely coherence effect, signalling effect and personalisation principles (Mayer, 2005), which were used to design the respective video lectures. However, their study was limited to mathematics instruction. Figure 2.2 illustrates the FC Model designed by Lo and Hew (2017).

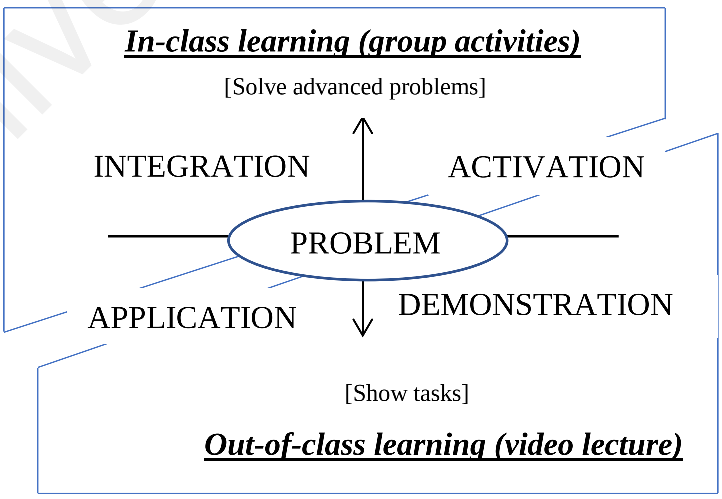


Figure 2.2 FC Model (Lo & Hew, 2017)

Cognitive apprenticeship. Learning in context is usually exemplified through an apprenticeship metaphor. Apprenticeship is a model of learning used to train beginners to become experts. It is used not only by professionals but also in the vocational contexts (Fuller & Unwin, 2010). Traditional apprenticeship was the natural way to access knowledge of expert practice -- apprentices observe the physical, tangible activities of the masters. Traditional apprenticeship has four critical components: Modeling, coaching, scaffolding, and fading. The learning process starts by an expert demonstrating to the apprentice through modeling, how the process is done (Putica & Trivic, 2015). Next, the apprentice tries to perform the process independently but under the supervision and coaching of the expert (Putica & Trivic, 2015). The coaching and feedback might include corrections for task performance, guidance on how to proceed and feedback on performance. Based on the expert's feedback and guidance, the apprentice gradually becomes more skilful and less dependent on the expert's assistance (scaffolding) (Putica & Trivic, 2015). Once the apprentice is proficient enough in performing the process independently, help is withdrawn (fading) (Putica & Trivic, 2015). Apprentices also need to verbalise their own thought processes as they perform their specific tasks. This allows the experts (instructors) to point out information or highlight the points that apprentices (learners) may have missed or to correct any misunderstandings that the apprentices (learners) may have.

In modern times, formal education has actively replaced the traditional form of apprenticeship. The shift from the traditional apprenticeship model where the apprentice learns from the master in the workplace context has resulted in a "gap" of skills, knowledge, and attitude required in the real workplace (Brough, 2008). The expansion of Culinary schools both locally and internationally led students to learn their skills from their Culinary instructors, but these are acquired within a learning environment very unlike the actual workplace. The implication is that students are learning those skills required of a Chef from their Culinary instructor minus the authenticity of the workplace. Due to limitations of finance, apparatus, and equipment, it may be difficult for institutions to create a learning environment that simulates an authentic workplace for the novice to practice their skills to become experts. Consequently, the skills and knowledge required of a Chef are being taught and learnt in an abstract manner (Collins et al., 1990). Therefore, little attention has been paid to teaching novices the processes actually applied by experts (Enkenberg, 2001). Moreover, in the Culinary arts formal classroom setting, more emphasis is being given to the Culinary skills (Deutsch, 2014) and less emphasis is being given to the cultivation of theoretical views and problem-solving responses (Deutsch et al., 2009; Wang, 2015).

The criticism that schools are inadequately preparing students for the actual work environment has brought the development of situated learning which employs the cognitive apprenticeship approach (Gessler, 2009). Cognitive apprenticeship is an instructional model which "refers to traditional apprenticeship but incorporates elements of schooling" (Collins et al. (1990). Savery and Duffy (1995) assert that cognitive apprenticeship can be used when designing authentic tasks for a particular context, but the aim should not be to simplify environmental complexity. It should ensure support for learners so that they are prepared to work in complex environments in the future. This makes the cognitive apprenticeship theory more appropriate for vocational students who are learning their skills in authentic learning environments but under the tutelage of their instructor who will provide guidance that will eventually fade away once the learners can work independently as competence is acquired.

The six methods in Cognitive Apprenticeship are as follows (a) modeling (e.g., show how an experienced person solves the problem), (b) coaching (e.g., observe performance and provide timely and constructive feedback), (c) scaffolding (e.g., implementing explicit support to facilitate learners' problem-solving), (d) articulation (e.g., getting learners to talk about how they are thinking about solving a problem), (e) reflection (e.g., encouraging learners to compare their solution with that of others), and (f) exploration (e.g., allowing learners to investigate new problems and problem approaches on their own with little or no guidance). See Figure 2.3.

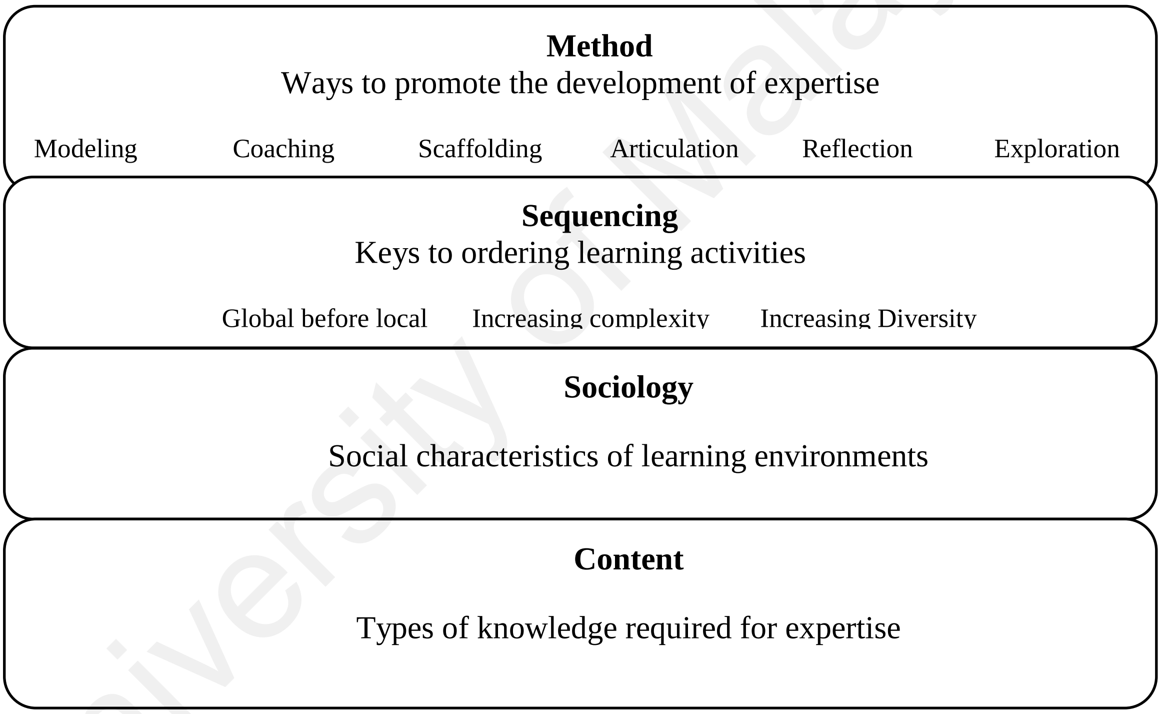


Figure 2.3 Cognitive Apprenticeship Model by Collins et al. (1990)

Cognitive apprenticeship is widely recognised as an effective approach to teaching problem-solving skills (Giuseppe, Luca, & Guido, 2016). Its paradigms may be used to simulate planning, production, and troubleshooting situations in TVET. The approach engages students in problem-solving practices similar to those in their future work environment (Cash, Behrmann, Stadt, & Daniels, 1997). As Brown et al. (1989)

described it, “In traditional craft apprenticeship, the steps taken to finish the tasks are easily observed while in Cognitive Apprenticeship, the thinking processes are made more obvious”. When instructors model and support students in how thoughts are processed through scaffolding, students learn to adapt the procedures when dealing with actual tasks. In this approach, students learn new practices as they are encouraged to observe, practice and reflect. Through the cognitive apprenticeship approach, the instructor becomes a facilitator who guides students. This guidance will gradually decrease as students become more competent. In the TVET programme, instructors become facilitators who model (demonstrate), scaffold (support) (which gradually decreases) and coach (offer suggestions, feedback, and hints to the student) (Kerka, 1997). Similarly, TVET students in a cognitive apprenticeship are engaged in acts of articulation, reflection, and exploration within a social context. Thus, the FC approach using Merrill’s First Principles can be extended to include Cognitive Apprenticeship, as shown in Figure 2.4 where the components of Cognitive Apprenticeship are in italics.

Before class	During class	During hands-on practicum	After class
[Activation phase] Instructors gets students to recall relevant prior knowledge using videos **[Demonstration phase]** Instructor demonstrate new knowledge for problem-solving using videos **[Application phase]** Students complete online exercise to apply knowledge learned from videos	**[Activation phase]** Instructor reviews topic **[Application phase]** Students apply concepts and knowledge learnt to solve simple problems **[Integration phase]** Students solve more complex problems [*Articulation*] Students articulate tasks and problem-solving process	**[Activation phase]** Instructor reviews topic **[*Modeling*]** Instructor demonstrates hands-on practicum tasks **[Application phase]** Students apply concepts and knowledge learnt to solve simple hands-on practicum problem **[Integration phase]** Students solve more complex problems [*Articulation*] Students articulate tasks and problem-solving process	[*Exploration*] Students explore other relevant problems [*Reflection*] Students reflect on tasks and problem-solving process

Instructor scaffolds (supports), fades (gradually decreases guidance) and coaches (offers suggestions, feedback and hints to the student)

Figure 2.4 FC Model adapted from Lo and Hew (2017) and Cognitive Apprenticeship Model by Collins, Browns and Newman (1998) for this study.

Theoretical framework of the PSFC module. In this study, the FC model was designed based on the framework of Merrill's First Principles as well as Cognitive Apprenticeship. The aim was to fit the pedagogical model into the Culinary Arts by focusing on the problem-solving instruction during the hands-on practicum as well as the theoretical aspects of the discipline. The theory guiding this study will incorporate distinct Flipped Classroom phases, i.e. 'before class', 'during class' and 'after class' activities as guided by the theoretical framework of Cognitive Apprenticeship and First Principles of Instruction.

Although many studies (Azemi, 2013, 2014; Ferreri & O'Connor, 2013; Gilboy et al., 2015; Kong, 2014; Kurup & Hersey, 2013) have acknowledged the benefits of FC in problem-solving, most studies did not account for the problem-solving feature of the FC and no problem-solving model had been recommended. This is a crucial area of interest since students who are given exposure to both aspects have been observed to produce higher quality works (Wolf et al., 2003). Thus, the student participants in this study were trained to engage in the key steps of problem-solving for solving ill-structured problems (Barrows, 1996; Jonassen, 1997). The key activities outlined encompass (1) problem identification; (2) goal selection; (3) generating alternative solutions; (4) consideration of consequences associated with solutions; (5) decision-making; (6) implementing solutions and (7) evaluating solutions. Although the stages for solving the ill-structured problem seemed to be a linear process, researchers (Choi & Lee, 2009) proposed that they are considered as dialectic and recursive. Figure 2.5 demonstrates the module which comprises the integration of the First Principles of Instruction (Merrill, 2007) as the instructional model and the Cognitive Apprenticeship Theory (Collins et al., 1990) as the learning theory. The concept of the FC was borrowed from (Ferreri & O'Connor, 2013; Lo & Hew, 2017). The problem-solving model was borrowed from (Barrows, 1996; Jonassen, 1997; Lohman, 2004) while the problem types noted in the Culinary Arts were based on (Soden, 2013) and (Jonassen, 2010; Jonassen, 2004). The lessons designed for the PSFC module used in the current study would reflect the ideas noted in the theoretical framework outlined.

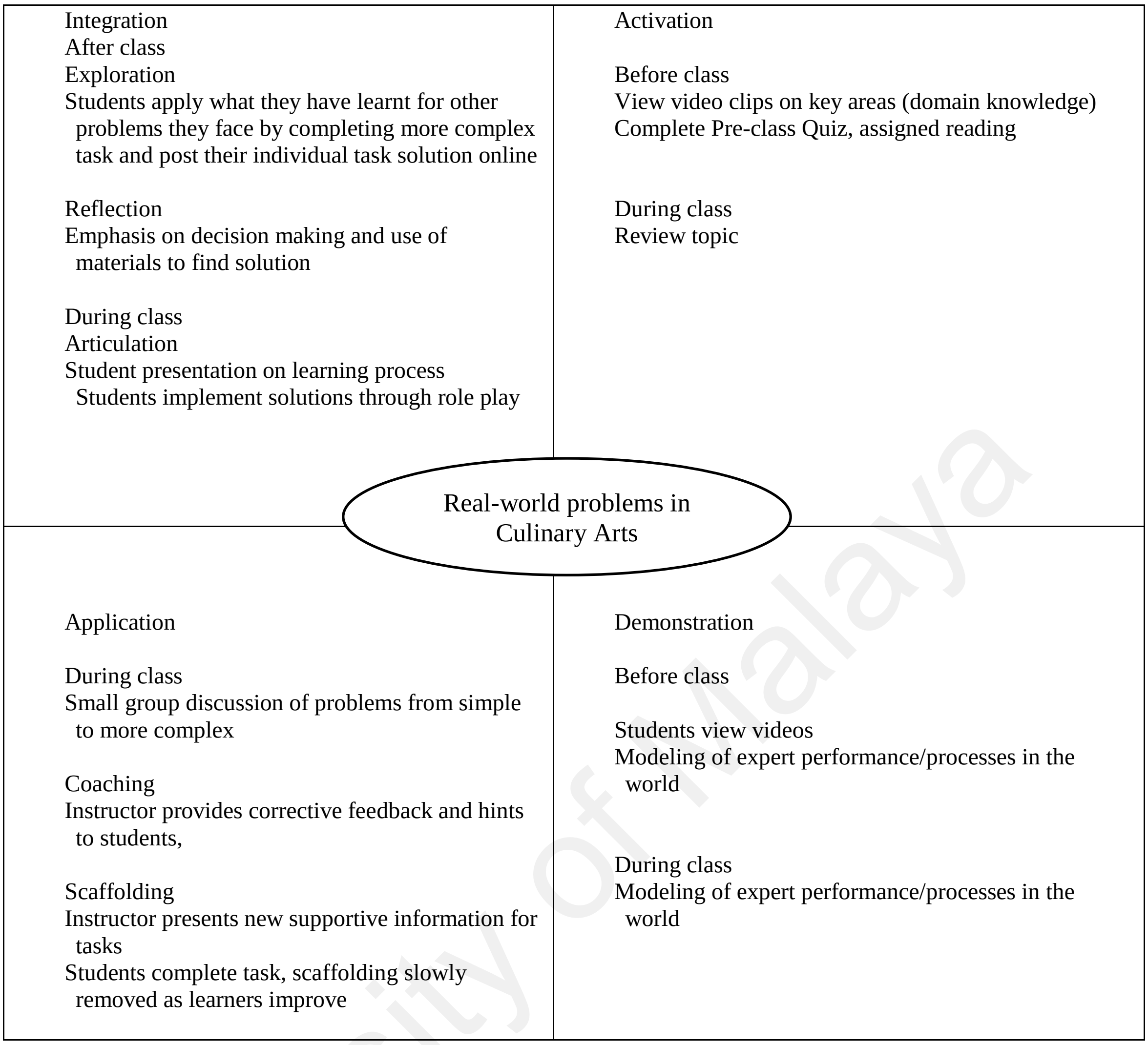


Figure 2.5 PSFC Module based on FC Model using First Principles of Instruction and Cognitive Apprenticeship.

Summary

This chapter has discussed literature which focuses on the specific concepts involved in a FC; it also outlines some of the existing models and the relevant theories of TVET education, Culinary Arts education, problem-solving and the FC. Based on literature, several gaps have been identified. For example, there is still lack of research on the design of the FC and the activities involved (O'Flaherty & Phillips, 2015; Khanova et al., 2015 ; Giannakos, Krogstie, & Aalberg, 2016; Lo & Hew, 2017b). There is also still limited empirical evidence on whether problem-solving skills improve following Flipped Classroom intervention (O'Flaherty & Phillips, 2015). Moreover, blended learning in Culinary Arts were still limited to using videos to polish technical skills (Brown, Mao, & Chesser, 2013; Hämäläinen & Cattaneo, 2015; Khalid, Ismail, Ab Aziz, Azdel, & Kamaruddin, 2014; Schaeffer & Warren, 2013; Mohammad Azli Razali, Farina Nozakiah Tazijan, Suzana Ab. Rahim, Nina Farisha Isa, & Hemdi, 2012). As has been emphasised, problem-solving skills are essential skills that should be cultivated within the Culinary Arts discipline so that when students graduate, they are more competent and more likely to be employed. However, despite the importance of the problem-solving skills development among graduates, it has been an area of little research. Plus, there is limited studies on instructional model to teach problem-solving in Malaysia (DeWitt & Alias, 2015). Thus, there is a need to spell out the design of the FC and the activities involved in a Problem Solving Flipped Classroom in Culinary Arts and find out the effectiveness of the intervention in TVET education. The next chapter focuses on the Methodology which follows the principles noted in the Design and Developmental Research (DDR) technique.

CHAPTER 3

METHODOLOGY

This chapter focuses on the research methodology employed in this study. The chapter includes the research design, population and sample size, sampling procedure, research framework, instrumentation, data collection and the data analysis methods used for each phase of the study. There were three phases involved in this study.

Research Design

This study followed the principles noted in the Design and Developmental Research (DDR) technique. It has become one of the most important research approaches in the field of Instructional Design and Technology (IDT) (Richey & Klein, 2014). Richey and Klein (2014) define Design and Developmental Research (DDR hereafter) as the systematic study of the design, development and evaluation processes with the aim of establishing an empirical basis that can enhance the creation of instructional and non-instructional products and tools as well as new or enhanced models that can govern their development (p. 1099). The DDR approach requires understanding of the dynamic nature of the instructional product development cycle; it also requires active collaboration of researchers, practitioners, and potential users, within a context-specific setting, with a common goal of developing good design practices for that particular setting (Hung, Smith, Harris, & Lockard, 2010; McKenney & van den Akker, 2005; Wang & Hannafin, 2005).

The DDR can be divided into two types (Richey & Klein, 2005; Richey & Klein, 2014; Siraj, Alias, DeWitt, & Hussin, 2013). Type 1 research focuses on context-specific products or programme-specific designs, development and evaluation projects aimed at validating the design/development technique or tool (Richey & Klein, 2014). In contrast, Type 2 research produces generalised conclusions about the building and validating of new models and processes and conditions which enable their effective use (Richey & Klein, 2014). Developmental research is essential to find out how new instructional designs can become potential solutions to important learning problems, thereby creating new learning experiences or opportunities in the real-world setting for students (Kozma, 2000). Past studies (Dewitt, 2014; Richey et al., 2004; Sahrir, Alias, Ismail, & Osman, 2012) have also emphasised DDR use for investigating new instructional designs. Based on this, it is apt to use the DDR approach to satisfy the aim of this study which is to design and develop the PSFC module for use at Community Colleges. This study is an exploratory case study on the implementation of the Flipped Classroom approach using the PSFC module for a foundational Culinary Arts class in a Certificate in Culinary Arts programme in a Community College in Malaysia.

The current study is considered a Type 1 product/tool research; it focuses on the PSFC module development cycle where resources and lessons are simultaneously developed. To develop the PSFC, this study also relied on the active collaboration of experts which include academicians, practitioners, and users related to the context-specific setting. The goal was to develop a good design practice so that the module is suitable for use within the Community Colleges' Culinary Arts teaching and learning context.

In this study, the design and development of the PSFC module were conducted in three phases. Namely, Phase 1 - Needs Analysis, Phase 2 - Design and Development and Phase 3 – Implementation and Evaluation. Both qualitative and quantitative approaches were used to triangulate the data to arrive at a more conclusive result, besides minimising any biases that could occur. Table 3.1 shows the three phases involved in developing the PSFC module.

Table 3.1

Phases Involved in the Study

Developmental phases	Phases of the study
Phase 1: Needs Analysis	Needs analysis of the module (Before the design of the PSFC module) • Analysis of learners: level of problem-solving skills and FC readiness of the students • Analysis of instructors: current teaching practices
Phase 2: Design and Development	• Experts' consensus on the elements to be incorporated into the design of the PSFC module • The design is then transformed into the PSFC module in the development phase.
Phase 3: Implementation and Evaluation	Evaluation of the effectiveness and usability of the PSFC module

Phase One: Needs analysis

Phase One of this study is the earliest. It involved a process of analysing the learners, their learning settings and the technologies they used to identify the best way to deliver the PSFC module in a conducive learning environment (Maier & Thomas, 2013). It is also crucial to assess the students' level of problem-solving skills before the design because this can provide an understanding of their current competence level. The lower their level of problem-solving, the more the module has to address this aspect of their learning.

It was also necessary to assess the students' readiness for using the FC. In this regard, it was essential to gather all this information so that more about their individual beliefs, readiness, proficiency, and inclination can be uncovered, thereby making the design and development more precise in meeting their needs. Past studies (Chen, 2014; Whillier & Lystad, 2015; Wong, Pang, & Wong, 2013) have documented students' resistance toward the FC. Literature had also noted that students have not adapted to the FC yet because they were unfamiliar with this teaching and learning approach. Moreover, studies (Pozgaj & Vuksic, 2013; Wong et al., 2013) have also noted a lack of information on student readiness to adopt new technologies even in today's era. Without this readiness, the project may fail. Hence, it is important to identify and assess students' needs and their technology readiness and instructors' needs before module implementation during the needs analysis phase.

The needs analysis phase comprised two major parts. The first part involves a quantitative data collection of the Culinary Arts students' cognitive skills that are applied in their problem-solving activities and their readiness for the FC. A survey was conducted instead because surveys are time effective especially for a large number of participants to explain their knowledge, attitudes, and behaviours (Sekaran & Bougie, 2013). Here, the survey was conducted with 831 students from 11 Community Colleges offering the Culinary Arts programme throughout the country.

The second part of the needs analysis phase involved the qualitative approach whereby data were collected based on a semi-structured interview with 10 Culinary Arts instructors regarding their current teaching practices. At this juncture, both the quantitative and qualitative approaches were applied in support of each other. Answers to both the survey and the semi-structured interview were crucial to the study; it helped to justify the need for incorporating a PSFC module. The design was meant to be used to increase students' learning gains as well as their problem-solving skills. This, therefore, justified the need to have a pedagogical support that can augment the Culinary Arts instructors' teaching through the module.

Research Procedure

A questionnaire was developed to address the survey as well as interview. This involved the adaptation of the survey instrument, pre-testing of the questionnaire, pilot testing of the questionnaire, administration of the questionnaire and finally, data analysis.

Survey instrument: problem-solving practices and FC readiness of culinary arts students at Malaysian Community Colleges (PSPFCR) questionnaire. In order to design an instructional intervention module that can help to develop the students' learning gains and problem-solving skills, there was a need to investigate what students think of their own levels of problem-solving. The questionnaire was administered on 1,025 Certificate level Culinary Arts students throughout the country. The students were studying for the Culinary Arts Certificate in 11 Community Colleges from six regions (Northern, Central, Southern, East Coast, Sabah and Sarawak) comprising nine states i.e. Northern Region (Kedah, Pulau Pinang and Perak), Central (Selangor), Southern (Melaka and Johor), East Cost (Pahang), Sabah and Sarawak. See Appendix A. Before collecting data, I needed to apply for permission from the Department of Community Colleges, the Higher Education Sector of the Ministry of Education, Malaysia to conduct this study. See Appendix B.

The questionnaire consists of five parts: Demographics (four items), problem-solving practices (25 items), mobile technology usage (eight items), online learning readiness (27 items) and readiness for FC (three items) (see Appendix C). The 25 items provided for the problem-solving strategies were classified according to the following domains: analogising (five items), Modeling (five items), causal reasoning (11 items), and argumentation (four items). The items or measures used for all these variables were adapted from the Learning Skills Questionnaire (Jonassen, 2013; Palraj, DeWitt, & Alias, 2016). These were anchored on a 5-point Likert scale (1 = never; 2 = almost ever; 3 = sometimes; 4 = frequently; and 5 = all the time). Respondents were asked to indicate the cognitive skills which best describe their typical problem-solving practices. A possible score for each of the four domains ranged from 25 to 125 points. The mean and standard deviation are the most common descriptive statistics for interval and ratio scaled data (Sekaran & Bougie, 2013). From the possible total score, the mean score and standard deviation were calculated for each of the problem-solving stages to measure the level of skills developed and interpreted as low when the mean score is 1.00-2.33, medium when the mean score is 2.34 – 3.66 and high when the mean score is 3.67 – 5.00.

Survey instrument: FC Readiness. To determine the students' readiness for using the FC module, the instrument used to assess this component was the Flipped Learning Readiness survey instrument (see Mohammed Amin Embi et al. (2014). This questionnaire was adapted based on the Online Learning Readiness scale which contained the following constructs: Technology Access, Online Skills, Motivation, Ability to Use Online Audio/Video, Internet Discussions and Importance to Your Success (Watkins et al., 2004). These constructs were finetuned by Mohammed Amin Embi et al. (2014) who added three more constructs extracted from the literature. They included the respondents' Flipped Learning Awareness; their suggestion for the proportion of face-to-face meeting versus online approach and the respondents' preferred content format for delivery of materials to be used in the Flipped Learning approach. Thus, the instrument is more current and it focuses on both technological capabilities and students' characteristics. The finetuned instrument Mohammed Amin Embi et al. (2014) showed a higher level of reliability with a Cronbach alpha of .89. The instrument is considered very relevant to the FC environment, particularly in the Malaysian context. In the current study, all the 30 items listed in the FC Readiness questionnaire (Mohammed Amin Embi et al., 2014) were adopted in the questionnaire which comprised: Part A until Part F and Part H until Part J. The items were anchored on a 5-point Likert scale (1 = Completely Disagree; 2 = Strongly Disagree; 3 = Not Sure; 4 = Strongly Agree; 5 = Completely Agree). The researcher added Part G: usage of mobile technology and Part K: Demographics based on review of associated literature at the end of the questionnaire. Demographics was put at the end to prevent boredom and to engage participants (Rattray & Jones, 2006). (See Appendix C). Permission to adapt items from these questionnaires was sought and approved through personal communication and through e-mails with the authors. (See Appendix D).

Translation process of instruments. The translation process of this study adhered to the guidelines of cross-cultural adaptation proposed by Beaton, Bombardier, Guillemin, and Ferraz (2000) as a measure to preserve the contents and meanings. The aim was to evaluate the clarity, comprehensibility, and adequacy of the wording to ensure that they can be understood by the Malaysian students (Yunus, 2013). Two forward translations were produced; one by a Community College lecturer who has a Ph.D. in Instructional Technology and another by a TVET expert who has a Ph.D. in TVET. The other was a certified translator from the Malaysian National Institute of Translation. These translators produced the M1 and M2 version of the questionnaire. They were then back-translated into English (the E1 and E2, respectively) independently by the certified translator. The researcher and the translator reviewed the different versions - the original, the two forward and two backward translations. The pre-final Malay version of the questionnaire was eventually produced by comparing E1 and E2 with the original English version. This was done by choosing the Malay version, which produced the back-translation that was closest in meaning to the original English version. Thus, the best translations in Malay were merged to produce the final harmonised Malay version.

Pre-testing of the questionnaire. The questions which were translated into Malay were checked by two experts who reviewed and examined the entire questionnaire (cover letter, directions, statements, and format) for clarity, appropriateness, quality of statement, layout, and aesthetics. Following that, the questionnaire was also pre-tested with three respondents "who are as similar as possible to the target respondents" (Tull & Hawkins, 1976). These three respondents were selected using purposive sampling; they comprise one weak student, one average student, and one good student. These three respondents were not included in the actual study.

In the pre-testing period, the researcher scrutinised the questionnaire individually with each respondent (Hunt, Sparkman Jr, & Wilcox, 1982). The respondents were not required to answer the questions because the pre-testing stage was conducted for ensuring comprehensibility of the questions (Hunt et al., 1982). During the pre-test stage, the three respondents were also probed by the researcher by asking questions after each item had been scrutinized. They were also asked how they each would interpret the items. This was to check if the respondents had any issue with any question item (Hunt et al., 1982). Based on the comments made by the respondents at the pre-test stage, it was suggested that the questionnaire is provided in Malay language and not bilingual (English and Malay). Any difficult or ambiguous questions were reworded. For better comprehension, the respondents also suggested that certain familiar terms be retained in English within brackets. This was adhered to for the final preparation of the questionnaire.

Pilot study. The last stage of the pre-test was to use the questionnaire as a pilot study to ascertain how well it would work after the modifications. This was undertaken to improve the internal validity of the questionnaire. During the pilot study, the questionnaire was administered to a sample of 30 students who were not included in the final sample, to prevent contamination. According to Cohen, Manion, and Morrison (2007), a minimum sample size of 30 is suitable for conducting the statistical analysis for a research study. This is attributed to the central limit theorem which states that as the sample size is larger, data tends to normalise; hence 30 is the minimal starting number.

During the pilot study stage, the questionnaire was administered in the same way as it would be administered in the main study. The time taken to complete the questionnaire was also measured, and instances of confusion were noted (Nassar-McMillan, Wyer, Oliver-Hoyo, & Ryder-Burge, 2010). The responses obtained were then analysed using SPSS version 21 to find out whether any item(s) need to be excluded. The Cronbach's alpha coefficient of internal consistency was then reported; it ranged between 0 and 1. The closer the Cronbach's alpha coefficient is to 1.0, the greater the internal consistency of the items in the scale (Gliem & Gliem, 2003). Since the instrument maintained certain terms in English, special attention was given to the clarity and content validity of the translation. This was achieved with the assistance of a linguistics expert who was also a certified translator. In this regard, inter-item consistency should be more than .8 for tested items but not more than .9 (Panayides, 2013). Table 3.2 illustrates the reliability coefficients for the major variables. All were noted to be more than 0.7.

Table 3.2

Reliability coefficients for the major variables Cognitive Skills used in Problem-solving

Variable	Number of items	Items dropped	Cronbach Alpha
Analogising	5	-	.781
Modeling	5	-	.832
Reasoning causally	11	-	.900
Argumentation	4	-	.784

Table 3.3

Reliability coefficients for the major variables in FC Readiness

Variable	Number of items	Items dropped	Cronbach Alpha
Technology Access	3	-	.771
Online Audio and Video	3	-	.718
Internet Discussion	4	-	.877
Importance to Success	5	-	.890

Table 3.3 reports on the constructs used for the FC readiness. As can be noted, all the constructs Cronbach alpha values were above .7. The Cronbach alpha values were noted to be above the criteria, as suggested by Chua Yan Piaw (2013), who indicated that a cut off value of .7 is acceptable. Thus, it can be concluded that the instrument used in this survey had good internal consistency and was reliable.

Population. Table 3.4 shows the Community Colleges that were offering the Certificate in Culinary courses in the six regions in Malaysia. It simultaneously also showed the target population of the study. Each Community College has been categorised according to the region, and specified as urban, semi-urban or rural (Federal Department of Town and Country Planning, 2011). The total number of students enrolled in these colleges as of March 2016 is listed in Table 3.4.

Table 3.4

Community Colleges around Malaysia offering Certificate in Culinary Arts (as of March 2016)

Region/Cluster	**Name of Community College**	**Urban/Semi-urban/Rural**	**Total students enrolled (as of March 2016)**
Northern Region (Kedah, Penang & Perak)	Kolej Komuniti Sungai Petani, Kedah	Urban	201
	Kolej Komuniti Nibong Tebal, Pulau Pinang	Urban	87
	Kolej Komuniti Langkawi, Kedah	Urban	158
	Kolej Komuniti Chenderoh, Perak	Rural	134
Central Region (Selangor & Negeri Sembilan)	Kolej Komuniti Selayang, Selangor	Urban	111
Southern Region (Melaka & Johor)	Kolej Komuniti Bukit Beruang, Melaka	Urban	112
	Kolej Komuniti Bandar Tenggara, Johor	Rural	64
East Coast Region (Pahang, Terengganu & Kelantan)	Kolej Komuniti Kuantan, Pahang	Urban	105
	Kolej Komuniti Rompin, Pahang	Rural	114
Sabah	Kolej Komuniti Beaufort, Sabah	Rural	27
Sarawak	Kolej Komuniti Sarikei, Sarawak	Rural	45
	Total		**1160**

As can be seen from Table 3.4, the total number of students attending the Culinary Arts courses or programs in these colleges is 1160. It can also be noted that the number is not only concentrated in just the urban or rural area. In fact, there is quite a good spread of among all these Community Colleges, whether in the urban or rural districts of the country.

Sampling technique for questionnaire administration. Allowing for a sampling error of five percent and a risk factor of one percent, as proposed by Krejcie and Morgan (1970), it appears that for a population of 1160 students (enrolled as of March 2016), a sample of 285 is adequate. To obtain the desired sample size, a multi-stage, random cluster sampling technique was used.

The first stage employed an area sampling whereby the study area was divided into six locations or strata namely, Northern Region, Central Region, Southern Region, East Coast Region, Sabah, and Sarawak, as illustrated in Table 3.2. To fulfil this, a random sample of clusters were drawn; for each selected cluster, either all the elements or a sample of the elements were included in the sample (Sekaran & Bougie, 2013). Proportionate and stratified simple random sampling techniques were then used to determine the number of subjects to be sampled in each selected Community College since some strata would be considered as too small and some too large (Sekaran & Bougie, 2013). Therefore, it is necessary to have a fair representation of each strata (Bernadette Nambi & Werner, 2013). The proportionate sampling method was used for this study is to ensure that at least 285 respondents from the different geographical areas could be selected. This sampling design is more efficient than simple random sampling because the population from each region is better represented in the sample size. Therefore, it can provide a more valuable and differentiated information with respect to each cluster (Sekaran & Bougie, 2013).

Calculating the sample size. Sample sizes for the strata were determined by the following equation: $n_h = (N_h / N) * n$; where n_h is the sample size for stratum h, N_h is the population size for stratum h, N is the total population size, and n is the total sample size. As shown in Table 3.5, the population size, N is 1160 and the total sample size, n is 285. The population size for each stratum is N_h as shown in the second column, whereas the calculated n_h is given in the third column. Response rate retrieved for the previous study in which the similar instrument was used was 94.3%, therefore, the actual sample size would be: Actual sample size, n actual = (n, is minimum sample size X 100)/ estimated response rate in percentage (285 * 100)/94.3 = 302, as shown in the rightmost column.

Table 3.5

Proportionate Stratified Simple Random Sampling

Stratum (Region)	**Population size (N)**	**Sample size (n)**	**Actual sample size (n_a)**
Northern Region (Kedah, Penang & Perak)	580	143	151
Central Region (Selangor & Negeri Sembilan)	111	30	29
Southern Region (Melaka & Johor)	176	30	46
East Coast Region (Pahang, Terengganu & Kelantan)	219	56	57
Sabah	27	11	7
Sarawak	45	15	12
Total	N_h=1160	n_h = 285	n_a = 302

The sample only consisted of traditional students, that is students from the secondary school level, after completing their Form Five (SPM) and then entering the various Community Colleges for their further education. Thus, these students would be under 25 years of age and are only full-time students.

Data collection procedures. Upon receiving permission to proceed for data collection, the researcher made an appointment to meet both the Directors of Community College A and Community College B to seek their permission to conduct the study at their respective premises. After permission was granted, the group of students taking the Certificate level in Culinary Arts was identified, and the questionnaire was administered. A cover letter was appended with the questionnaire to explain the purpose of the study and my contact number. Then, details about the study, the time taken to complete the questionnaire and the nature of the data were also given. The participants were also informed that participation was voluntary. Following this, the instructors from both the Community Colleges were approached to seek their permission to conduct a semi-structured interview.

Data analysis. Due to the large sample size (> 200), the sampling distribution tends to be normal, according to the central limit theorem (Field, 2009; Ghasemi & Zahediasl, 2012). In the context of this study, the outcome was analysed based on the First Principles of Learning framework (Jonassen, 2013). The data were analysed through the descriptive statistics derived from SPSS version 21 and the mean, and standard deviation was identified for each construct: analogising, Modeling, reasoning causally and argumentation. The analysis of the results will provide a description of the students' readiness to adopt the FC approach in the context of this study (Figure 3.1).

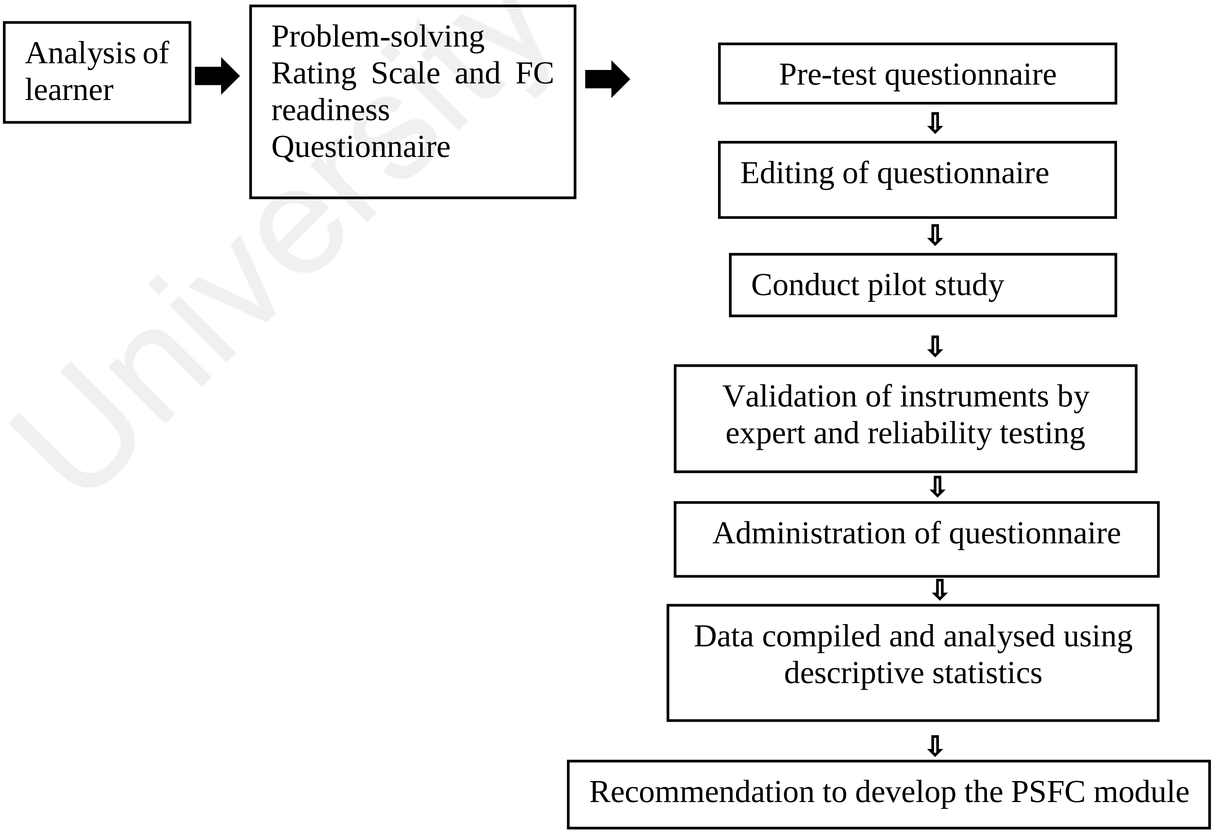


Figure 3.1 Summary of Phase 1: Analysis of Learner

Data screening procedure. In this study, the Expectation-Maximization (EM) algorithm was employed as the main technique to handle the issue of missing values. This is because when compared to other strategies, this technique has some important statistical advantages in predicting and replacing missing values (Ghasemy, Hussin, & Daud, 2016; Tabachnick & Fidell, 2013) for only two cases.

Instructors' needs analysis. The second part of the needs analysis phase involved the semi-structured interview which provided the qualitative data. In total, 10 Culinary Arts instructors were recruited as interviewees. The core of the interview focused on identifying their current teaching practices.

Sample. In total, ten instructors from two Community Colleges offering Culinary Arts programme from two different Community Colleges from two different states were selected. The interviewees were interviewed at their place of work. This is because they were expected to be more willing to express themselves in a comfortable environment (Boyce & Neale, 2006). By conducting the interview on an individual basis, I hoped to gather data that were expressed freely and without the influence of others (Barriball & While, 1994). These data were then used to compare with responses from the other respondents (Barriball & While, 1994).

Interview protocol. In conducting the semi-structured interview with the instructors, an interview protocol was developed based on literature review. Consequently, the following areas were identified for investigation: (a) Instructors' current teaching practices, (b) Instructors' current teaching practices of problem-solving skills among students, (c) Instructors' current use of technology in their lessons, and (d) Instructors' challenges in integrating problem-solving skills into their current teaching practices.

Data collection procedure. Invitation to participate in the study was sent to the directors of the respective Community Colleges. I then contacted the head of programmes from the college to inform the person involved about the study being conducted. The head of programmes was also requested to suggest some potential participants. Arrangements were then made by the head of programmes for the interview to be conducted within college grounds. A consent form was provided those who agreed to participate. All participants were advised that they could withdraw from the study at any time. The response rate of the participants identified for the study was 100%. No one refused to participate, and none of the participants withdrew participation from this study. The ten participants were reminded that they were selected as they were considered experts in their field; so they were encouraged to be honest and open with their answers.

I read the introduction script to ensure that the participants understood that the interview was conducted not to evaluate their teaching techniques or skills, but instead, to find out their challenges so that the teaching pedagogy in Community Colleges can be upgraded. The participants were informed that the interviews would be audio recorded. The interview transcripts were later sent to them for member-checking. The ten culinary instructors were then invited for the individual interviews which were conducted for approximately one hour. During this time, some notes were also taken.

Data analysis. An audio recording device was used to record the interview. Following each interview, the data were coded according to the instructors' names and the date. They were then transcribed verbatim, and the transcripts were checked against the recordings a few times for accuracy. Following the transcription, the interviewees were sent a copy of the transcript for factual corrections. No additional comment was given when interviewees returned the transcript. These were then analysed using the computer package *Atlas.ti 7* where responses were coded according to one or more themes that emerged.

The Braun and Clarke (2006) thematic analysis method were used throughout the procedure. In Step 1, an initial scan of the data was performed by repeated reading to discover the more commonly used words and phrases which were then highlighted to locate the initial codes. In Step 2, the codes were generated systematically and then collated into potential themes. In Step 3, the codes were connected by finding links in the data to create themes through commonalities, differences, patterns, and structures (Basit, 2003). In Step 4, a thematic 'map' of the analysis was generated. In Step 5, the themes were defined and refined. The final step was to extract the excerpts related to the analysis of the research questions. They were then reported in the analysis. The qualitative data were revisited several times until saturation was reached. Morse (1995) noted that the term "data adequacy" is synonymous with data saturation. This was accomplished when no new information could be obtained through data collection. Evaluation of the adequacy and comprehensiveness of the results indicated a point of saturation, offering enough information to form patterns or themes (Morse, 1995). Figure 3.2 shows the steps in Phase 1 (Analysis of Instructors' Needs) of this study. Interviewees' responses were identified by pseudonyms.

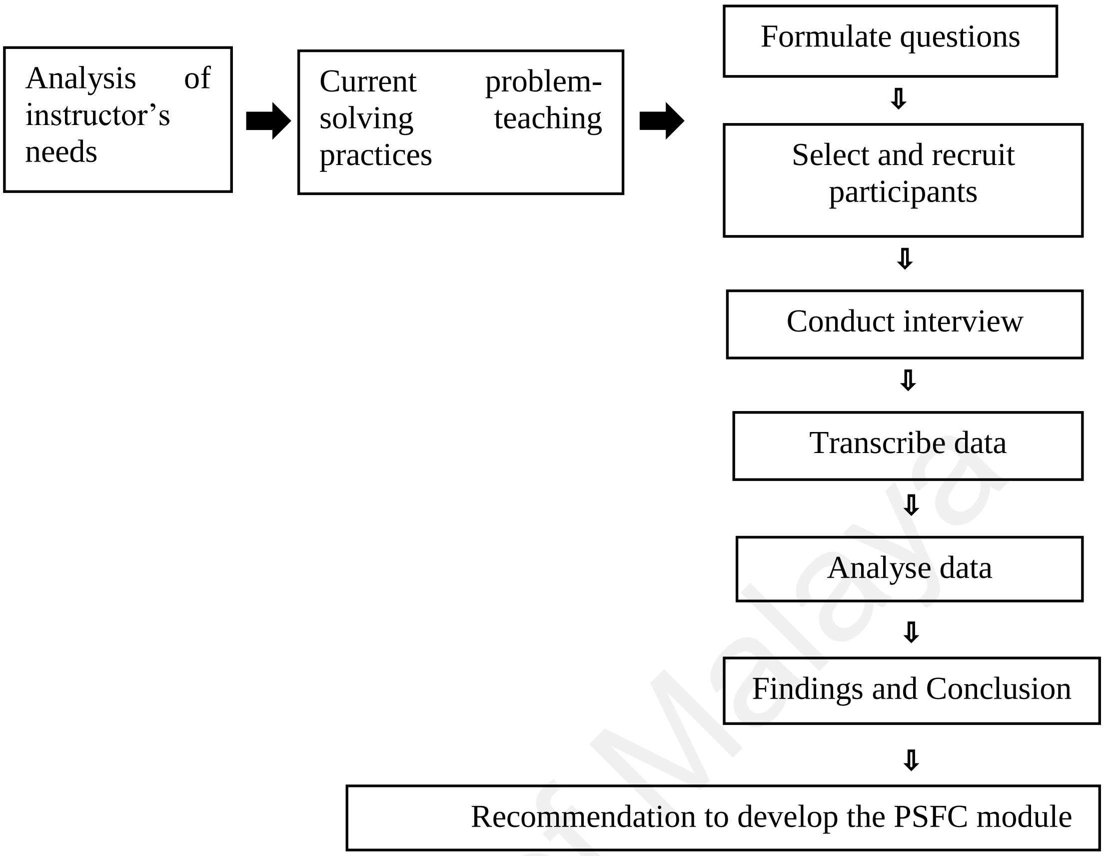


Figure 3.2 Summary of Phase 1: Analysis of Instructor's needs.

As a form of conclusion, the implications that can be drawn from this phase indicates that the need for the module (PSFC) had arisen from three areas: firstly, quantitative data regarding the cognitive skills used for problem-solving by students, students' FC readiness, followed by the findings of culinary instructors' current teaching practices (qualitative data).

Phase 2: Design of the Module

Purpose. Designing an educational module that would be used as an intervention needs to be supported by a team of multidisciplinary experts (Lu, Meng, & Tam, 2014). Moreover, any collaboration or consultation with the industry can also help ensure the needs of student, educators, and industry employers are met (Riggs &

Hughey, 2011; Walo, 2000). It is also deduced that experts in culinary studies can share their stories which contain background information, heuristics, real-world insights, and their identities (Jonassen, 2013; Schön, 1983) which can be used to design the real-world problems used in the module. In this study, The Fuzzy Delphi technique (FDM hereafter) requires the consensus of experts when integrating elements that have been identified as most appropriate when designing the PSFC module.

Fuzzy Delphi Method (FDM). The Fuzzy Delphi Method (FDM hereafter) is not a new concept; it has been improvised from the traditional Delphi method which does not require multiple sessions of feedback which can be time-consuming when collating experts' opinions. Moreover, it is also not as costly as the traditional Delphi where a survey needs to be repeated many times (Glumac, Han, Smeets, & Schaefer, 2011; Ho & Wang, 2008; Hsu, Lee, & Kreng, 2010; Mohd Ridhuan Mohd Jamil, Zaharah Hussin, Nurul Rabihah Mat Noh, Ahmad Arifin Sapar, & Alias, 2013). This technique also allows experts to express their views freely without their opinions being altered based on the perspectives of other participants (Dalwinder Kaur, Esther Yong, Norhayati Mohd Zin, & DeWitt, 2013; Mohd Ridhuan Mohd Jamil et al., 2013). Another advantage of this technique is that it only calls for a small survey sample for obtaining an objective and sensible result (Wu, 2011) with an increased recovery rate of questionnaires (Mohd Ridhuan Mohd Jamil et al., 2013).

More importantly, this technique takes into account the fuzziness of that range, unlike the Delphi method which does not take into account the range of fuzziness which generally occurs in a survey since the consensus of expert opinions only applies to a specific range. In this research, the cumulative frequency distribution and fuzzy scoring were used to collate the opinion of the experts into fuzzy numbers (Ho & Wang, 2008). This means that the experts' opinions were described by linguistic terms which were expressed in triangular fuzzy numbers (Cheng & Lin, 2002). To ensure consistency in the consensus between experts, the Fuzzy Delphi Method (FDM) was used to adjust the fuzzy rating of every expert. The aggregate fuzzy numbers were obtained by multiplying the fuzzy decision matrix with the corresponding fuzzy attribute weight. This method does not misinterpret the experts' original opinions and provides an accurate reflection of their responses.

In the Malaysian context, the FDM has been used to design an instructional module on Basic Life Support for homeschooled children (Sakinah Awang, Shamsuria Ahmad, Norlidah Alias, Dorothy DeWitt, & Gritter, 2016), to the design of a learning module for deaf students (DeWitt, Alias, Ibrahim, Shing, & Rashid, 2015) and to investigate the potential of Twitter for post-reading activities among students in Malaysian Community Colleges (Hamidon et al., 2013). Based on these outcomes, the current study also employed the FDM to examine the degree of experts' consensus to determine which of the elements could be considered as most important when developing the PSFC module.

Sampling technique. Participants for a Delphi approach are usually chosen based on their willingness to participate, their expertise, or membership in an organisation (Birdir & Pearson, 2000; Boulkedid, Abdoul, Loustau, Sibony, & Alberti, 2011) or based on their knowledge and hands-on experience with the issue being investigated (Sekaran & Bougie, 2013). They may also be selected because they have sufficient time to participate in the Delphi exercise and also because of the effective communication skills between the researcher and the experts (Adler & Ziglio, 1996; Dapari, Ismail, Ismail, & Ismail, 2017; Skulmoski, Hartman, & Krahn, 2007). The appropriate number of experts in the Delphi method is between five and 20, depending on the number of experts available that can fully reflect the full scope of the problem at hand (Armstrong, 1978; Rowe & Wright, 1999). In their study, Boulkedid et al. (2011) reported that the median number of panel members in a Delphi study was 17. In another study, Okoli and Pawlowski (2004) recommended a panel of 10-18 experts.

In the current study, the experts were chosen based on their knowledge and hands-on experience in the issue being investigated (Nworie, 2011). They were also selected based on a listing of professional organisations (Holden & Wedman, 1993) with at least a decade of deliberate practices in their fields (Ericsson & Charness, 1994). In this study, the expert panellists were identified using sources listing professional organisations (Chef Association of Malaysia) as well as listings of experts/development committee of the NOSS documents. They were also recruited based on the snowball technique through word of mouth and recommendation from professional colleagues. This was to ensure that only the best-qualified panellists with knowledge of the issue being studied were chosen. The diversity of the experts' backgrounds was also expected to provide more depth and breadth in terms of perspectives on the issue being investigated (Nworie, 2011). This study was able to engage experts who were from a heterogeneous population and from different social/professional stratifications such as culinary instructors, university academics, and chef practitioners. The inclusion of both academicians and practitioners was aimed to balance insight from theoretical understanding with practical experience (Hearnshaw, Harker, Cheater, Baker, & Grimshaw, 2001). A diversification of experts groups allows for identification of issues which is valuable and can be achieved by FDM(Glumac et al., 2011). A total of 10 to 30 people was suggested by (Glumac et al., 2011; Jones & Twiss, 1978); the panel size of 19 experts who agreed to participate in this study was within the recommended range.

Table 3.6 shows the criteria of the panel of 19 experts who participated in this study. Okoli and Pawlowski (2004) suggested that the experts be divided into panels and this was also applied to the current study. They were listed according to academics, practitioners and government officials.

i. Academics: Academics with knowledge and experience in areas such as problem-solving, FC, pedagogy, technology in education, TVET, Culinary Arts and Instructional Technology

ii. Practitioners: Kitchen supervisors typical of the Malaysian hospitality environment: Food Service Operators, Instructional Designers,

iii. Government officials: Officers from Department of Community College Education (DCCE).

Table 3.6
Distribution of Expertise

Field	Expertise
University Lecturers	Experts possess knowledge and experience in using the FC model extensively and successfully for at least one year or developed successful and innovative instructional applications to be used in a FC.
Culinary educators	Experts possess a postgraduate degree in subject matter with at least 10 years of experience in teaching subject matter
	Experts have experience working in the industry for at least two years before joining academia.
Chefs/Industry Practitioners	Experts have at least 10 years of experience working in restaurants/hotels.
	Experts possess at least a Diploma in Culinary Arts/Hospitality/Food and Beverage/Catering/Chef Training
Food Service Operators	Experts have experience hiring Community College students to work in the kitchen

Field	Expertise
Problem-solving Expert	Experts have knowledge and experience in designing, developing and implementing a problem-solving teaching and learning environment.
Instructional Designers	Experts should possess a postgraduate degree Experts have at least 10 years of knowledge and experience in Instructional Design
Officers from DCCE	Experts have at least 10 years of experience in policy decision making.

Table 3.7 demonstrates the experts' background in terms of their experience, knowledge and other information.

Table 3.7

Criteria of Experts

Designation	Selection criteria	Years of expertise	Discipline or Skills	Organizations	Number
University Professor	Have extensive experience and has successfully implemented the FC model for at least one year or developed successful and innovative instructional applications to be used in a FC for at least one year Has presented at conferences or have publications on Flipped Classroom	At least one year	Flipped Classroom	University/ Polytechnics/ Community Colleges	3
Culinary Educators	At least Bachelor Degree in Culinary/ Hospitality/ Food and Beverage/ Catering Willing to participate in the study Expertise in development, design, provision, and evaluation of Culinary Education programme	At least 2 years industrial experience More than 10 years teaching experience	Culinary Arts/ Gastronomy/Hospitality	Community Colleges Private universities Public universities	2 3 2

Designation	Selection criteria	Years of expertise	Discipline or Skills	Organizations	Number
Kitchen Supervisors: Junior Sous Chef, Sous Chef, Chef, or Executive Chef	Currently employed at 4 stars and 5 stars hotel/Independent restaurants At least Diploma in Culinary Arts/Hospitality/Food and Beverage/Catering/ Chef Training	More than 10 years	Culinary Arts/Gastronomy/Hospitality/Chef Training	Hotel/ Restaurants	3
Chef Restauranteur	Knowledge of food service operation Has experience in hiring Community College graduates	More than 10 years	Culinary Arts/Hospitality	Hotel/ Restaurants	1
Instructional Designer	Have knowledge of instructional design and instructional technology Masters in Instructional Design/Instructional Technology Experience in at least two ID projects	More than 10 years	Instructional design and instructional technology	University/ Private Companies	2
Problem-solving Expert	Has presented at conferences or have publications on problem-solving skills, higher order thinking skills, critical thinking skills Knowledge of teaching and learning methods Expertise in development, design, implementation, and evaluation of higher education programmes	More than 10 years	Problem-solving skills, higher order thinking skills, critical thinking skills	University/ Private Companies	2
Stakeholders from TVET institutions	Attached to the Academic and Continuing Education Division of Department of Community Colleges, Putrajaya	More than 10 years	Decision-making on curriculum development, research, and innovation, instructional technology	Department of Community Colleges, Putrajaya	1
				Total experts	19

As mentioned earlier, Table 3.7 illustrates the experts' personal data in terms of designation, selection criteria, years of expertise, discipline/skill and the organization they come from.

Data collection procedure, first phase: semi-structured interviews. The first phase of the data collection through the semi-structured interview involved six experts with expertise and experience in the following areas: Problem-solving, FC, Pedagogy, Technology in Education, TVET, Culinary Arts and Instructional Technology. As stated earlier, these experts were chosen based on their knowledge and competence that can help to increase the validity of the study. The interview protocol was prepared beforehand. (See Appendix F).

After the appropriate objectives were identified, the experts were requested for some suggestions for key concepts and principles of interest for inclusion into the syllabus or content domain and which may also be able to reflect the real-world situation. These should be useful for teaching problem-solving in the Culinary Arts discipline. The key concepts were used to create the module content and to develop materials and resources that could link students to using the key concepts to solve problems (Azemi & Toto, 2012).

Next, the experts were asked to provide suitable problems that students can use for developing their problem-solving skills, an important skill for the industry. This was done by having the experts who were also professionals, "think out loud" such problems encountered in the workplace setting. Based on this, I was able to map not only up-to-date content, but also real-world problems and the relevant solution/outcomes/lessons learned for application in the module. From the contents provided by the expert practitioners, the problem-solving processes for the module which consists of problem-solving scenarios, the sequence of the problem-solving steps (how-to) and problem constraints/requirements/conditions for each problem, could further be developed, as proposed and recommended by the experts.

In addition, the specific tools and resources needed to solve such problems were also identified. Experts were probed for suggestions on how the elements of multimedia such as text, graphics, animation, and video, audio, and interactivity could be used to present the instructional events for problem portrayal, for guidance, for navigation and for interaction purposes. They were also approached for ideas on the best and most effective method of delivering the module. Finally, the experts were also asked for suggestions on how the assessment could be planned and conducted. From this perspective, ideas of the categories and criteria to be included in a rubric to evaluate students' solutions were thus generated.

Data analysis of the first phase of the FDM. The qualitative interview data were coded using *Atlas.ti* 7 qualitative data analysis software. Data from the interview with experts were analysed using thematic analysis (Braun & Clarke, 2006) where data were categorised to identify elements for incorporation into the PSFC module.

Second phase: Fuzzy Delphi instrument distribution. The Fuzzy Delphi instrument was designed based on the categories that the panel of experts has suggested during the interview. The instrument was administered by other experts to locate the extent of their agreement based on the themes that had emerged from the interview in the first phase. The six experts out of the 19 interviewed to develop the Fuzzy Delphi Instrument also responded to the Fuzzy Delphi Instrument. This was to ensure that findings are consistent with the elements found.

Data analysis. Data from the instrument were analysed by using the FDM as stated from Step 2 to 6, discussed earlier in the Data Collection Procedure for Phase 2: Design. (See Figure 3.6.). In order to address the issue of fuzziness among the experts, a linguistic scale similar to the Likert scale but with additional fuzzy numbers was provided. The outcome resulted in every response having three fuzzy values: minimum value (m_1), most plausible value (m_2) and the maximum value (m_3). See Figure 3.3.

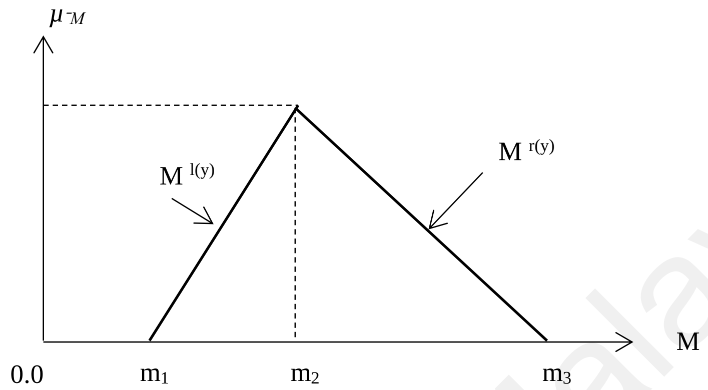


Figure 3.3 Triangular Fuzzy Number

In this context, the FD instrument was designed to consider the following: The degree of importance for each of the identified elements (in terms of objective, content areas to develop real-world problems, instructional strategies, resources/media, platform and assessment strategies) of the problem-solving instruction, by using the FC approach. Only those relatively important elements would be considered for further study. The degree of importance can be positive or negative, and it can range from 'very unimportant' to 'very important' (Kardaras, Karakostas, & Mamakou, 2013). This is also represented in a 5-point Likert scale, 1= Unimportant, 2 = Of little importance, 3= Moderately important, 4 = Important, 5 = Very important, which represents 5-point linguistic scale for the level of agreement. (See Table 3.8).

Table 3.8 *Fuzzy Scale Used in the Study*

Likert scale	Linguistic variable	Fuzzy Scale
1	Unimportant	(0.0,0.1,0.2)
2	Of little Importance	(0.0,0.2,0.4)
3	Moderately Important	(0.2,0.4,0.6)
4	Important	(0.4,0.6,0.8)
5	Very Important	(0.6,0.8,1.0)

The analysis of the FDM at this phase, was based on the triangular fuzzy number and the defuzzification process. The condition for the triangular fuzzy number involves the threshold value (*d*). The percentage of expert consensus which is the threshold (minimum requirement) value (*d*) for each item (component and element) must be less or equal to 0.2 (Cheng & Lin, 2002) and the expert consensus percentage must be equal to or more than 75.0% (Chang, Hsu, & Chang, 2011; Chu & Hwang, 2008). The threshold (minimum requirement) value (*d*), which is the distance between two fuzzy numbers, was analysed by using *Microsoft Excel* according to the following formula:

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}}$$

According to Cheng and Lin (2002), if the distance between the average and expert's evaluation data is less than the threshold value of 0.2, then all the experts are considered to have achieved a consensus. For the defuzzification process, only one condition needs to be fulfilled, and that is, the *fuzzy* score (A) which must be equal or more than the alpha-cut value of 0.5. There is only one condition to be fulfilled which is that the fuzzy score A, must be equal or more than the alpha-cut value of 0.5, as a threshold that is used to select the elements for developing the PSFC module. The value of 0.5 was noted to be the middle point (median) of the interval [0, 1]. It reflected the logical reasoning that only those elements from the support of a fuzzy set with ‘‘sufficiently large’’ membership grades in a fuzzy set, were included (Bodjanova, 2006; Tang & Wu, 2010). Typically, the defuzzification allows the researcher to classify the elements agreed by the consensus of the experts according to the ranking of the elements. This fuzzy score was also analysed by using the Microsoft Excel, according to the following formula:

$$A = \frac{1}{3} \times (m_1 + m_2 + m_3)$$

The following are the steps involved in FDM:

Step 1: Select eligible panel of experts based on criteria 10-15 experts (Adler & Ziglio, 1996) or 10-50 experts (Jones & Twiss, 1978).

Step 2: Determine the linguistic scale based on the triangular fuzzy number to frame feedback

Step 3: Calculate the mean of their opinions for each dimension for each (m_1, m_2, m_3)

Step 4: Determine the distance between two fuzzy numbers to determine the threshold, *d*. If $d \leq 0.2$, it means that all the experts have reached a consensus. Otherwise, a second round is required.

Step 5: Determine the group’s consensus. The percentage of the group consensus must exceed 75%, if not a second round needs to be conducted.

Step 6: Identify the Alpha-cut level in order to select the elements for developing the PSFC module; most of the literature used the Alpha-cut level that is equal to .05.

Step 7: Aggregate the Fuzzy Evaluation by adding all the fuzzy numbers.

Step 8: The Defuzzification process which is a technique to convert numbers into crisp real numbers.

Step 9: Ranking to choose the elements based on the defuzzification value, as the element that has the highest defuzzification value is ranked highest in priority.

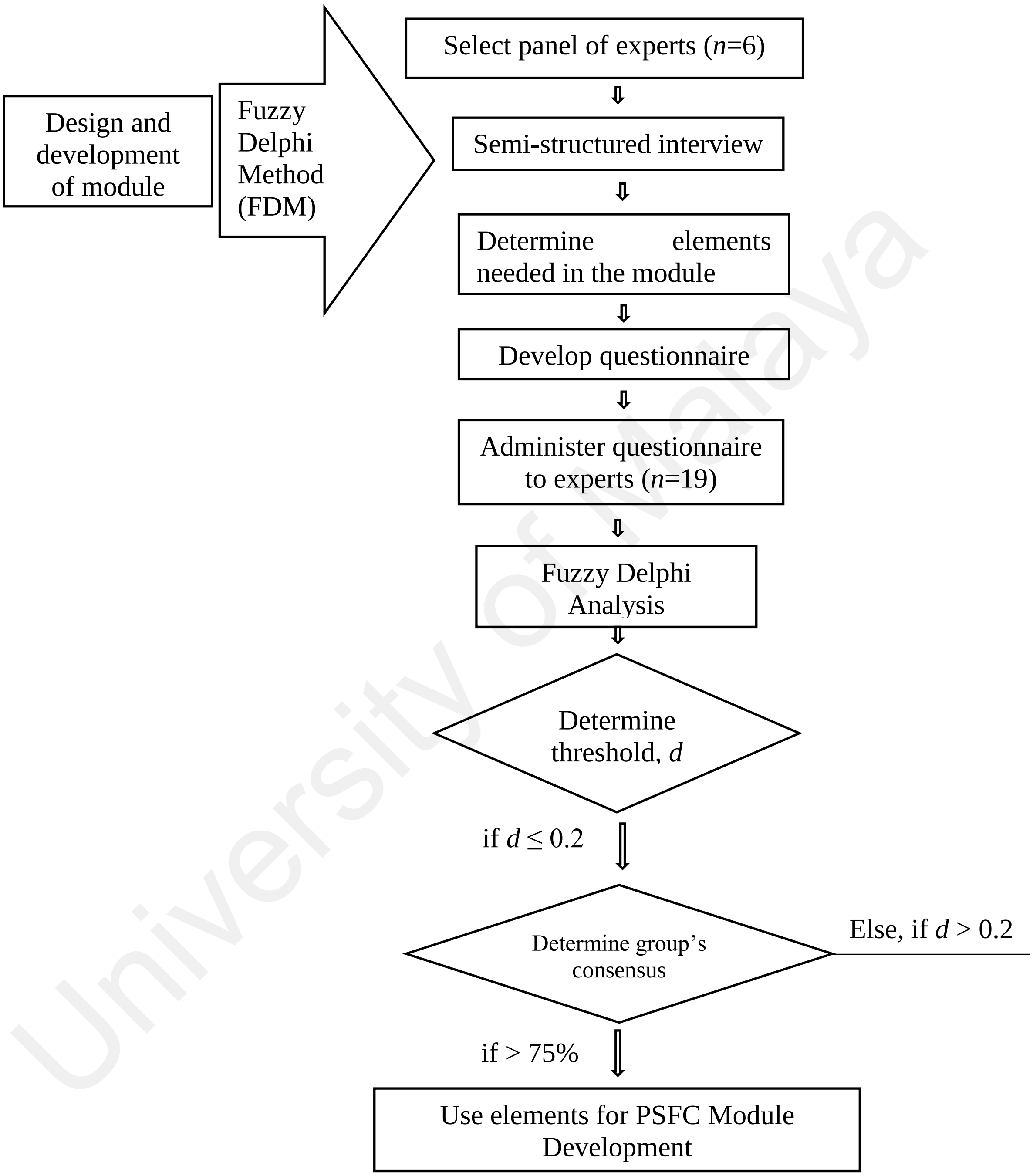


Figure 3.4 Summary of Phase 2: FDM

PSFC Module Design

Next, the lessons in the PSFC module were not only designed based on the expert consensus (achieved through the FDM) but also according to Merrill's First Principles of Instruction (Merrill, 2012), Cognitive Apprenticeship (Collins et al., 1990). FC Model based on First Principles of Instruction (Lo & Hew, 2017). These principles provide a unique conceptual framework which can be implemented in the PSFC approach. (See Figure 5.2). Since the Culinary Arts course at the Community Colleges consists of both theoretical and hands-on practicum components, the lessons for the PSFC module were also planned accordingly, to comprise both these components.

Expert review for PSFC module design. A team of three experts was further selected from the pool of experts based on their experience and expertise in the field of FC, problem-solving and the discipline of Culinary Arts. They were expected to review the design documents of the PSFC module. The educational technology expert, ET1, focused on the technical aspect and the module instructional design, while SME1 and SME2 concentrated on the module content.

Experts' reviews in validating the PSFC module. The PSFC module development took into account the input gathered from the FDM and the experts' reviews. Based on their suggestions, the PSFC module was improved. Upon this stage of improvement, six experts further evaluated the module. The six experts were from the FDM pool: one university professor (expertise is Flipped Classroom, Problem-solving, Pedagogy, and Technology in Education), two university professors (one from a public university and one from a private university) whose expertise is in Culinary Arts and problem-solving, one university lecturer whose expertise is Home Science, Culinary Arts, Problem-solving and TVET, one Executive Sous Chef from a five-star hotel and one Community College Culinary Arts instructor. (See Table 3.9).

Table 3.9

Panel of Experts to Validate the PSFC Module

Expert	Position	Expertise	Years of Experience
ET1	Professor–Public University	Problem-solving FC Pedagogy Technology in education	29
SME1	Professor-Private University	Problem-solving Culinary Arts Pedagogy	33
SME2	Senior Lecturer – Public University	Pedagogy TVET Culinary Arts Home Economics Education	19
SME3	Professor-Public University	Problem-solving Culinary Arts	40
SME4	Culinary Arts Lecturer-Community College	Culinary Arts	16
IND1	Executive Sous Chef, 5-star hotel	Culinary Arts	23

As can be noted in Table 3.9, the profile of the experts is indicated by their discipline and years of experience. During the process of the evaluation, the six experts validated the module by using a checklist highlighting the elements of task-centred learning principles (Francom and Gardner (2014) and the module validity criteria Sidek Mohd. Noah and Jamaludin Ahmad (2005). (See Appendix G).

Phase 3: Implementation & Evaluation

Purpose. Upon the second evaluation by the six experts, the PSFC module was improved according to the suggestions. Following this improvement, the module was implemented on a group of Culinary Arts students and one participating Culinary Arts instructor who was from one Community College located in the Klang Valley. As mentioned earlier, the module was designed for first-semester students only. In this regard, all the first-semester students of the Community College were included. Because of their small population, they were then treated as a single group participation with no control group assigned. No random assignment to evaluate the effect of the intervention was assigned due to the one group participation. Hence, this study was considered as quasi-experimental, and it involved the application of a pre-test/post-test approach that was specifically designed to assess the students' learning gains and problem-solving skills. Since the secondary aim of this study was to assess the PSFC module effectiveness, a survey was thus implemented. After the intervention was completed, a survey was administered to gather the students' perception of their learning experience using the PSFC module. A semi-structured interview was also conducted with the participating instructor. Both approaches were to gather more information on the participants' views regarding the usability of the PSFC module. Both sets of data were used to substantiate the quantitative data.

Sample. The sample included in the implementation of the PSFC module involved 30 first-semester students (n = 30) and one participating instructor. The first-semester students were new to tertiary level education; thus, they would not have established any learning routines. This ties in with the suggestion made by Burke and Fedorek (2017) who mentioned that the FC is more suitable for new students because they need less orientation time. Unlike final year students who have undergone traditional lectures throughout their tertiary life would find the FC a challenge. The instructor involved in the current implementation was a female academic with nine years' teaching experience in the same college.

Data collection procedure.

Access to the course. Once the PSFC module was validated and improved in the second round, a cover letter and an implementation schedule were forwarded to the director of a selected urban Community College located in the Klang Valley. This was meant to acquire the necessary permission to implement the PSFC module. To gain access to the course, the course instructor, who was also interviewed during the needs analysis phase, agreed to allow the researcher to recruit the students who were given participating marks for taking part in the study. They were not given any form of monetary rewards.

Orientation to the PSFC module. After permission was granted by the director, an orientation workshop was organised for the participants. It was held for two hours in a lecture theatre equipped with audiovisual functionality. The aim was to introduce the module to the research participants. Before the orientation workshop, the participants had received a memo from the participating instructor via a *WhatsApp* group which informed them about the workshop. The memo also instructed them to install specific required apps on their mobile devices. They were further given a link to three *YouTube* websites which were expected to help them familiarize themselves with the FC approach. They were also expected to watch the videos from the *YouTube* links before attending the orientation workshop.

During the orientation workshop, I introduced myself and explained the purpose of the research. The PSFC was also highlighted, and justification was given to emphasise on its benefits compared to the traditional class structure. A clear example of the process involved and how the instructor was going to implement it was also explained. These measures were necessary as a pre-intervention step that helps students to be familiarised with the module (Findlay-Thompson & Mombourquette, 2013; Gilboy et al., 2015). Following the explanation, the FC template that had been developed was displayed (See Appendix L). The flow of the teaching and learning process was also described. At the end of the briefing, a cover letter and an informed consent form were distributed to each participant of the study. All the participants were requested to return the informed consent form on the same day. All of them agreed to participate in the research. As a confidentiality measure, all the students were then randomly assigned a number which begins with one (1) and ends at 30. This coding technique will also facilitate the pre-test and post-test instrument administration. All the participants also received a copy of the informed consent form for them to keep. Due to the voluntary nature of the study, it was also made clear to students that they could end their participation in the study at any point and that their marks in the class would not be affected by their decision to participate or withdraw from the study. Following this, hands-on training to set up their *Schoology* and *EdPuzzle* accounts on their mobile devices was conducted. This is because the participants were expected to access the prepared materials for the orientation through the *Schoology* platform on their mobile devices.

One group pre-test post-test design study. While a controlled study with random assignment is typically considered as the "golden standard" in educational and psychological research, there are some challenges involved. In this study, the challenge faced is the difficulty in assigning a random assignment for a one-group participation in the college setting (Zappe & Litzinger, 2017). To look for an appropriate comparison group was not conducive, given the logistical constraint of the discipline, the number of students involved, the time of day classes are conducted and when particular sections are offered. These factors could potentially impact the results of the evaluation (Zappe & Litzinger, 2017). Thus, the quasi-experimental, one-group pre-test/post-test design study was assigned to the current study. Without a control group, a pre-test and post-test comparison were considered as enabling the quantification of the intra-individual change in student learning to occur although this may not allow for causal statements to explain why the change occurred.

The design of this study is shown in Table 3.10, where *O* refers to some process of observation or measurement, where *X* represents exposure to the experimental treatment (PSFC module), and X_s and O_s in the row, are referred to the same specific group (Sekaran & Bougie, 2013). The effects of the treatment were obtained by measuring the difference between the pre-test and the post-test scores to arrive at the net effects of treatment (Sekaran & Bougie, 2013).

Table 3.10

Pre-test and Post-test Experimental Group Design

Group	Pre-test score	Treatment (PSFC module)	Post-test score
Experimental group	O_1	X	O_2
Treatment effect = [($O_2 - O_1$)]			

Table 3.10 illustrates the formula of the pre-test and post-test design. It also shows the course design which also uses the following symbols: *O* =observation of the dependent variable and *X*= Problem-solving task. The *O*'s are numbered with subscripts from left to right, based on time order. The pre-test conducted at the beginning of the intervention is noted as O_1, and the post-test conducted at the end of the intervention is noted as O_2.

According to Shadish, Cook, and Campbell (2002), there are internal and external threats in a study involving a one-group pre-and post-test design. In the context of this study, the internal threats are the history, maturation, testing, instrumentation and statistical regression. Meanwhile, the external threats include the interaction effects of selection biases and the experimental variables (Shadish et al., 2002). The time span used for the implementation was considered too short for maturation, but it is well spaced for fatigueness which increases the validity of the study. Although, both the internal and external threats can cause some minor effects to the study, both threats cannot be used to generalise the findings of an untested population such as one involved in this study (Creswell & Clark, 2011; Shadish et al., 2002).

Data collection procedure. To assess the learning gains and problem-solving skills of the students involved, the test was conducted by using a "one group pre-test post-test study" which defines a baseline score through a pre-test and which measures the outcome of the treatment through a post-test. Before the hands-on training on using the PSFC module was conducted, I passed several hard copies of each pre-test instrument, face down, on the desk of each participant. A secret four-digit code was involved such that it would include both the pre-and post-tests to be matched at the end of the study while analysing the data. I reminded the students of the confidentiality terms of the study and then asked them if they have any further questions during the distribution of the pre-test. A timer for 60 minutes was set, and the participants were instructed to begin the pre-test. Upon completion, they were requested to remain seated while the pre-test instrument was collected. Similarly, at the end of the intervention, the students were given the post-test instrument in the same procedure. The total score of the pre-test and post-test were both 100 marks. The questions for both instrumentations was divided into 20 multiple choice questions which focused on the specific domain knowledge (maximum of two marks each) with two short questions asking about 'decision-making problem type' and 'troubleshooting problem type' respectively. The maximum score for domain knowledge is 40, and the maximum score for the problem-solving domain is 60.

Data analysis. The participants were measured twice, thereby obtaining two scores in two different situations: the pre-test and the post-test. In this regard, the paired samples *t*-test was used to determine if there is a difference between the mean of both sets of data. Since this study was focusing on a single instance of the FC intervention, with a small population of students, the next step after the pre-test was to measure the normalised gains of the students' learning. This was measured by the pre-test/post-test score differences (Talbert, 2014). The use of the single-student normalised gains and its related calculations has received empirical justification as an easy-to-use instrument to gauge course effectiveness when applied within hundreds of classroom teaching involving different instructors and student populations (Colt, Davoudi, Murgu, & Zamanian Rohani, 2011). Therefore, the effectiveness of the PSFC module was established by using the pre-test/post-test model, with calculations of the various measures of learning gain, including measures of the class-average and single-student normalised gains.

Firstly, the individual's actual gains G_i (where G_i = post-test score – pre-test score) were tabulated in order to calculate the percentage of absolute gain (where Δ = average G_i/maximum score achievable), and the relative gain expressed as a percentage (where C = average G_i/pre-test score) for the class. As a measure of the module effectiveness, the class average normalised gain ‹g› was calculated (Colt et al., 2011; Hake, 1998; Hill, Sharma, & Johnston, 2015). The ‹g› is defined as the average actual gain divided by the maximum possible gain, where G is the actual gain ‹%post› and ‹%pre› is the final (post) and initial (pre) class averages, while the angle brackets "‹…›" indicate the average of the students taking the tests:

$\langle g \rangle = \langle \%G \rangle / \langle \%G \rangle_{max}$

$\langle g \rangle = [\langle \%post\text{-}test \rangle - \langle \%pre\text{-}test \rangle] / [100\% - \langle \%pre\text{-}test \rangle]$

A pre-defined target ‹g› of 30% was taken to define the minimum value at which the educational intervention could be regarded as effective (Colt et al., 2011; Hake, 1998; Hill et al., 2015). In addition, the individual's single-student normalised gains (g_i) were calculated for all the students and averaged as g(ave) = $[\sum_1^N (g_i)]/N$, where N is the number of students taking both the pre-test and post-test. To diminish the skewing effect of the outlier students with very high or very low pre-test scores, the individual single-student's normalised gain, where g_i = [%post-test - %pre-test]/100% - %pre-test], where the actual gain divided by the maximum gain achievable by each student was calculated. As previously stated, the use of the single-student's normalised gains and its related calculations has received empirical justification as an easy-to-use instrument to gauge course effectiveness used within hundreds of classroom teaching involving varying types of courses with different instructors and student populations and 30% is considered as the defining minimum value for an effective intervention (Colt et al., 2011).

Validity and reliability. To confirm the content validity, the pre-test and the post-test items were examined by three Community College Culinary instructors, who had more than ten years' teaching experience. First, I provided an outline of the module content. The instructors then reviewed the items to check if they were representative of the contents being taught. They also reviewed the content wording and layout which resulted in minor revisions made to improve the final versions of the tests. To confirm the internal validity, the value of the alpha reliability coefficient (KR20) was established for both tests. The reliability coefficients were .713 and .644 for the pre-and post-tests, respectively. Alpha coefficients between .60 and .70 are considered acceptable (George & Mallery, 2003). The pre-test and post-test scores were based on the answer scheme. The internal validity of the quasi-experimental study was increased due to the short time interval between the pre-test and post-test as the maturation effect would not occur.

The PSFC Module implementation. The total duration of the face-to-face contact hours during the PSFC module implementation encompassed eighteen hours per week. Based on the curriculum specification, face-to-face lectures should be conducted six hours per week while the hands-on practicum classes should be conducted 12 hours per week (over two days). Hence, students were expected to spend two hours outside classroom time, going through some learning materials that have been identified in the module, as a measure to help them prepare for their face-to-face classes. The PSFC module was implemented over nine lessons within three weeks. This is to allow for developing the students' foundational knowledge and to scaffold the development of their problem-solving skills within a short time span (Gosper, 2011). Although the FC approach implementation was short in the context of this study, there may be valuable experiences to be acquired by the participants (Wong et al., 2014). The module design had provided students with a "before class" preparation task such as watching videos and completing interactive video quizzes before attending the face-to-face classes. The "before class" preparation was expected to enable students to use the face-to-face class time for further discussion of the concepts learnt and for solving problems. After the class, students were also required to record their reflections to enable them to link what was learned before class and what was learned during class. They were provided with additional activities after the face to face class to allow them to explore the knowledge learned. Rubrics were used for the class discussions and practical tasks throughout the course, to ensure consistent grading across all discussion groups (Black et al., 2017). The summary of the intervention is presented in Figure 3.5.

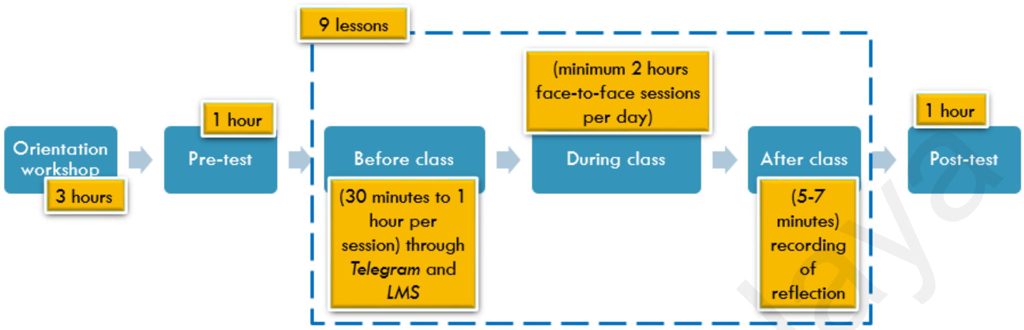


Figure 3.5 Research procedure for evaluating PSFC module effectiveness.

Reliability and validity. In the design and developmental research approach, the researcher is the participant observer who must be objective to ensure the internal validity of the research (Kawulich, 2005). In the context of this study, the role of the researcher was as a participant observer who was not involved in any classroom activity beyond observation and data collection (Kawulich, 2005). Although selection bias was still a concern when this study applied the quasi-experimental research approach, the use of a pre-test allowed me to examine the nature and extent of the selection bias (which usually occurs in a quasi-experimental research). This is achieved by comparing the groups before the intervention (Bell, 2010; Cohen et al., 2007). I also kept a journal to document observations, experiences, thoughts, and insights involving the FC module, on a daily basis after implementation. Objectivity was also ensured through the systematic data collection applied throughout all the three phases of the research. Data triangulation was also accomplished through the survey, interview and observation approach. In the product and tool research approaches such as the current study involves, validity was established through the needs analysis which then determined the product specification, pilot study, and experts' reviews.

Students' perception of their learning experience using the PSFC module. The Students' Perception of the Instruction Questionnaire (SPIQ hereafter) survey was designed to determine the students' opinions on content and course delivery, assessment and evaluation as well as communication and learning experiences (Araño-Ocuaman, 2010). (See Appendix I). Permission to adapt items from these questionnaires was sought and approved through personal communication and through e-mails with the authors. (See Appendix J). The SPIQ comprise 13, 5-point Likert-scale items which had been previously assessed for internal consistency and reliability. The instrument has a Cronbach alpha coefficient of approximately .75 (Johnson & Renner, 2012). Items were found to be consistent with the evaluation of perceptions involving a curriculum with hybrid approaches for instruction (face-to-face lecture/discussion mixed with instructional technology). The SPIQ had been used by other FC studies (Siti Zuraidah Md Osman et al., 2014; Sohrabi & Iraj, 2016) to compare students' perception about the FC interventions. In the context of this study, the survey asked students to evaluate four areas that helped them to improve their learning. They include:

a. Course content and delivery: This area provided questions asking how the students accessed relevant media and resources to acquire the materials suggested in the PSFC module and how satisfied they were in using them.
b. Use of mobile-based communication tools for communication and collaboration: This area looked at the LMS and the mobile messaging applications that enabled them to communicate among themselves and the participating instructor.

c. Tools for assessment and evaluation of student performance: This area encompassed the provision of an LMS, interactive quizzes, online worksheets and other relevant resources.
d. Learning strategies of the students and their personal learning experiences when using the PSFC module: This area covered their self-assessment of how much they had learned with real-world applications of the learning activities during the face-to-face classroom session and outside of class.

PSFC module usability. After the intervention, a semi-structured interview was conducted with the participating instructor who taught the lessons through the PSFC module. The aim was to detect her perceptions about the module's usability in terms of its pedagogical and technical usability. The interview protocol was developed based on the technical usability and pedagogical usability criteria (Hadjerrouit, 2012; Lavonen et al., 2012; Nielsen, 1990; Nokelainen, 2006). (See Appendix K for the interview protocol).

Data analysis. From the semi-structured interview, data were recorded, transcribed and then analysed by following the thematic analysis as defined by Braun and Clarke (2006).

Reliability. The interview protocol was pilot tested with one instructor who was not part of the study before the needs analysis phase. After the interview was conducted and data were recorded, the interview was transcribed. Following the transcription, a copy of the transcript was sent to the interviewee for verification or member check. During the member check phase, "the provisional report (case) was taken back to the site and then subjected to the scrutiny of the persons who provided the information" (Lincoln & Guba, 1985).

During this process, the research participants were able to determine if the researcher had accurately reported their stories before coding and analysis were applied (Goldblatt, Karnieli-Miller, & Neumann, 2011). This process allowed the participants to make corrections to the data, as a manner of correcting mistakes made during the interview, or adding new information, confirming or denying the relevant information as well as the summaries that reflected their views, feelings, and experiences as participants of the study (Hagens, Dobrow, & Chafe, 2009). Reflecting on the conceptual framework, the questioning of the data, and the emerging of the ideas based on categories, a framework was necessary to generate these categories (inductively); thus, themes which had emerged from within the data (deductively) were applied.

Summary

This research had adopted the DDR approach to be able to design and develop a PSFC module for Culinary Arts students at Community Colleges. The design of this study were based on three different phases: (1) The needs analysis phase to locate users' needs so as to develop the PSFC module that can cater to the students' level of competence and instructor's needs; (2) The design and development of the PSFC module and (3) The Implementation and Evaluation of the module. In the first phase, data were collected using a survey administered to 831 Culinary Arts students from 11 Community Colleges in Malaysia. The needs analysis phase also included a semi-structured interview conducted with 10 Culinary Arts instructors from two Community Colleges. The findings from the needs analysis were used to determine the design of the module so that the needs of the students and instructors could be met. The second phase was the design and development of the PSFC module. The module design was developed by using FDM that involved 19 experts. During this phase, their input was collected to gather the appropriate elements for the design of the PSFC module according to experts' consensus. Once the module was finally developed, the module was reviewed by three experts. Their input was further considered to improve the module before implementation. After some improvement, six experts from the FDM pool validated the contents of the module (including the three experts who reviewed the module previously). In the third phase, the PSFC module was implemented on a group of first-semester Culinary Arts students and one participating Culinary Arts instructor. As a quasi-experimental study, one-group pre-test/post-test study was designed to assess the PSFC module effectiveness. Following this, a survey was administered to gather students' perception of their experience using the PSFC module while a semi-structured interview was conducted with the participating instructor to gather data on the pedagogical and technical usability of the PSFC module. Figure 3.6 provides a clearer illustration. The next chapter will focus on the analysis of data according to the three phases conducted.

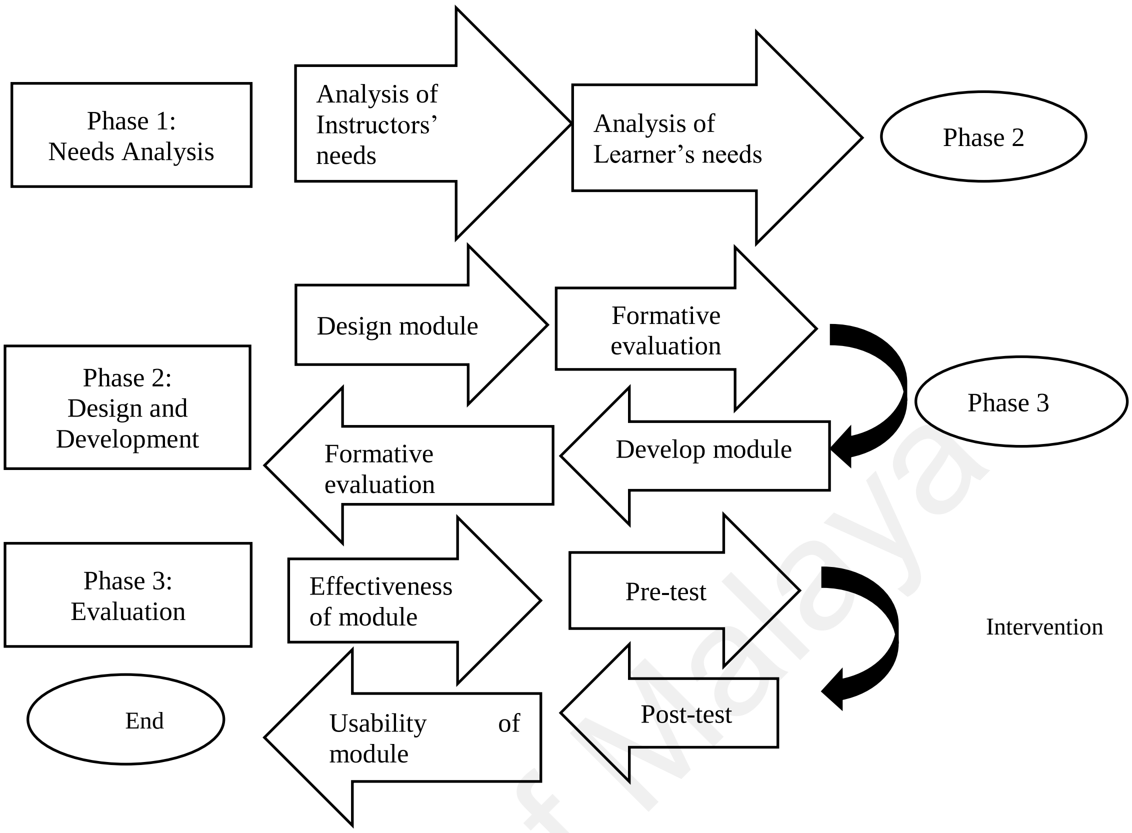


Figure 3.6 Summary of phases of the study.

As can be noted in the figure, the three phases of the study were linear although to some extent they were also interdependent. Table 3.11 to Table 3.13 gives a detailed illustration of the research design for the different phases of data collection in the study.

Table 3.11

Research Matrix for the Study: Phase 1

Phase	Research Objectives	Research Questions	Participants	Technique Data Analysis
Phase 1: Needs Analysis	To identify the needs to develop a PSFC module for Culinary Arts at Community Colleges.	i. What are students' perception of their level of problem-solving skills? ii. What are students' level of readiness towards adopting the FC approach if it is incorporated into the Culinary Arts course at Community Colleges?	**Sample:** Culinary Arts students at Community Colleges in Malaysia (*n*=831)	Survey Descriptive Statistics
		iii. What are the current teaching practices among Culinary Arts instructors at Community Colleges?	**Sample:** Culinary Arts instructors from two Community Colleges (*n*=10)	Semi-structured interview Thematic Analysis

Table 3.12

Research Matrix for the Study: Phase 2

Phase	Research Objectives	Research Questions	Participants	Technique Data Analysis
Phase 2: Design	To identify the appropriate elements for the design of the PSFC module for Culinary Arts according to experts' opinion.	i. What are experts' views on the elements that should be incorporated into the PSFC module for Culinary Arts at Community Colleges in terms of objective, content to develop real-world problems, instructional strategies, resources/media, and assessment?	**Sample:** Culinary Instructor at Community College (*n* =1) Culinary Instructor from Private University (*n*=2) Chef-Restaurateur (*n*=1)	Semi-structured interview Thematic Analysis to design the FDM instrument

Phase	Research Objectives	Research Questions	Participants	Technique	Data Analysis
	To develop the PSFC module for Culinary Arts according to experts' opinion	ii. Based on experts' consensus, how should the elements be included in the development of the PSFC module?	Professor (Public University) – expertise in FC (*n*=1) Professor (Public University) – expertise in Instructional Technology, Problem-solving, and TVET (*n*=1) University Professors with expertise in FC, Technology in Education (*n*=4) University Professor and Senior Lecturer with expertise in TVET and Problem-solving in TVET (*n*=2) Chefs from 5-star hotel (*n*=3) Community College Culinary Instructors (*n*=2) Culinary Professor and Instructors from other Institutions (*n*=5) Instructional Designer (*n*=2) Policymaker (*n*=1)	Fuzzy Delphi Instrument (*n*=19)	Fuzzy Delphi Method (FDM), the elements with the highest rank is used the develop the PSFC module Analysed using Excel

Table 3.13

Research Matrix for the Study: Phase 3

Phase	**Research Objectives**	**Research Questions**	**Participants**	**Technique**	**Data Analysis**
Phase 3: Evaluation	To evaluate the effectiveness of the PSFC module on Culinary Arts students' learning gains and problem-solving skills.	i. Is the PSFC module effective for improving students' cognitive knowledge (learning gains)? ii. Is the PSFC module effective for developing students' problem-solving skills?	Culinary Arts students from one Community College (*n*=30)	One group quasi-experiment Pre-test post-test	Paired samples t-test Normalized gain
	To evaluate students' perception of their learning experience using the PSFC module	i. What are students' perceptions of their learning experience using the PSFC module?	Culinary Arts students from one Community College (*n*=30)	Survey	Descriptive statistics
	To evaluate the usability of the PSFC module	ii. Is the PSFC module pedagogically and technically usable?	Culinary Arts instructor (*n*=1)	Semi-structured interview	Thematic Analysis

CHAPTER 4

FINDINGS OF PHASE I: NEEDS ANALYSIS

Introduction

This chapter discusses the research findings emerging from the preliminary phase of the study. Labelled as the needs analysis phase, the first part (Part I) focuses on the quantitative findings of the Culinary Arts students' cognitive skills that had been applied in their problem-solving activities and their readiness for FC. The second part (Part II) comprise the qualitative findings of the 10 instructors' view on their current teaching practices and their perception of the students' problem-solving skills. The third part (Part III) discusses the implications for designing the module as shown by the quantitative and qualitative data.

Part I(a): Students' Cognitive Skills in Problem-solving

To be able to design a module that can develop students' problem-solving skills it is necessary to investigate their current level of cognitive skills before immersing them in problem-solving activities. In that regard, the attempt portrayed in this chapter aimed at answering the following research question, "What are the students' perception of their level of problem-solving skills?"

In this attempt, the questionnaire designed to measure 'Problem-solving Practices and Flipped Classroom Readiness of Culinary Arts students at the Community Colleges of Malaysia' was administered on 1,025 Certificate level Culinary Arts students from 11 Community Colleges. These Community Colleges were located in six regions of Malaysia namely the Northern region (Kedah, Penang, and Perak), the Central region (Selangor), the Southern region (Melaka and Johor), the

East coast region (Pahang), and East Malaysia (Sabah and Sarawak). These states were selected because other states such as Perlis, Kelantan, and Terengganu do not have Community Colleges offering Culinary Arts and in the Federal Territories of Kuala Lumpur, Putrajaya and Labuan, there are no Community Colleges.

From the 1,025 questionnaires administered, a total of 854 questionnaires were retrieved, indicating a response rate of 83.3%. There were 831 suitable questionnaires which were from 380 male students and 451 female students. (In this thesis, the term respondents and students are used interchangeably.)

Respondents' profile. The demographics of the 831 respondents are tabulated in Table 4.1. There were slightly more females (54.3%) than males (45.7%). The majority of respondents were of Malay ethnicity (98%). More than half or 56.8% of the respondents were *Sijil Pelajaran Malaysia* (SPM, Malaysian Certificate of Education) level school leavers who were below 20 years old and 30.9% of the respondents were in semester three of study. A large proportion of the respondents were from the Northern region (Kedah, Penang, and Perak) (38.6%) while those from the East Coast region (Pahang) comprised 30.0% of the respondents.

Table 4.1

Profile of Respondents (*n* = 831)

Demographics	*N*	%
Gender		
Male	380	45.7
Female	451	54.3
Race		
Malay	768	92.4
Chinese	10	1.2
Indian	7	0.8
Others	46	5.5
Age		
Under 20	472	56.8
20-24	335	40.3
25-29	22	2.6
30-34	2	0.2
Semester		
First	201	24.3
Second	218	26.2
Third	257	30.9
Fourth	154	18.5
Region		
Northern (Kedah, Penang, Perak)	321	38.7
Central(Selangor)		
Southern	68	8.2
(Melaka and Johor)	124	14.9
East Coast (Pahang)	249	30.0
Sabah	52	6.3
Sarawak	17	2.0

Students' level of problem-solving skills. From the questionnaire collected, the respondents' data were extracted and then organised according to their modes of cognitive thinking used for meaningful problem-solving strategies. Table 4.2 presents the mean scores and standard deviation of the four subscales of cognitive skills used in problem-solving. To calculate each student's mean score for every construct, the sum of the answers to each item in that construct was divided by the number of that construct's items. As can be seen, all the students' average scores relative to the different dimensions ranged from 3.21 to 3.38 on a 5-point Likert-type rating scale. This indicates that on average, the respondents exhibited medium level of problem-solving skills because of the medium us of cognitive skills in problem-solving practices. When comparing the cognitive skills used in problem-solving, the findings indicate that all cognitive skills were rated as medium. The results suggest that the dominant cognitive skill applied by students during problem-solving practices is that of argumentation (*M* = 3.38, *SD* = 0.630) followed by reasoning causally (*M* = 3.30, *SD* = 0.619) and then Modeling (*M* = 3.27, *SD* = 0.711). Analogising was used less frequently by students (*M* = 3.21, *SD* = 0.661). (See Table 4.2).

Table 4.2

Results of Students' Cognitive Skills Used in Problem-solving Constructs

Constructs	***M***	***SD***	**Skill level**
Analogizing	3.21	. 661	Medium
Modeling	3.27	.711	Medium
Reasoning Causally	3.30	.619	Medium
Argumentation	3.38	.630	Medium
Total mean score			Medium

Results suggest that the argumentation strategy was applied when students justified their arguments or claims with evidence. However, when required, rebuttals and counter-arguments with alternative theories may be used to support the arguments or claims. It also appears that causal reasoning was applied by students to make logical arguments and inferences. Analogising was crucial for students when they encountered problems they had experienced previously. However, students may not have enough prior experience to be able to apply analogies more effectively. For example, when learning new contents, students need to have a familiar frame of reference which can be used as an analogy to facilitate the learning process (Kauchak & Eggen, 1998); yet this was not seen. It is deduced that the lack of analogising strategy use by the students can be attributed to their lack of exposure to real-world problems. Thus, real-world problems should be used as part of instruction as outlined by the FPOI (Merrill, 2007).

Table 4.3

Results of Students' Cognitive Skills Used in Problem-solving

Item	Frequency of use % (*n*) Never 1	2	3	4	Always 5	*M*	*SD*
Compare similar problems or cases that have been done in class?	8.5 (71)	14.7 (122)	45.2 (376)	26.8 (223)	4.7 (39)	3.04	.971
Compare similar problems or cases to find the answer to the problem?	5.3 (44)	12.5 (104)	46.2 (384)	29.5 (245)	6.5 (54)	3.19	.925
Organise the ideas presented when solving a problem?	3.9 (32)	6.3 (52)	43.8 (364)	37.8 (314)	8.3 (69)	3.40	.874
Use ICT tools or software to organise the idea?	6.9 (57)	10.1 (84)	40.8 (339)	30.9 (257)	11.3 (94)	3.30	1.025
Use ICT tools, such as graphics, graphic organisers, and mind maps?	7.6 (63)	15.0 (125)	43.0 (357)	26.5 (220)	7.9 (66)	3.25	.878
Use ICT tools or software to show relationships between the concepts?	8.1 (67)	9.3 (77)	43.4 (361)	29.2 (243)	10.0 (83)	3.24	1.025
Use ICT tools or software to construct a model?	8.9 (74)	13.5 (112)	41.5 (345)	27.2 (226)	8.9 (74)	3.14	1.050
View interactive simulations or other ICT resources to show relationships between concepts?	4.0 (33)	11.0 (91)	45.1 (375)	31.0 (258)	8.9 (74)	3.30	.920
Find relationships between the concepts?	2.3 (19)	6.9 (57)	42.5 (353)	36.6 (304)	11.8 (98)	3.49	.872
Construct a model in your mind (mental model) to show relationships between concepts?	5.5 (46)	12.0 (100)	45.2 (376)	30.3 (252)	6.9 (57)	3.21	.936
Change the relationship between concepts to see the results?	3.9 (32)	11.2 (93)	46.9 (390)	31.8 (264)	6.3 (52)	3.25	.878
Make predictions to forecast the answer?	4.5 (37)	8.1 (67)	41.2 (342)	37.5 (312)	8.8 (73)	3.38	.917
Discuss the implications when a variable is changed?	4.7 (39)	9.5 (79)	45.2 (376)	30.8 (256)	9.7 (81)	3.31	.940

Find the effect of changing different variables?	6.0 (50)	14.2 (118)	50.8 (422)	25.2 (209)	3.9 (32)	3.07	.886
Test predictions made?	6.4 (53)	14.3 (119)	47.3 (393)	26.2 (218)	5.8 (48)	3.11	.939
Guess the answer?	2.2 (18)	7.8 (65)	44.2 (367)	37.1 (308)	8.8 (73)	3.42	.841
Use a real situation to test the answer?	3.7 (31)	10.3 (86)	42.0 (349)	35.6 (296)	8.3 (69)	3.34	.908
Experiment with the mental model of the case to solve the problem?	5.5 (46)	13.6 (113)	46.8 (389)	27.4 (228)	6.6 (55)	3.16	.934
Focus only on important points in a complex question?	2.3 (19)	6.4 (53)	39.7 (330)	41.6 (346)	10.0 (83)	3.51	.846
Answer a complex question by writing the answers, step by step?	1.9 (16)	9.5 (79)	43.2 (359)	35.6 (296)	9.7 (81)	3.42	.863
Ask questions to find important aspects to focus?	1.7 (14)	6.1 (51)	39.0 (324)	40.7 (338)	12.5 (104)	3.56	.849
Answer a complex question and justifying each of the steps in the answer?	4.1 (34)	12.8 (106)	47.2 (392)	29.2 (243)	6.7 (56)	3.22	.898
Consider several possible answers?	1.8 (15)	8.4 (70)	43.9 (365)	39.5 (328)	6.4 (53)	3.40	.803
Consider other methods/approaches to find answers?	1.9 (16)	8.7 (72)	42.2 (351)	38.7 (322)	8.4 (70)	3.43	.839
Consider that there may be criteria, other than method and final answer, for evaluating solutions to problems and complex questions?	3.1 (26)	9.9 (82)	48.4 (402)	31.3 (260)	7.3 (61)	3.30	.861

As the respondents of this study were those in the Culinary Arts programme whose learning exposure ranged from semester one to semester four, it is necessary to identify whether their semester exposure in the programme made any difference in their use of cognitive skills in problem-solving. Identifying this can also help to determine where the new module can be implemented, i.e., at which semester of their education it would be appropriate. Table 4.4 shows that students in the first-semester have the lowest level of problem-solving skills.

Table 4.4

Students' Levels of Cognitive Skills Used in Problem-Solving by Semester

Semester	***n***	***M***	***SD***
One	202	3.21	.661
Two	218	3.27	.711
Three	257	3.30	.619
Four	154	3.38	.629

Part I(b): Students' Readiness for FC

This section will provide some responses that can indicate whether the respondents of this study are ready for FC.

Ownership and usage of smartphone and tablet computers. The use of high tech equipment among the 831 respondents was also noted to gauge their readiness for the FC environment. Table 4.5 highlights the ownership of smartphones and tablets among respondents and statistics suggest that 97.4% of respondents owned smartphones; only 2.6% do not own smartphones. It was noted that tablet computers appear to be less popular among the respondents; only 28.2% of the respondents owned tablet computers. In addition, 80.5% of the smartphone users used the Android operating system; only 19.5% were using *iOS* operating systems. Of those using tablet computers, 89.1% of tablet computers ran on *Android* platforms; only 9.9% respondents owned *iPads*. Among the smartphone users, 26.1% owned *Samsung* smartphones; 19.5% were *iPhones* users, and 16.5% were *Lenovo* users. Among the tablet users, 9.9% of the respondents reported owning *iPads,* and 9.7% used *Samsung* tablets, whereas 8.6% of tablet computer users did not report which brand they were using. The difference between smartphone and tablet ownership may be attributed to the availability of *Android* in both high-end and cheaper smartphones, making it affordable for most respondents to purchase an *Android* smartphone. The *iOS*, however, was targeted at more affluent individuals as the operating system is only available on *Apple*'s high-end smartphones which are usually more expensive.

Focusing on the respondents' experiences in using the Internet, statistics shown in Table 4.5 suggest that experiences may vary. Those without experience and/or having less than a year's experience in using the Internet was only 2.6% and 2.5% respectively. The majority of the respondents have been using the Internet for more than a year, with 32.6% of the respondents have used the Internet between three to five years. The statistics also show that 32.9% of the respondents use the Internet for one to five hours daily while 19.2% use the Internet for six to ten hours daily. Taking into account that 91.8% of the respondents have mobile Internet subscription services which allow continuous Internet access, it was observed that 15.4% of the respondents use the Internet for more than 20 hours daily. Some 45% of the respondents have access to *Wi-Fi* in their homes.

Table 4.5

Ownership and Access to Mobile Technologies

Mobile Technology Usage	***N***	**%**
Own Smartphone		
Yes	809	97.4
No	22	2.6
Smartphone Brand		
Apple	162	19.5
Samsung	217	26.1
Sony Xperia	39	4.7
Lenovo	137	16.5
Asus	89	10.7
Oppo	68	8.2
Others	97	11.7
No smartphone	22	2.6
Own Tablet		
Yes	235	28.3
No	596	71.7
Tablet Brand		
Apple iPad	82	9.9
Samsung Tab	81	9.7
Lenovo	26	3.1
Asus	35	4.2
Others	11	1.3
No tablet	596	71.7

Mobile Technology Usage	*N*	%
Experience using Internet (years)		
None	22	2.6
Less than one year	21	2.5
One to two years	96	11.5
Three to five years	271	32.6
Six to ten years	220	26.4
More than 10 years	202	24.3
Time spent on Internet in a day		
None	29	3.5
Less than an hour	58	7.0
One to five hours	274	32.9
Six to ten hours	160	19.2
11 to 15 hours	97	11.7
16 – 20 hours	86	10.3
More than 20 hours	128	15.4
Mobile data plan subscribers		
Yes	764	91.8
No	68	8.2
Availability of *Wi-Fi* at home		
Yes	374	45
No	457	55

Online learning readiness. This section presents the findings of the needs analysis regarding the respondents' online learning readiness which is required for FC. Table 4.6 presents the respondents' mean scores and standard deviations on the six subscales. To calculate each student's mean score for every factor (dimension), the sum of the answers to each item in that factor was divided by the number of factor items. As Table 4.6 indicates, all the respondents' average scores relative to the different dimensions ranged from 3.48 to 3.95 on a 5-point Likert-type rating scale. This indicates that on average, these online learners exhibited high levels of readiness for FC activities.

Table 4.6

Results for Students' Level of Readiness in FC

Dimension	*M*	*S.D.*
Technology Access	3.52	.915
Online skills	3.79	.671
Motivation	3.48	.825
Online Audio/Video	3.53	.798
Internet Discussion	3.56	.716
Importance to your success	3.72	.728

Having discussed the respondents' FC learning readiness, Table 4.7 is presented to illustrate the students' online learning readiness. The descriptive statistics drawn from the respondents' level of agreement based on the questions that asked their online learning readiness are shown in Table 4.7. About technology access, results show that 444 respondents (53.5%) agreed or strongly agreed that they had access to a computer with an Internet connection. Some 425 respondents (51.1%) agreed that they had access to a fairly new computer, while 507 respondents (61%) also agreed that they had access to a computer with adequate software. This seems to mean that students have access to technology to ensure flipped classroom can be implemented successfully.

Table 4.7

Results of Online Learning Readiness: Technology Access

Item	Level of Agreement, % (n)						
	Strongly disagree 1	2	3	4	Strongly agree 5	*M*	*SD*
I have access to a computer with an Internet connection.	7.9 (66)	7.8 (65)	30.8 (256)	39.4 (327)	14.1 (117)	3.44	1.078
I have access to a fairly new computer (e.g., enough RAM, speakers, CD-ROM).	5.1 (42)	10.0 (83)	33.8 (281)	36.1 (300)	15.0 (125)	3.46	1.026
I have access to a computer with adequate software (e.g., Microsoft Word, Adobe Reader).	4.3 (36)	5.9 (49)	28.8 (239)	41.5 (345)	19.5 (162)	3.66	.997

It is hereby noted that an important aspect of the FC is students' online skills and this element that is required of the students seems to be verified by the results shown in Table 4.8. So, this may mean that technology can be integrated in the module.

Table 4.8

Results of Online Learning Readiness: Online learning readiness

Item	Level of Agreement, % (n)						
	Strongly disagree 1	**2**	**3**	**4**	**Strongly agree 5**	***M***	***SD***
I have the basic skills to operate a computer (e.g., saving files, creating folders).	3.5 (29)	5.2 (43)	20 (166)	42.5 (353)	28.8 (240)	3.88	.998
I have the basic skills for finding my way around the Internet (e.g., using search engines).	2.4 (20)	4.1 (34)	15.5 (129)	45.2 (376)	32.7 (272)	4.02	.929
I can send an email with a file attached.	3.7 (31)	5.8 (48)	34.8 (289)	35.6 (296)	20.1 (167)	3.63	.988
I think that I would be comfortable using a computer several times a week to participate in a course.	2.3 (19)	6.4 (53)	27.2 (226)	41.5 (345)	22.6 (188)	3.76	.950
I think that I would be able to communicate effectively with others using online technologies (e.g., chat).	3.0 (25)	4.1 (34)	18.6 (155)	40.4 (336)	33.9 (282)	3.98	.980

It was found that 593 students (71.3%) agreed or strongly agreed that they have the basic skills of operating a computer. In rating their basic skills for finding their way around the Internet, 648 respondents (77.9%) agreed that they were capable of doing so. Some 618 students (74.3%) also agreed or strongly agreed that they were comfortable in communicating with others using online chatting platforms. The area indicating the lowest agreement was their ability to schedule a time to provide timely responses to other students and/or the instructors when using online technologies with 56 students (6.7%) disagreeing and 37 students (4.5%) strongly disagreeing. This seems to show that students are comfortable working online.

In looking at the respondents' motivation, 446 (53.7%) felt that they would be able to complete their work even when there are online distractions such as sending e-mails and surfing websites. Respondents showed the lowest agreement for the ability to complete their work even when there were distractions at home (e.g., television, children and such). Here, 76 students (9.1%) disagreed and 38 students (4.6%) strongly disagreed. This seems to mean that students will be motivated to complete their tasks with the presence of distractions. See Table 4.9.

Table 4. 9

Results of Online Learning Readiness: Motivation

Item	**Level of Agreement, % (n)**						
	Strongly disagree 1	**2**	**3**	**4**	**Strongly agree 5**	***M***	***SD***
I think that I would be able to remain motivated even though the instructor is not online at all times.	2.4 (20)	8.3 (69)	36.6 (304)	40.0 (332)	12.8 (106)	3.52	.903
I think that I would be able to complete my work even when there are online distractions (e.g., friends sending emails or Web sites to surf).	4.6 (38)	9.1 (76)	32.6 (271)	39.7 (330)	14 (116)	3.49	.994
I think that I would be able to complete my work even when there are distractions in my home (e.g., television, children and such).	6.1 (51)	10.2 (85)	32.3 (268)	37.2 (309)	14.2 (118)	.43	1.050

FC also requires students to access online materials in the form of audio and video formats which are used for delivering lessons. (See Table 4.10).

Table 4.10

Results of Online Learning Readiness: Online audio/video

Item	Level of Agreement, % (n)						
	Strongly disagree 1	**2**	**3**	**4**	**Strongly agree 5**	***M***	***SD***
I think that I would be able to relate the content of short video clips (1-3 minutes typically) to the information I have read online or in books.	4.2 (35)	7.2 (60)	35.0 (291)	40.9 (340)	12.6 (105)	3.51	.949
I think that I would be able to take notes while watching a video on the computer.	4.7 (39)	8.2 (68)	35.7 (297)	39.4 (327)	12.0 (100)	3.46	.967
I think that I would be able to understand course-related information when it is presented in video formats.	3.5 (29)	6.0 (50)	32.0 (266)	41.3 (343)	17.2 (143)	3.63	.953

From the statistics analysed, 486 students (58.5%) agreed or strongly agreed that they would be able to understand course-related information presented in video formats. The area of lowest agreement was for their ability to take notes while watching a video on the computer. Here, an equal number of students agreed and strongly disagreed, 68 students (8.2%) in each category respectively. This seems to indicate that videos may be included in the module to present course-related information. Internet discussions also play a role in FC as students need to be able to participate in online discussions as part of the before class or after class tasks. (See Table 4.11).

Table 4.11

Results of Online Learning Readiness: Internet discussions

Item	Level of Agreement, % (n) Strongly disagree 1	2	3	4	Strongly agree 5	*M*	*SD*
I think that I would be comfortable having several discussions taking place in the online chat even though I may not be participating in all of them.	3.7 (31)	8.9 (74)	31.5 (262)	39.7 (330)	16.1 (134)	3.56	.986
I think that I would be able to follow along with an online conversation (e.g., Internet chat, instant messenger) while typing.	4.9 (41)	7.5 (61)	33.6 (279)	40.7 (338)	13.5 (112)	3.50	.982
I sometimes prefer to have more time to prepare responses to a question.	2.6 (22)	5.2 (43)	32.7 (272)	46.6 (387)	12.9 (107)	3.62	.870

In looking at their preference of having more time to prepare responses to a question, 494 students (59.5%) agreed or strongly agreed. The area showing their lowest agreement was for their ability to follow an online conversation while typing, with 61 students (7.5%) who disagreed and 41 students (4.9%) who strongly disagreed. This seems to indicate that instructor's presence may be needed to facilitate internet discussions.

In the dimension focusing on the importance of success, the items being assessed include regular contact with the instructor, quick technical and administrative support, frequent participation, prior experiences with online technologies and the ability to immediately apply course materials. (See Table 4.12).

Table 4.12

Results of Online Learning Readiness: Importance to your success

	Level of Agreement, % (n)						
Item	**Strongly disagree 1**	**2**	**3**	**4**	**Strongly agree 5**	***M***	***SD***
Quick technical and administrative support is important to my success in online coursework.	2.0 (17)	6.4 (53)	31.3 (260)	43.6 (362)	16.7 (139)	3.67	.899
Frequent participation throughout the learning process is important to my success in online coursework.	1.7 (14)	7.1 (59)	26.7 (222)	46.1 (383)	18.4 (153)	3.72	.901
I felt that prior experiences with online technologies (e.g., e-mail, Internet chat, online readings) are important to my success with online course.	1.9 (16)	5.8 (48)	30.3 (252)	42.0 (349)	20.0 (166)	3.72	.912
The ability to immediately apply course materials is important to my success with online courses.	2.2 (18)	5.2 (43)	29.4 (244)	43.0 (357)	20.3 (169)	3.74	.913

About 526 students (63.3%) agreed or strongly agreed that both regular contact with the instructor and the ability to immediately apply course materials are crucial to their success. The most crucial aspect of FC success, in their view, is frequent participation and this was noted by 536 respondents (64.5%). This seems to indicate that face-to-face lessons need to be planned well to ensure the concepts learned can be applied to solve problem-solving activities that requires active participation.

Besides the six dimensions of online learning readiness, an awareness of the FC approach is a pre-requisite for successful FC (Mohammed Amin Embi et al., 2014). From the 831 respondents surveyed, 561 (67.4%) were unaware of FCs. Results shown in Table 4.13 show that 699 students (84.2%) agreed or strongly agreed that face-to-face instruction should constitute between 50% and 90% of the course delivery while 284 of the respondents or (34.2%) were of the opinion that face-to-face should make up more than 90% of the course delivery. This is followed by 176 of the respondents or 21.2% who felt that the course should be delivered with equal portions of face-to-face elements and online learning. This seems to indicate that the lessons in the module should be designed with an emphasis on face-to-face session to ensure better success.

As for the respondents' preferred content format for online materials, statistics show that their highest preference was for materials to be delivered using *PowerPoint* with video explanations (35.4%), followed by the use of videos (27.9%). (See Table 4.13).

Table 4.13

Results of Students Level of Readiness in FC

FC Readiness	*n*	%
Awareness of Flipped Classroom		
Yes	276	32.6
No	560	67.4
Face-to-face (f2f) versus online		
f2f 90%: Online 10%	284	34.2
f2f 80%: Online 20%	87	10.5
f2f 70%: Online 30%	98	11.8
f2f 60%: Online 40%	54	6.5
f2f 50%: Online 50%	176	21.2
f2f 40%: Online 60%	31	3.7
f2f 30%: Online 70%	29	3.5
f2f 20%: Online 80%	13	1.6
f2f 10%: Online 90%	59	7.1
Content Format		
Text Only (PDF)	211	25.4
PowerPoint Presentation Only	387	46.6
Audio Only *(Audio recording of teaching content)*	118	14.2
Video Only *(Video recording of teaching content)*	232	27.9
PowerPoint with audio explanation	204	24.5
PowerPoint with video explanation	294	35.4
Animated video	198	23.8
Animated text	105	12.6
Text with Audio (*Notes with audio explanation*)	96	11.6
Text with Video (*Notes with video explanation*)	155	18.7

This seems to indicate the potential use of multimedia to demonstrate new knowledge especially key concepts to the students as highlighted by the First Principles of Instruction.

Part II: Instructors' current teaching practices

This section discusses the findings obtained to answer the first research question which is as follows: "What are the current teaching practices of the Culinary Arts instructors of Community Colleges?" Among the areas investigated were (i) instructors' current teaching practices, (ii) instructors' current teaching practices of problem-solving skills among students, (iii) instructors' current use of technology in their lessons, and (iv) the challenges instructors face in integrating problem-solving skills into their current teaching practices.

Profile of instructors. The ten instructors chosen were those currently teaching in the Culinary Arts programme of two Community Colleges of two different states in Malaysia. Students from Community College A were mostly from the urban areas whereas students from Community College B were mainly from the rural areas. The diversity of the instructors involved enabled this study to accumulate the experiences and viewpoints for a more in-depth analysis. (See Table 4.14).

Table 4.14
Profile of the Participants

Pseudonyms used	Community College	Sex (M/F)	Years of teaching experience	Years of industrial experience	Subject Taught
Faizad	A	M	11-15 years	2	Basic Western
Aleesya	A	F	6-10 years	1	Pastry and Local Delicacies
Raina	A	F	11-15 years	1	Malaysian
Zaharah	A	F	1-5 years	1	Art of Garde Manger
Aiman	A	M	6-10 years	8	Malaysian
Liyana	B	F	6-10 years	1	Basic Western

Pseudonyms used	Community College	Sex (M/F)	Years of teaching experience	Years of industrial experience	Subject Taught
Farhan	B	M	11-15 years	2	Art of Garde Manger
Qaseem	B	M	6-10 years	1	Art of Garde Manger
Aziah	B	F	1-5 years	1	Pastry
Munira	B	F	1-5 years	1	Pastry

Findings. The interviews with the 10 Culinary Arts instructors were recorded, transcribed and analysed. The five main themes emerging from the interview data are as follows: the use of the traditional Culinary Arts pedagogical model, the lack of instructional support to teach problem-solving, the students' preferences/needs, the students' skills, and the challenges instructors face in developing students' problem-solving skills.

Use of the traditional culinary arts pedagogical model. All the instructors mentioned that the Culinary Arts programme taught in Community Colleges consists of both the theoretical component and the hands-on practicum component. Their interview data are provided to support this claim.

> Ok, for the Certificate in Culinary Arts in this Community College, we usually conduct the programme in two modes. One is the practical mode where classes are conducted in the kitchen or workshop, and the other is the theory class conducted in classrooms… which are conducted in the lecture rooms we have. And mostly during practical, we are more to the demonstration, and for theory class, we use slides, [multimedia] projector…something that students can watch or view… Usually, during theory [class], no practical work is conducted… Just theory… (Munira, Line 6-12)

From the interviews, it was observed that five instructors from Community College A would allocate one full day per week (eight hours) to conduct the theory component. Since the allocated hours were long, the traditional lectures were conducted for a minimum of two hours. After the lectures, the instructors would give students assignments requiring to search for information to complete their tasks independently. After this activity, students were required to present their work to the instructors. Besides having one session a week to deliver the theory component, instructors at Community College A also slotted the theory component into their weekly schedule as a briefing before the hands-on practicum commenced in the kitchens. The following interview data are provided to illustrate the teaching method used at Community College A in an average week:

> …means, 16 hours, theory class is supposed to be like eight hours; total is 24 hours in one week…but, usually, the theory does not take eight hours *lah*… Because, what do you want to talk for so long, eight hours? [laughing]… Usually, I will try to make it like two hours like that and then that's it *lah*… some of the lecturers, they usually give some of the students to go somewhere else and let the students do group discussion, so they carry out the assignment this way…
> (Aiman, Line 8-17)
>
> Usually, we will slot theory during practical… we also have a separate time to conduct theory. (Raina, Line 36-38)
>
> … after three hours of lecture, then we give them tasks in groups, then we go to the library, then after lunch, [once] they have gathered their input, they present their work to me. That's my way; I don't just let students go like that. (Raina, Line 44-47)
>
> For this certificate programme, we mostly use demonstration. Before the demonstration, there is a bit of theory. In a week, we have three days of class; we will take one day for theory, then [the other days] are followed by practical [kitchen class]. In a day, our class is from 8.00am to 4.00pm. So, if the whole day we conduct theory, sometimes we have oral presentations… have to look for information, do group work…. (Zaharah, Line 24-32)

Although an eight-hour slot comprising theory and hands-on practicum was used in urban Community College A, the scheduling of classes was done differently in rural Community College B where lectures were conducted between two to three hours followed by a minimum of five hours of hands-on practicum in the kitchens, three days a week. Formative evaluations such as quizzes and tests were conducted during the theory component in the class, and this practice adheres to the programme syllabus. The following interview data is provided to illustrate the teaching method employed at Community College B in an average week.

> So, if on Mondays, class start with theory class first, for three hours. It is Monday, the first day of the week, so, coincidentally every time, the curriculum is set such, at the start of the week, we start a new topic. That is when we give the introduction, in a way, it is helpful. I prepare slides if there are extra materials like online videos, so we show it as an introduction. [I show what will be covered], like the whole week, what we are going to do, like Tuesday and Wednesday are practical [kitchen classes], five hours everyday, but for Thursday, like today, we have a hands-on practicum for five hours and [followed by] theory class for another three hours, so, [I] use the slide again, I compare, what I have shown to students' [at the start of the week and compare] to their end product… during theory, we also conduct the quizzes or tests as mentioned in the syllabus. (Aziah, Line 11-19)

Thus, instructor's current teaching practices consist of traditional lectures and hands-on sessions which are limited to demonstration and replication of hands-on techniques in the kitchen.

Traditional lectures: Ineffective in retaining students' attention. In many higher institutions of learning around the world, the classroom environment is still using the 'chalk and talk' method where learning is teacher-centred, and instructors still perform the role of the 'sage on the stage'. Observations of various classroom environments also indicate that most classroom time is spent on passive lectures which may be in the form of printed *PowerPoint* handouts or *PowerPoint* slides; lectures are also conducted in lecture rooms equipped with whiteboards only, also termed as low-tech settings. In such settings, instructors need to bring their laptops and portable multimedia projectors to conduct their lectures. Thus, their teaching resources may be said to be partially aided by technology. In some instances, instructors may also take the initiative to conduct their lectures in lecture theatres or computer labs equipped with computers and built-in multimedia projectors so that slides and videos can be used to draw students' attention and interest. This has been verbalised by instructors as:

> During theory class, we usually show *PowerPoint* slides… depending on the module, we are teaching… There are times we use videos… printed

> images…because students will sit in groups and we will display on the screen and explain each topic we are going to cover that day
> (Munira, Line 20-23)

The partial technology aided lectures followed by instructors' initiative to conduct lectures in computer-aided labs indicate that instructors are aware that traditional lectures where the instructor is the only one talking while the rest of the class listens, can be ineffective in retaining student attention. Hence, one can see the introduction of the *PowerPoint* slides and videos into classroom lectures by the respective instructors. In addition, the instructors also mentioned that traditional forms of lectures could also bore students, making them suffer from inertia. Evidence noted by instructors are illustrated below:

> Our students prefer hands-on, they don't like the theory part much, perhaps they are bored (Aleesya, Line 144-145)

> … because they are students, so when learning things directly from what is being displayed on the *PowerPoint* can be quite boring and makes them sleepy. So, we have to make a group. Make sure they do something that allows them to do things because it involves their psychomotor… to make it more interesting and not feel sleepy. (Munira, Line 103-106)

Thus, traditional lectures do not involve student participation, but students prefer class participation or being active and involved in the learning activities because this allows them to do something in groups when learning.

Modeling during traditional lectures. The idea of Modeling is an important element to consider. For instance, instructors noted that depending entirely on *PowerPoint* slides to conduct their lectures especially in low-tech settings can be equally ineffective in maintaining student attention. Here, instructors noted that using stories to engage students during lectures can be one way of overcoming this traditional method of conducting lectures. They noted that storytelling such as instructors sharing stories of the realities of the industry with their students could increase student motivation to listen. The instructors also expressed that their students' well-being was of utmost importance to them. They stated that it is their priority to inspire their students to be more involved in Culinary Arts, especially for those who lacked confidence. Among instructors who may have fewer years of experience in the real-world, the experiences of their friends in the same industry are also shared, as expressed below:

> Usually, during theory class, I don't usually read the notes or the slides out… I tell stories… experiences… We tell stories based on our experience or our friends' experiences (Aleesya, Line 147-150).
>
> If we were to see, when they first come in, they do not understand the work routine required in the industry, they will have to stand for eight hours. They don't understand, so, I have to tell them stories on my experience working when I was studying, which is different from now. If we were to sit for a while, we would have got a chopping board thrown at us, but, students nowadays, you can't do that. Once they get home, they will complain. So, I tell them that, "here does not reflect the real-life of being in the hotel industry. If you really want to find out what it is like, you will have to go for your industrial attachment and see what it is like, here is just a fraction of the real deal, but the real deal of being in the culinary field is at the hotel kitchen. That's when all of you would not even be able to sit around, when you work, you can't be afford to be sitting around, you'll be running around here and there, preparing food for events, other than that, have to watch a lot of shows on food, whatever is related to culinary". Initially, they don't understand; they complain that they are exhausted, the kitchen is hot and all… but, we will tell them this is the reality of the industry. (Raina, Line 254-265)

It appears that using stories as a teaching strategy can be one way of inspiring students to be engrossed in the course. This strategy helps students to visualise what the world outside is like based on the experiences shared by their instructors as some of the students may not have the opportunity to visit places dealing in the same industry because of financial constraints.

Modeling during the hands-on practicum. The teaching component in the Culinary Arts programme that seems to be most valuable for the students is the hands-on practicum which involves personal involvement and hands-on experiences in the kitchen, which helps students to develop their cooking skills. The instructors also noted that more weight is given to the hands-on practicum as compared to the theoretical component as outlined in the syllabus. Illustrations are also provided by the instructors:

> Based on skills *lah*… skills are 80%, and the balance 20% is more to theory… (Raina, Line 36-37)

> So most of the time… because [it] is culinary… is spent in the kitchen *lah*, doing all the practical training in the kitchen. (Aiman, Line 3-6)

During the hands-on practicum, the teaching method applied was described in the same way by all the ten instructors. After a short briefing which attempts to introduce the students to the lesson, the instructor usually demonstrates the procedures to prepare a dish. Students then go to their respective workstations to replicate the steps shown by the instructor, step-by-step. At the end of the hands-on practicum session, instructors brief students again, as a means of concluding the lesson. This procedure was also illustrated by the instructors involved.

> So, usually, instructors will do the product demonstration first. So, students will be able to watch. After that, students will have to replicate. (Liyana, Line 11- 13).

> If we conduct demonstrations, we demonstrate, one by one step, after that student will replicate…(Farhan, Line 86)

> "In the first hour, I will brief them, about the menu and all, after they have understood [what to do] and get into their groups, they will take the tools and equipment and divide it among themselves… after that, I will call all of them back to [watch me] demonstrate, for example, there are seven items, I will demonstrate one by one. They will go back to their groups and do just as I taught them to (Raina, Line 132-136)

It can be seen that the teaching method employed is similar to the traditional culinary pedagogical model which follows the "instructor briefing-instructor demonstrates-student replicates-instructor debriefing" flow of instruction.

Scaffolding during the hands-on practicum. Scaffolding means providing some kind of protection to an internal issue from the external factors. In the case of the instructors' interview, it was noted that when it was the students' turn to prepare the dishes, instructors normally become more active as they walk around the kitchen, from table to table, to oversee their students' performance. Their movement from table to table serves as a scaffolding for the students because, as they move around, they will observe and provide feedback to the students until the students complete all the tasks required. During the movement, instructors usually provide explanations, and they may demonstrate to the class again if necessary, on what needs to be done. Thus, as the instructors move around, they can also observe and give feedback through continuous knowledge supervision and critique. Illustrations from the instructors are provided:

> During the lesson, I will walk around… in each group… what they did not understand, I will explain it again… (Raina, Line 136-138)
>
> Sometimes, they cannot follow what I have been [sic] demo. Either they are going to forget to put something… the step… the method… you ask them to deep fry; they do something else, they *rebus* (boil) it. [laughs] (Aiman, Line 327-328)
>
> …for example, they made a cake, and the cake did not turn out well or did not rise well, I'll ask, "did you put this in just now?... did you put this in?"…"Ah yes, I forgot to add it in," usually our students are like that…. (Aleesya, Line 64-66)
>
> The problem with our students… even when we already demonstrated, they've already tasted what we cooked, [they say],"Madam, it is so tasty!", but when I go to their place, they don't even replicate the way I have taught them, even though I have already demonstrated to them. (Raina, Line 181-182)

Ongoing coaching and scaffolding play an important role in such classes. This too has been pointed out by the instructors who noticed that some students might face struggles in replicating the steps or the specific cooking methods to produce the particular dish despite watching demonstrations earlier.

Coaching when students present end product. Coaching is the activity of asking students the right questions to stimulate their awareness in realising what needs to be done correctly should a situation arise. Coaching does not critique or scold. In general, this activity would be conducted toward the end of the hands-on practicum session, when students present their end products created during the demonstration-replication session, to the instructor. During this activity, instructors would assess the end products by checking on whether these products meet the standard and fulfil the instructors' expectations. If the end product fails to meet the standard required, the instructors would then try to troubleshoot by finding out from the students the possible cause. Here, the instructors posed questions to the students until they are able to point out the mistakes that had been committed in the process of creating the end product. This is traced to the interview of two instructors:

> Once their work is finished, right?... we put all the products in front of us. [I ask] what is the problem here? Why is the bread too brown? Why isn't this darker brown? So, students keep on guessing… maybe the temperature was not high enough… So, they keep telling us what are the possible problems that arise during the process… (Munira, Line 221-224)

> As usual, we would check the product… the end product, give marks after that, then let's say their product did not turn out well, we will explain… we would trace… why it happened… usually, I'll ask why *lah*… for example, they made a cake, but the cake did not turn out well or did not rise, I will ask, "did you add this just now?.. did you add this?"… "haah… I forgot to add that in", usually that's how our students are… or other students kept opening-closing the oven; pastry products are sensitive [to temperature]… which may result in the product not turning out well, so we will trace the mistake too, after that, we will explain why it happened like that… bread, for instance, the bread did not turn well… we will tell them maybe the bread was overproofed, he let the bread rest for too long, so it went out of shape… it is like that… (Aleesya, Line 62-70)

Earlier, it was mentioned that during the hands-on practicum, the instructors would normally hold a briefing before the session and a debriefing after the session. During the debriefing session, instructors conclude the lesson by giving feedback and critique. At this phase, instructors may use words of reproof to highlight the mistakes made by the students to raise their consciousness. This approach is meant to motivate the students to perform better in the next round.

> Usually, before the class ends, we would recap what they have done. If there were mistakes, we tell them where the mistakes were and what should be done so that it would not happen again. (Qaseem, Line 95-97)

> We conclude [the lesson] *lah*… according to what they have done daily… I think we give them motivating words and some words of reproof so that they are made aware of their own faults… We can't be praising them all the time, right? [laughs] (Farhan, Line 91-97)

The use of written reflections was also mentioned by one senior instructor who indicated that some written reflective exercises were expected from students at the end of the hands-on practicum session. As an instructor who trains students for competitions, he mentioned that his students need to include printed pictures of their end products also accompanied by their comments on "what needs to be improved". These are included in their Student File.

Fading during the hands-on practicum. Among the instructors interviewed, one mentioned that she took her own initiative to employ the "mystery box" activity where students had to create new products based on the ingredients available. This activity stimulates student autonomy and encourages independent learning. From this activity, students need to create various products such as cookies and cakes just by using the same products. However, the "mystery box" problem-solving activity was seldom employed as it was not part of the syllabus. It appears that completing the syllabus was of utmost priority; hence, such activity was only employed as a strategy to clear the stock in the chiller, as she illustrated:

> I have done that *lah*, that usually depends on the items we have in the kitchen, so there are these raw ingredients I leave on their table, so they have to think what to do with it, but it has to be parallel to what is in the module, so, they can do it, some made cookies, some made cakes… I have

> done that. We can’t do that often because we have to follow the module given and we need to finish the syllabus… (Aleesya, Line 132-138)

In this section, it can be seen that the teaching method employed is similar to the traditional culinary pedagogical model which follows traditional teacher-student relationship, the model which is based on a one-way communication involving modeling, coaching, scaffolding and fading.

Lack of instructional support to teach problem-solving

Curriculum guides. Curriculum guides refer to the Certificate in Culinary Arts curriculum provided by the Department of Community College Education (DCCE) since 2011. This curriculum structure, syllabus, and notes were supplied to the instructors only as a guideline for conducting their weekly lessons. This implies that different instructors may take a different route to teaching. This was expressed as: “…depend on us *lah*, it is up to us” (Raina, Line 360); “…that is the creativity of the instructor *lah*” (Aleesya, Line 166). This lack of uniformity was a concern among the instructors because the lack of uniformity can affect the skills acquired by students since different teaching methods influence how learning takes place.

Instructional materials and resources. About the availability of other instructional materials and resources instructors can use to support their teaching, it was mentioned that instructors had to look for other resources beyond the programme structure, syllabus and notes supplied to them. However, there is flexibility only to do so when these resources do not diverge too far from the existing module. It was also mentioned that if curriculum materials were not provided to instructors, a high variation between what the curriculum specifies that students should learn, what instructors teach, and what students learn would occur. This may be detrimental to the students.

> No…usually we have to look for it ourselves… They only provide the programme structure, syllabus, notes from the DCCE, so we teach according to the notes given… usually, the instructor teaches more, according to their creativity as long [as] it does not diverge much from the module (Aleesya, Line 236-240)

As noted before, since traditional lectures play a significant role in the current teaching practices of the instructors, there was a note of conscientiousness being expressed by the instructors; they were aware that they need to make their classes more interesting. Providing *PowerPoint* slides as one means to deliver the syllabus contents was one way. It was also highlighted that a group of Culinary Arts instructors had been assigned the task of preparing *PowerPoint* slides as instructional materials. These would be compiled and then forwarded to all the Community Colleges offering Culinary Arts as a programme. The evidence is traced to the interviews:

> Like last year, I think, there were several lecturers from specific Community Colleges who were assigned to create *PowerPoint* slides [for the programme], and then they compiled it and blast it to all the Community Colleges. So, our materials are just those *PowerPoint* [slides], that's it. However, in *the PowerPoint* [folders], certain lecturers did download videos, so there were videos of knife skills, basic vegetable cutting, but that's about it. So, my style is, I use them as a guideline for what I should teach and the rest [of the materials] I read on the Internet. (Aziah, Line 280-284)

> The *PowerPoint* [slides] are from DCCE; they have already prepared the notes according to the syllabus… they have called [Culinary] lecturers from the whole of Malaysia to compile notes for the subjects. We just follow the guideline from the *PowerPoint*. (Zaharah, Line 279-281)

> I had to do for the Western [cooking] subject. So I have done the *PowerPoint* [slides] actually. So the things we prepared were distributed to all the Community Colleges offering the course. Western [module] is quite big, so there were three persons in charge of [the] Western [module]. Me, then one lecturer from Community College C and Community College D. But for me, making notes in three days is not enough. There is so much to cover… the notes are not sufficient… and there are so much of changes in the syllabus (Aiman, Line 718 -735)

It was further stated that when such *PowerPoint* slides were received, instructors did not make any amendments to the digital copy of the *PowerPoint* slides. They were only expected to use them as is. In most teaching practices, the slides were printed out and then distributed as handouts to the students during lectures. Any additional information to be added to the slides would be indicated by the instructor who will then instruct the students to write down the extra information on their printed handouts. Students were also urged to keep these notes in their Student File for record keeping.

> I will use it as it is, so if there is any new information, students have to write it down, I would not type it on the slides… if there is any new information or new technology or any new information, they will note it on the slides. (Zaharah, Line 283-285)
>
> I don't think anyone is producing their notes because we follow the HQ directly, so we just follow them directly. If there is any additional information, they will jot it down manually on the notes. The notes will be filed in student files (Zaharah, Line 288-290)
>
> Usually, some additions need to be done [to the slides]. We will tell the students, "Ok, this is extra, you write it down". So, we will add this [extra information] to the notes, but we don't add anything to the *PowerPoint* slides. Usually, we add to the notes. (Munira, Line 81-84)
>
> Some we use, some we don't (sic)… depends on the suitability. We will look at it and do it… print it out. (Farhan, Line 329-333)

Assessments. In the Culinary Arts programme of the Community Colleges, examinations and other assessments such as quizzes, tests, and practical tests are standardised. They are also made available online by the DCCE. One instructor who is also the Exam Unit personnel for the Culinary Arts unit in her college mentioned that all related assessment documents had been deposited into the "Electronic Question Bank" system which can be retrieved online by the Exam Unit personnel in their respective Community Colleges. Currently, all the ten instructors are using the standardised quizzes, tests and practical tests in their teaching activities. Quizzes and tests are conducted during the theory class sessions whereas practical tests are conducted in the last lesson of each module.

> … test questions…they are from the bank (Farhan, Line 72)
>
> Of course, each learning area has its quiz, oral presentation, and assignment [to be given to students]. Hands-on practicum assessment is during the class, whereas quizzes and assignments are usually conducted during theory class… (Raina, Line 105-109)
>
> If the curriculum outlines quiz, we will do a quiz, if the curriculum outlines assignment, we would [have them] do the assignment, if there is an oral presentation we would [have them] do oral presentation, if there are practicals, they do the hands-on practicum (Qaseem, Line 87 – 89)

Accordingly, student assessment is conducted at the end of the second day of the hands-on practicum session. Marks given by the instructors are individual, based on a set of rubrics also provided by the DCCE. The rubrics not only assess students' end products but also other skills such as teamwork ability, punctuality, discipline, hygiene as well as sanitary practices.

> There is a rubric, given by the exam unit. The rubric usually evaluates the hygiene and sanitation, kitchen safety and end product… the understanding of the product… how the product is produced for example was the right timing used, was the right tools and equipment [used]? (Munira, Community College B, Line 203-207)

Since all students keep a Student File, all records of their notes received and all assessment-related documents are expected to be preserved in their individual files. After the instructor fills up the rubrics for each student, the rubrics are maintained in their Student File:

> "Each student has to have a file each." (Zaharah, Line 291)

In the Culinary Arts programme, students were expected to complete their assignments which may be individual or group, during the theory component of their classes. Undoubtedly, oral presentation skill is one of the communication skills being assessed as it is a skill extensively employed in both Community Colleges. Thus, it is also a part of the course assessment, and this is also mentioned in the syllabus. The instructors acknowledged that the students genuinely struggle to produce quality work in this regard. One comment was: “I expect [them to provide] examples which are not in the textbook, and I don’t mind if it's not that accurate, I just want them to seek [for the answers]!” (Faizad, Line 230-231).

Instructors mention that students usually “copy and paste work from the Internet” (Aleesya, Line 49-50) and “regurgitate the same thing” during presentations. (Faizad, Line 223-224).

Student preferences/needs. Another theme emerging in the interview data of the instructors was about how the instructors considered their students’ preferences and needs when implementing their classroom teaching practice. It was noted that students’ preference could be classified into four sub-themes of active learning activities instead of boring lectures, the use of visual media to deliver information, the use of smartphones as a tool to deliver materials and resources at low-tech settings and the use of smartphones as a platform to enhance student-instructor communication.

Prefer active learning activities instead of boring lectures. It was mentioned earlier that lectures could be overwhelming and boring for students as instructors’ cram in as many slides as possible in their lecture sessions. It was also mentioned that storytelling would be one way to deal with this issue. Another thing noted by the instructors was to chunk the slide presentations. This was performed by one instructor who described how she alternated lectures between quizzes and active learning activities such as word search games. From her experience, she noted that students preferred active learning activities more than lectures because they get to do something instead of passively listening to the lectures.

> … Halfway of my class, I would do a quiz; sometimes I play Word Search, something related… games… because they are students, so when learning things directly from what is being displayed on the *PowerPoint* can be quite boring and makes them sleepy. So, we have to make a group. Make sure they do something that allows them to do things because it involves their psychomotor... to make it more interesting and not feel sleepy. Because hands-on practicums are tiring. So, before going for hands-on practicum class, we make sure that they have an idea of what to do during class. That's better *lah*, because, for pastry [theory] class, it is four hours directly, you know? Sometimes, three hours directly, so [it is] quite boring. Let's say there are 85 slides; you have to break it down, maybe in three hours… 20 slides in the first hour. Then, break for ten minutes. After 10 minutes, we come back to do another quiz perhaps. Usually, I'll play word search, because word search lets you do something.
> (Munira, Line 103-112)

> Because my students, this time *lah*, I realised that they like things that use their skill. When you read out, they seem to get it, but when you ask them the next day, they have already forgotten. So, when you do a word search, they have to look [for something]. After that, they will ask, "Madam, what is this… what is this?". So, they become more curious…
> (Munira, Line 114-117)

Since students may forget what they have learned from the lectures, hands-on learning activities such as word search help to engage student attention, and when this is applied, it also increases student curiosity.

Use of visual media to deliver information. Visuals refer to the use of materials that can be seen and media refers to the use of technology. In this regard, an instructor who cannot manage this delivery method is going to be a disadvantage to the students. "I am like a dinosaur you know [laughs]… the dinosaur teacher…" (Aiman, Line 75-76).

The instructor's reference to himself as "the dinosaur teacher" clearly indicates his awareness that he has not been up-to-date. It was apparent that using technology in class is important for students to visualise concepts. This is mainly because students do not like to read for information, as noted by several instructors. Thus, most instructors tend to use the Internet to gather visual-based instructional materials. As for where those sources of materials were gathered from, the instructors mentioned:

> Nowadays, it is more easy [sic] to use technology, right? You can just use *YouTube* and show… (Aiman, Line 71 – 74)
>
> Just show the slide *lah*…and the video when we give the theory part, we bring them to the lab, and then show them the video… (Liyana, Line 251-252)
>
> I will download from *YouTube*, something from the CD supplied in books, for example, the book by Gisslen, comes with a CD. So, anything related to your teaching and learning, you must download and show. (Munira, Line 492-494)
>
> I get information from the Internet, from reliable sources. Sometimes, I show it to them. They get excited! (Liyana, Line 265-267)
>
> I get it from the Internet, either from *YouTube*,[where] I download it or get it from friends who pass [the videos] around (Qaseem, Line 74-75)

Visual-based materials were used in addition to the *PowerPoint* slides supplied by the syllabus. It was emphasised that the instructional materials commonly used were relevant videos and images downloaded from the Internet because they were considered as helpful in delivering the theoretical concepts in addition to their hands-on practicum sessions. The use of videos was better noted in comparison to still images. Examples of videos enabled the students to capture the understanding of real examples such as the equipment and tools used in the industry, based on the demonstrations of professional chefs. The instructors believed that video use could motivate their students better besides sparking more interest in the culinary industry.

> In the form of graphics, video… Usually [I] show videos because images do not move. So, something that moves in reality, how? You have to show a movie or something that moves. So that when they go for industrial attachment or hotels, they won't be surprised to see the thing (Munira, Line 487-490)

> If they just read it, it's difficult to grasp, so they have to watch demonstrations on how professional Chefs do it, [on content] that matches their syllabus (Zaharah, Line 46-47)

> Ermmm, sometimes I put videos on, but not that frequently, depends on the module itself. It helps to inspire them… motivate them… so that they'll know what to do. So, using videos helps to spark their interest to do something… (Qaseem, Line 66-72)

Besides videos, infographics may also be used because they are attractive and can help students to sum up fundamental concepts more quickly. Students preferred this as compared to a list or mind map. The following quote illustrates:

> I love looking at graphics, so, I love downloading infographics, as it summarises everything. Students prefer it more than us making a list or doing a mind map in black and white; not all students can [visualise that way]. The infographics contain well, like the ones I have, vegetable cutting, it has everything about French cuisine, with correct size, infographics on pie versus dough, infographics about metric conversion, from *gram* to *ml* and I am crazy [about] infographics or pictocharts (Aziah, Line 280-292)

As can be noted from the interviews, visual-based materials were judged to be better and more effective for students in the Culinary Arts and the materials used tend to be taken from the Internet.

Use of smartphones as a tool to deliver materials and resources in low-tech settings. Although we are currently in the new millennium that is surrounded by more advanced technology, it is sad that technology use in the Culinary Arts classrooms is still limited. One major barrier is the lack of on-campus technological facilities. To address this inadequacy, some instructors opted for the instructor's preparatory room which is equipped with computer and speakers, as a means of using technology such as videos, to teach certain concepts. This was highlighted by Aiman:

> I rarely use videos during [theory] class… but, in the kitchen, during practical *lah*… inside the instructor's preparatory room, there, I show them the videos… supposed to bring [multimedia] projector and all, but that's my problem *lah*… I am lacking [in using technologies]… (Aiman, Line 71-73)

Besides the lack of technology in the classrooms, it was also mentioned that students were not given the liberty to access the computer lab unless under instructor supervision. As a result of this lack of technological support, some instructors also take the initiative to book lecture theatres equipped with audio-visual facilities. However, there is another challenge to this. "There were red tapes to follow" (Qaseem, Line 80). "Sometimes time… facilities… it is not that there are no facilities, but you know *lah*, have to book here, book there…" (Aiman, Line 663-664).

The other option resorted to by instructors is to bring technology into the kitchen because the kitchens are in the low-tech setting category. This proactive move may be impractical because it may not be conducive to have a kitchen equipped with multimedia projectors and laptops. Moreover, there could also be other hazards attached to technology use in the kitchen. Munira and Aziah said "…. just use what they have" (Munira, Line 512)

> Like in the kitchen, if we want to display videos, we have our limitations. We don't fix [multimedia] projectors or do we have computers; we don't have those. I have thought of bringing that equipment, but, I don't think it is proper… it is a working area, kitchen some more [sic], with gas and sharp things… (Aziah, Line 100-103)

Since smartphones are also high tech these days, instructors have also mentioned using smartphones coupled with the availability of free *Wi-Fi* connection in the campus for the sake of their students, especially if they want to make classes more interesting.

> … they just show me on their phone. Print screen everything, screenshot everything, and then they will ask, "Madam, is this the one? Is this what you are talking about?" … I will be like, "Yes, yes…" (Aziah, Line 34-35)

> Because we spend long hours in the kitchen and there is a limitation in bringing technology [into the kitchen] right? The simplest way is to bring our phone, "Haaa, look at this video!" … on my five-inch screen handphone (Aziah, Line 270-272)

> Students can use the computer at the lab but under instructor's supervision. There is *Wi-Fi* here. Most of them are using very advanced phones. Usually, in the class, I tell them to browse [the

> Internet] through the phone for the following terms (for example) …. So, they will browse and let me know. We are not like in certain universities…. You have one PC for one student, right? However, here no, so you have to use whatever it takes *lah*. What we have, we use it, utilize it! It is very easy to access smartphone using *Wi-Fi* which is free (Munira, Line 507-516)

Use of smartphones are feasible as smartphones were readily available can also be used as an audio-visual aid within low-tech settings such as a kitchen.

Use of smartphones as a platform to enhance student-instructor communication. As mentioned earlier, since smartphones also contain many functions, they can be used as a means to connect lecturers with students using the mobile instant messaging app, for example using *WhatsApp* on occasions when students have questions to ask or to share videos.

> The easiest is *WhatsApp*, they have a *WhatsApp* group, so they can ask whatever they don't understand through that… Usually, I'll respond *lah*… (Aleesya, Line 217 -222)

> For example, when I asked them to look for videos, like the previous hands-on practicum class, I asked them to look for videos, they shared for everyone to see in class...I would give brief explanations, "this is the method of…" for example a video on making muffins, so we tell them that, "there are several methods of making muffins, the one shown in the video is the all-in-one method", so they would say, "ooo"…It is like that *lah* (Aleesya, Line 224-226)

Smartphones seem to be used as a platform to conduct mini classes, especially using mobile messaging apps such as WhatsApp.

Students' skills or their lack of it. Another theme emerging from the interview data was the way the instructors viewed the level of their students' skills or their lack of it. From this aspect, eight sub-themes were identified including: poor content comprehension and knowledge retention to solve related problems, lack of language proficiency, not ready to join the industry, inability to solve problems caused by mistakes, inability to solve problems caused by changes in situations, inability to perform basic calculations, poor articulation skills and lack of creativity.

Poor content comprehension and knowledge retention to solve related problems. The students in the Culinary Arts programme of Community Colleges had some inadequacies. Among these, the main one was their poor content comprehension and poor knowledge retention in solving related problems. The instructors pointed out that the students' poor problem-solving skills were their main weakness. When asked how they would inculcate problem-solving skills among their students, one instructor mentioned:

> [Through] their knowledge *lah*. Knowledge is what they are learning that one if they have the knowledge, they can solve problems, if they don't, they won't be able to solve problems. (Farhan, Line 158-160).

Specifically, students' poor content comprehension and poor knowledge retention may cause them to become incompetent in some basic skills required of them.

> There are cases where only some students may not be able to prepare the sauce they learnt during their first-semester when requested by the instructor in Semester 4. (Farhan, Line 118-120).

> If I just tell the theory of cross-contamination, they will just look at me; they don't understand… so, I better provide examples… "Owh, that's cross-contamination", they will understand better. During practical class, I tell them again *lah* [giggles], for example, when they clean the kitchen, chicken must be kept in the freezer, vegetables in the chiller, they can put the chicken in the chiller next to the vegetables as it may cause cross contamination, it is like that, I have to tell them many times [giggles]. I have to tell because they need to be reminded all the time, else they will forget, right? (Aleesya, Line 205-215)

> … It is normal for students, in two weeks, if we were to ask them [what they learnt on their first lesson] they can't remember, try asking them basic vegetable cutting [taught in Semester 1], as for them during Semester 2, they can't remember… I can't be showing that every day, right? (Raina, Line 352-355)

> There is a problem when students have forgotten [what they have learnt]. For example, how to fillet a fish… they have learnt it during their first-semester, they apply it during their second semester, then, during the third semester, they don't apply it. (Qaseem, Line 166-168)

> In the recipe, unsalted butter is used, so you need to reduce the salt as we are using salted butter, I still have to remind them simple things because of things like that sometimes, they need to reminded… again and again… So, I have to be honest; I can't be telling you that they can think. (Aleesya, Line 80 - 90)

It was emphasised that the students' poor knowledge retention caused them to come unprepared to class. To overcome this issue, the instructors mentioned that notes would be handed to their students at least a week earlier to ensure that they read and understand before coming to class. About this the instructors stated that their students were lazy to read; consequently, they were often unprepared for classes.

> The problem is when you have already given [the notes and the recipe], they don't read it, and when we explain, they will ask, "Is it there [in the notes]?" … They don't know that the ingredient exists in the recipe. If they read, it is OK. Sometimes… it is normal… like the notes I gave two weeks ago, they never bother…sometimes, they don't read it. Give it a month earlier… [would not make a difference] … (Aiman, Line 284-288)

> Usually… Community College students do not come prepared… (Faizad, Line 194)

> The usual notes itself, they do not read. They are the type who are lazy to read, so I tell them to gather images instead. (Zaharah, Line 310-311).

> Lecturers have given their best, but sometimes, they don't even read the notes we have given. They can't remember [what they've learnt]. So, sometimes, that is the problem. (Munira, Line 312-314)

As there are two sides to a story, it is inevitable that there will also be some students who are serious about their classes and they would come prepared. As a result, these students were the ones who were more likely to engage in creative problem-solving needs. This was recalled by one instructor whose student was able to provide an alternative way of decorating the shortbread cookies during her class. It was apparent that the student had looked at the notes given before coming to class.

> I made Scottish shortbread, just a simple shortbread, then a student asked, "Madam, can we roll the shortbread in castor sugar?"… He remembered because he did his revision before class. (Aziah, Line 242-246)

Lack of language proficiency. The next theme gathered from the instructors' interviews was the issue involving students' low proficiency in both English and Malay. This was noted by one of the instructors: "their English is not so good, even their Malay is not so good, although they are Malays…" (Line 39).

Class activities were mainly conducted in both English and Malay. This is because the instructors were aware that their students' low English proficiency could only be supported by another language that is familiar to them, Malay. Consequently, classes conducted tend to be bilingual as a means of increasing student understanding of the course contents. However, when using culinary terms which were mostly French or English terms, the terms were emphasised as English or French and not translated into Malay.

> I do it in both languages… It is because of our students… one of the weaknesses of students in this college is their English proficiency. It is very evident. I am not sure about the other Community Colleges, but regarding English proficiency and use, the problem is quite … we can say it is quite bad… Most of them do not understand the related terms. Maybe it is because of the lack of reading materials. So, from there we know we need to do something with [sic] using English. So, most of the quizzes are in English. Most of the culinary terms are in French and English. Sometimes when we translate [into the Malay language], it doesn't mean the same. So, most of it is still in English. So, we explain to them, ok, this term is pronounced how [sic]… the meaning [of the term] (Munira, Line 123-130)

> Yes, [activities] must be done ... bilingually. Because if it is only in English, they might not understand it, so you have to explain in Malay. Seriously, because we have tried. We have put terms in English… what is planning …what is proofing… They will give a puzzled look. So, we have to explain *lah*… (Munira, Line 136-140)

> Language *lah* actually (sic), actually teaching Culinary right, we must use the Culinary terms when teaching, it is better not to translate unless you are cooking Asian or Malay cooking. Because Western cooking, is from classical French cooking, and sometimes there are terminologies in French and English, so, I always remind my students, don't ever translate it *lah*…. (Aziah, Line 298-301)

As evidence that culinary terms need to be maintained in their original language just like how they are used in the industry, students were expected to acquire these terms correctly; because if they were unable to use the proper terms when they join the industry, they would become the laughing stock of their colleagues.

> Blind baking, don't tell me we want to say *bakar buta*, right? Blind baking is like putting rice, or paper or some weight on your dough, [there are] some terms you need to know, because there are some books translated into Malay, it seems it is so that students can better understand, but when you go to the industry, do you think anyone will be using the translated terms? You'll be their laughing stock [laughing] (Aziah, Line 298-308)

Not ready to join the industry. In the Culinary Arts, students were required to go for industrial training attachments for six months after having completed four semesters of the programme. During their industrial training attachment, it was observed that every batch of students had different issues to deal with, but the main issue highlighted involve mainly their critical thinking skills. The instructors noted that the students' performance on operational tasks was commendable, but their communication and critical thinking skills were not.

> Employers mentioned that the last batch [of students] were very good. It's just that they also said, "They can do the work, but can't do [sic] critical thinking". Employers said our students are good in terms of doing the task… operational tasks are OK… Can give an A; but then, in terms of communication… in terms of critical thinking, they have a lot to be improved. (Munira, Line 305-309)

It was noted that the students lacked in higher order thinking skills; thus, when they faced problems in the course of their industrial training, they were unable to solve them. The instructors admitted that this is probably caused by the students' lack of ability in remembering what they had learnt before. The poor performance of students during industrial attachment had tarnished the name of the institution because employers blamed the institutions for not preparing their students well in advance before joining the workforce.

> The student themselves can't think beyond; they become stuck. That is the problem. Sometimes, they can't even remember what they have learnt. The employer does not blame the student. They keep on blaming the institution,

right? The institution did not teach whatever it takes (sic) for them to perform better. That's the problem (Munira, Line 314-317)

For culinary… usually, employers are looking for those who are competent… complete… You can speak, you can work, you can think! This means, let's say a customer asks you to prepare something different. So, you have to think… How to do that? What does it take? How to handle? Who to ask? At times, our students panic! So, it's like that they do not know what to do. Perhaps, they would have already covered in during class. (Munira, Line 319-323)

….one more thing, we need to prepare them for industrial placement… it is our responsibility… when they go for their industrial training, they won't ask them what have you studied? They'll just ask where are you from? So, there is already a bad reputation there (Zaharah, Line 163-167)

… because we are training these students to remain in the industry, so, if we don't prepare them for what is happening in the industry, pity the students… (Qaseem, Line 238-240)

Inability to solve problems caused by mistakes. The next theme identified from the interviews was the students' inability to solve problems related to Culinary Arts. This was evident as instructors had few instances to relate where their students were able to solve problems related to Culinary Arts. Instructors who were teaching pastry and local delicacies in the third semester shared some instances where the students manifested a low ability to solve problems.

Aziah's third-semester students gave her the dinner spoon instead of a measuring spoon to measure one teaspoon of salt, to which she said, "You are already in semester three, you should know better". (Aziah, Line 148).

Even if there are those who can solve problems, maybe it was due to reason that they already had some working experience, but those SPM school leavers who are fresh from school, it may be hard for them, because even in semester three [they still have problems solving problems]…
(Munira, Line 249-251).

Erm… truthfully, the current batch, frankly, only 20 to 30% that are able to solve problems, some of them can't think, you know?
(Aziah, Line 130-131)

… for example, something was baking inside the oven, then I asked, "Why did you not put it in?" You just have to put it in, let's say there are 20 minutes left, do, let's say your cake has to bake for 40 minutes, you put

> yours first, then you continue to add another 20 minutes. The student could not think that way. The oven deck is long, with just one tray inside. The other classmates were waiting for the other items because they thought, they were not allowed to open the oven. Those are the things we think we need not teach, but we have to teach. (Aziah, Line 158-163)
>
> OK, let's say you have told students that they can use the lower deck of the oven if they want to be fast. However, if let's say you have forgotten to inform students that they are allowed to use the lower deck of the oven, they do not have the analytical thinking or critical thinking [mind to enquire] … "Ok, we should ask Madam if we can use the lower deck of the oven". No! Still not yet, because their problem-solving's inquiry is not there. They just follow whatever you say. If you say A, they will do A; if you say B, they will do B. (as observed by Munira when they were pressed for time during a pastry class, she noted that students were still waiting for instructions from the instructor, regardless of the situation. She observed: Line 251-256)
>
> If you are in the field, you are working, during practical [training]… if you are at the entry-level as a commis or cook, it is your job to receive, take the product, to put in the store, to put in [according to the] "First in, First Out (FIFO)" system [you] just don't put whatever you like into the freezer, you don't put vegetable in the freezer. You might say… "they should know already know that, but as I said, don't have high expectations for our students… Sometimes they put [it] in [the] wrong place… For example, they put vegetables in the freezer". (as observed by Aiman, who teaches Malaysian Cooking, students lack "common sense" as knowing what to do. He states, for example, Line 143 – 150.
>
> For me… yeah, *lah*, for us the adults, it is "common sense" *lah*, but sometimes, they are not used to this, they are quite young… they rarely do work [at home], so they don't know… (Aiman, Line 151-153)
>
> For instance, during Malaysian cooking, they will put the wrong thing in, for example, we have asked them to add salt, they add in sugar, and then, they do not taste it, they just add it in… we are the ones who have to taste it! Our students usually do not taste their food, they are supposed to taste it, but the problem is, they just add in things, without even tasting it! (as observed by Raina, who is also teaching Malaysian cooking, who says that students do not even taste the food that they are cooking, Line 284-289).

Instructors noted that students had poor content comprehension and poor knowledge retention which resulted in poor problem-solving skills.

Inability to solve problems caused by changes in situations. The instructors also noted that their students were unable to deal with the unexpected, for example, when there is the substitution of ingredients used. These students were additionally, incapable of using their "common sense" in a normal situation such as being unable to justify why a sauce lacks the right consistency.

> Their problem-solving skills are still lacking… They still depend on us, for example, when the ingredient is not available, so what to substitute with, they will still refer to us. When the bread improver is not in stock, they will go blank, you know… (Aleesya, Line 85-90)

> For example, they are making the sauce, and the sauce becomes too thick… they will be like…. Urmmm…. I am the one who has to tell them…. "If it gets thick, what to do? So, you have to add a bit of stock to dilute it?". I still have to tell them, even though, when we ask them [verbally], "What to do if the sauce is thick?". They can answer… but, when it comes to practical, they always forget! It's like they will get jammed!... so, they will call you and ask, "Madam, what to do now?". So, I'll have to show them…. "If this happens, you have to take some stock or liquid, to dilute the sauce a little…" It's like that *lah*… (Aleesya, Line 94-100).

> They like… they have to wait for me to solve the problem. "Sir, is this ok?", "Sir, it is too salty, what should I do?". You don't laugh; this is the reality [laughs]… For me, actually because of the lack of self-confidence to add water, afraid of being wrong, and then I will come [and ask], "Why so watery?". That's why if it is very salty, they will present it…if it is burnt already… they will just present it because they don't know what to do.
> (Aiman, Line 351-355)

Instructors noted that students struggled to solve problems when faced with unexpected situations.

Inability to perform basic mathematical operations. This issue was also highlighted in the interviews where instructors teaching the Basic Western module mentioned that first-semester students displayed this lack of competence when they were expected to do basic calculations involving ratios. As a consequence of this, no further problems of a similar nature were given. Instructors worked on the assumption that students' basic calculations were just too low for calculating ratios.

> "When they are doing the vegetable cutting, there is one term we call *mirepoix*. *Mirepoix* contains carrot, celery, and onion. There is a proportion of 2:1:1. So two is for [two parts of] onion to one [part of] carrot and then one [part of] celery… Sometimes you know Community College students, they are not so clever, their result is just [mediocre]... So, we tell them, "I need five hundred gram of mirepoix, how much … onion you want to put? I give them a simple problem-solving …. They have to think about that.

> Sometimes even though it is simple, there are students that cannot answer you know? (Liyana, Line 140-146)

> One more thing is ratio… For instance, I just taught them that one kilogram is for 10 people to eat, some could remember, but when I repeated, I asked them, “for twenty people, how many kilograms do we need”?, the thing is I have already written 1 kilo is for 10 person, and I told them, “I want you to prepare for 20 people to eat, how many kilograms [are required]”. That is the problem of our culinary students… maybe because of their academic results… (Raina, Line 188 -192)

> In 1996, if anyone were to ask me, “What is the cost of a plate of fried noodles?”, I could explain, even though I was just a Certificate level student… I knew what gross profit was, what net profit was… I could explain. (Faizad, Line 329-331)

Instructors noted that students struggled to solve problems involving basic mathematic operation.

Poor articulation skills. Articulation skills relate to communication as they require a person to speak and say something. This issue was also noted to exist among the Culinary Arts students. The instructors stated that they would have preferred their students to be able to speak confidently. It was mentioned that not excelling in their SPM result should not deter them from speaking confidently.

> I like them to talk (sic) public speaking on whatever because… because the problem is that they have no confidence in talking in front of people. You also know that right? Not because of… self-confidence... One thing because of the thing… their SPM results were not excellent. So, they feel down… Then, when they speak… it is one word… one word…Then, when we ask them to elaborate like as we are teaching them something right…When they are asked something, they will [give] one point only. For example, subjective… Give me five… We rarely give essays. Give me five things, procedures, OK… This… this… this… that’s all. Sometimes, we want them to elaborate on something. They keep quiet… Ha… Like one step, one step is this, and then, and then, and then, and then, and then, and then. They are not like that way; they will stop… stop… like this (sic)…. argh…. You understand… They can’t… So, sometimes I want them to be able to speak *lah*. That’s all. (Aiman, Line 463-473)

Instructors noted that students struggled to articulate themselves confidently.

Lack of creativity and innovativeness. Creativity is a necessity in Culinary Arts as it projects one's ability to do something that is different from others. In the interviews, the instructors noted that this skill was also lacking in their students. Although replicating the instructor is deemed important when viewed from the traditional Culinary Arts pedagogical model, the instructors explained that there was often no creativity or innovativeness in the final semester students particularly, when evaluating the final product of their creation.

Their behaviour was likened to the act of photocopying (see Farhan Line 412).

> After class, once the product is done, we will evaluate, and they will share with us whether it was easy to do the product, whether they were interested or they just followed us exactly… [we can see whether] they took the initiative, they were creative or they followed exactly. If they had followed exactly, we know they are not that interested and rather just follow instructions. If they had plated it slightly different [than demonstrated], we can see they are interested. (Zaharah, Line 123-127)

> Usually, students will just follow the basic steps… they might just change the plating by garnishing it slightly different from the instructor, but the products are still basically the same…. Still the same… there are no cases of students adding herbs such as oregano, or thyme or anything like that…. So, just basic… (Zaharah, Line 218-227)

> It is a like a photocopy. When we photocopy something, we get the exact copy. (Farhan, Line 412)

Although replication of demonstration is part of the traditional Culinary Arts pedagogical model, when evaluating students' final products, instructors observed that students lack creativity or innovativeness.

Challenges in developing problem-solving skills. The final theme emerging from the interview data was the perceived barriers that instructors faced in developing their students' problem-solving skills. There were five sub-themes gathered from the interview data ranging from: students were mostly low achievers, students lack interest in the Culinary Arts, lack of opportunities for students to practice their problem-solving skills and lack of training on teaching problem-solving skills, the curriculum is not up-to-date and lack of instructional materials and resources related to problem-solving.

Students were mostly low achievers. Most instructors acknowledged that the majority of the Culinary Arts students from Community Colleges were low achievers as they had not performed well in their *Sijil Pelajaran Malaysia* (SPM) examinations. Their poor results had prompted them to opt for this course. The instructors agreed that the students were given opportunities to learn a vocation despite their poor academic results.

> We know why they are here… because their results are not so good. (Liyana, Line 215-216)
>
> One thing because the thing[sic]… their SPM results were not excellent… So, they feel down… (Aiman, Line 465)

However, because these students would be competing with other graduates, there were concerns from the instructors who felt that the students' quality and the standard is also the responsibility of the instructors. This is because, as instructors, they ought to take the initiative to elevate the quality of their students so that their students are at par with other Diploma graduates.

> Maybe our students feel that when they go out, they will get good jobs, right positions. They do not know the current situation where we have to fight with other colleges, fight with other SPM holders, with degree holders, because they do not have the exposure… (Zaharah, Line 171-173).
>
> Sometimes, I don't want them to think that just because they are from a Community College, so the instructors are teaching them only the simple things… Because of their poor academic performances, some people would say, the students are not going to be able to digest it, even if you have given your best. But, I feel it is us [instructors] who have to increase their standards, so that they will be on par with other Diploma students from other private colleges, right? (Aziah, Line 151-156)

Students' lack of interest in the field. The instructors also indicated that from their observations, they could see that most students displayed a lack of interest in the Culinary Arts. The majority were present merely because it was a necessity to complete their studies. Some students were there because of their peers and not because of their interest. In this regard, such students do not take the initiative but merely wait for instructions. Only a few students in the class showed interest and among those who were interested, problem-solving becomes something that they willingly embrace: "It is so rare to find even one in a group of 29 students… maybe just one or two will show the interest in the subject" (Zaharah, Line 129-130); " … from two classes, only four students … turn up [for training], they really want to know more; they really want to do it..." (Faizad, Line 342-343)

> Usually, those who are genuinely interested, they will listen and do all the things because they have interest. The ones who are not interested… they come to class just to finish the eight hours (Aiman, Line 408-412)

> Those who can [solve problems] are those who are very interested, they have a high inclination to our field. There are some who are just here because they joined their friends. So they joined [the course], the interest may not be there, the most important thing is the interest. That's all. (Qaseem, Line 213-217)

> Perhaps it is the students' attitude, normal *lah*… our students, right? Those who really want to study, you can see their initiative to solve a problem, those who came to study because their parents told them to, they are lazy… they'll just wait for us to tell them what to do… that is what our students are…(Aleesya, Line 247-250)

The instructors noted that the students' lack of interest was a hindrance to their problem-solving.

Lack of opportunities for students to practice problem-solving skills. One of the major barriers to implementing problem-solving skills in the class, as reported by the instructors, was the lack of opportunities for the instructors to do so. This is because instructors were obliged to follow and complete the syllabus. Moreover, due to budget constraints, innovations could not be carried out.

> We follow the syllabus, and with a limited budget, we just teach according to the syllabus and the limited budget… real-life is different… (Zaharah, Line 182-184)

> There was this time I wanted to bring them to the hotel [for a visit], but, there was no budget, so the programme was canceled. I also tell them to watch movies related to the industry; else I tell them the problems I faced when I was working at the hotel, or how the chef did things. (Raina, Line 265-267)

In addition, it appears that situations that would require students to be prepared and be able to solve problems seldom occur, other than the small situation of "not receiving raw materials from the supplier" or "when suppliers are unable to supply certain things". Nonetheless, even on such occasions, it was the instructors who solved the problem, not the students (see Farhan, Line 281-283).

The instructors also noted that if problem-solving skills need to be implemented in classroom teaching, then the current learning environment needs to integrate with the "real-world" so that real scenarios could be created. For example, scenarios such as handling guests during a situation where food supplies were less would assist students in dealing with real contexts of problem-solving. This was traced to the subject of the 'mock restaurant' previously known as "Commercial Kitchen" subject but which no longer exists in the current curriculum. Without the mock restaurant subject, students may not be able to encounter problems (Qaseem, Line 120-124). This is because students are not given the real context with real issues to face and deal with on the spot.

> Depends on the situation, now mistakes are rare because we do not have real-life situations, we do not have a mock restaurant. Like previously, our module we had to supply food, we would know what it is like, for example, a guest comes and happens to be a vegetarian, so they do not eat chicken… they do not take beef… [so, what to do]. Because, now there is no such module if there is… students may be able to encounter problems that arrive.

> We can show them alternatives of what to eat. Usually, Indians don't eat beef right, so what to do? (Qaseem, Line 118-126).
>
> Usually, in practicum class, there are none [of such situations]. We used to have commercial cooking class, for instance, we have to prepare food for 15 pax. We have prepared all non-vegetarian meals, Suddenly, there is a guest who is vegetarian, does not eat chicken or meat, how to solve that problem? So, we have to prepare vegetarian food. (Farhan, Line 234-237)
>
> Cooking-cooking-cooking, then we have forgotten to add in salt when guest tastes it, the guest finds the food is bland. How do we settle that problem? That is a problem! (Farhan, Line 411-412)
>
> Yeah, like to me, problem-solving is always needed, we want to use the oven, and the thermostat is not calibrated, so we have to think of a solution, or like that day, we ran out of gas, so I had prepared a chicken-based product, so instead of pan-frying, we ended up baking the product. (Aziah, Line 224-226)
>
> … you simulate workplace; you show them how to settle [matters]. Students will be able to better apply that compared to just telling them how to apply it. (Munira, Line 683-684)

In the interviews, the instructors highlighted that problems caused by changes of situations such as preparing food for unexpected guests can be real, or the scenario of preparing meatless meals or vegetarian meals for guests can also be real; while the scenario of dealing with customer complaints when the food prepared is bland can also serve as real situations for implementing problem-solving skills.

Lack of training on problem-solving approach to instruction. The emphasis on problem-solving was clearly outlined in the curriculum specification for the Community College Culinary Arts Certificate course. It was also stated in the document that students should be able to solve problems creatively and innovatively by the end of the programme. Despite this, all the ten instructors reported that they had not received any training on problem-solving approach to instruction thus far; neither were they given such skills during their own formal training before they qualified to become instructors. It was clear that little attention has been paid to training instructors on the steps to take to inculcate problem-solving skills among students by using suitable pedagogical approaches: "I don't know how… ermmm" (Aziah, Line 181); "I got no idea" (Liyana, Line 376); "… I don't know much about pedagogy" (Zaharah, Line 349).

The curriculum is not up-to-date. Several instructors reported that there were certain important content areas that were, however, not covered in the current curriculum, for example, more current cooking methods. Thus, instructors had to take their own initiative to prepare the necessary resources and materials to align the curriculum as well as to prepare their students to be on par with graduates from other institutions. The instructors believed that their students need to be exposed to more things so that they will not lose out to other Diploma graduates. They emphasised that their students need to be exposed to relevant skills required in the industry at the present time. One instructor (Faizad) strongly felt that there were some elements in the existing curriculum that were not up-to-date. He thinks that he needs to teach students to prepare a menu that is "… more relevant". For example, he provided examples which showed how he maintained the same cooking method, i.e. roasting, grilling but he changed the preparation technique to one that requires "effort and a good technique" and at the same time, the technique must be moving forward, without leaving out the concept that is required in the module" (Faizad, Line 25-26).

> In the past, we used to follow the module accurately, we would follow one-by-one, but… once the "climate" has changed and moved forward… I don't follow what is required… I don't really follow the module, but I only follow the concept of the module… For instance, for roasted chicken, [according to the syllabus] we have to make the whole roasted chicken, I won't do it… but, I will still teach roasted… method of cooking will still be roasted… because to me there are certain elements which are orthodox… I say orthodox because it is too old… it's been around since my time, and it doesn't attract our students because when we look at it, it seems boring… as there are so many programmes on TV, so we have to prepare a menu which is more relevant to time… So, I came up with… using chicken breast meat, we prepare the stuffing; we roast it, we change its concept, we change its character! For example, we throw the chicken leg away, but, we don't

> only roast the chicken, we debone it, we stuff it with spinach, with whatever we have, we roll it, then only we roast it, it is something that requires effort and good technique, but at the same time, move forward… (Faizad, Line 11-26)

To update the outdated curriculum, maintaining close ties with Chefs who are still in the industry may be one way of adding a ‘new recipe’ to the old curriculum.

> ... he is always up-to-date with what is happening in the industry, he deals with professional chefs, so he knows the latest techniques, so he can apply [in his teaching]. (Zaharah, Line 90-92).

> “Easier to learn from people from the industry (Aziah, Line 325-326)

> What we can do… we invite Chefs to give some exposure to students on what the latest technology can do. When they want to do it, we can’t because we don’t have the technology… so, they don’t know how to do it. So, they will just get the exposure… what is the latest technology… the Chef can just share his knowledge with our students… (Zaharah, Line 192-196)

She later added:

> … if possible, we need to liaise with people from the industry more, not only during students’ practical attachment… (Zaharah, Line 378-379)

Lack of instructional materials and resources related to problem-solving. The emphasis on problem-solving has been outlined in the curriculum specification of the Community College Culinary Arts Certificate course. It also stated that students need to acquire this skill at the end of the programme, but the fact remains that the current syllabus does not provide real-world problems to be used as classroom material for instruction. This was highlighted by the instructors when asked if they had new ‘real problems’ for students to work on. As a result of this, instructors tend to reach a plateau in seeking new problems for students to solve. As one of them said: “Nope!” (laughing) (Aziah, Line 332). Another said, “Nope! Not at all… we have to create ourselves” (Aleesya, Line 172) and yet another remarked: “Instructors also do not have a problem to solve. We can’t think of problems to solve… We just do the same thing repeatedly”. (Farhan, Line 413-414)

Only two senior instructors emphasised that they take some initiative to prepare additional resources and teaching materials to ensure that their students are equipped with the relevant skills the industry needs. This occurs in contexts when the content area is not included in the current syllabus. For this, it was mentioned that the materials can be in the form of checklists which can assist students to perform the tasks better.

> How about receiving? What must be done when receiving [items]? So, we take our own initiative… Students go and receive the item, they check the quantity and the quality of the item. So, I give them a sheet [of form] for them to check items upon receiving, even though it is not part of the syllabus (Farhan, Line 39-40; Line 50; Line 52-53)

Another instructor highlighted the fact that it is crucial for students to hone other skills besides their cooking skills. For instance, their skills in time management, organisation and preparation need to be developed because these are important and necessary skills for the Culinary Arts discipline. Thus, a set of checklists is also helpful.

> … they need to know everything, [from] preparing the job flow, preparing [the]equipment and utensils, preparing the daily *mise-en-place*… they must do it daily, so we have to have a checklist, and we check [for] everything… (Faizad, Line 445-450)

The instructors felt that this aspect of the curriculum is important because it will add value to their students. However, it was not always possible to hone students' other skills because instructors seem to be carrying an overwhelming workload. In such instances, the instructors mentioned that they would rather adhere to the existing curriculum guide then venture out of it because time is crucial. Nonetheless, it was noted that such workload may have nothing to do with teaching and learning but was purely administrative. One instructor said: "To me, [I] must come prepared for class. The problem is in college because there is too much of [other] work. (Aiman, Line

295-297), and also expressed that "… because of too busy sometimes, I lack reading something new" (Aiman, Line 672-675)

> I don't teach pastry for the whole year. Like the previous semester I taught Malaysian cooking, the semester before that I taught Basic Western, so I have been hopping-hopping (sic), right? So, that is a challenge for me *lah*. Because every semester we get a new subject [to teach], so, have to refresh everything, right? My sister says, "You are a jack of all trades *lah*", but, sometimes, it is tiring, like when we want to develop a proper model, and develop proper notes, it takes time, it doesn't mean this week you have prepared all the [materials] for Learning Area One to Four perfectly, right? Like during semester break, we want to make our notes tip top, [include] infographics *lah*, but then, the following semester you teach this subject instead, why bother to do this stuff, like, why *lah* bother to do this? (Aziah, Line 69-78)

> Just like mentioned earlier… I wanted to learn Prezi, Prezi can move, right? *PowerPoint* can have movements too, right? At least, it is visually pleasing to look at? However, this semester, I have to teach a different subject, so, I stopped [working at it]. (Aziah, Line 292 -295)

Overall, it can be concluded that the Culinary Arts instructors' current teaching practices tend to adhere to that of the traditional culinary pedagogical model which includes demonstration and replication and lectures and hands-on practicum. It was also clear that completing their syllabus was important although it was not denied that some innovative teaching techniques are necessary to enhance the learning environment. Looking for classrooms with advanced technology is another initiative taken by the instructors to promote student interest in learning the Culinary Arts. It was also mentioned that both instructors and students lacked opportunities to acquire problem-solving skills because this was not highlighted in the curriculum.

To conclude this chapter, a summary of the three parts of the Needs Analysis is presented. First is the summary of the Needs Analysis indicating the students' perception of their problem-solving skills and their perception of their flipped classroom readiness. This is followed by a summary of the Culinary Instructors profile indicating their perception of their current teaching practices and the obstacles between them and the students in implementing problem-solving skills. Finally, a summary of the themes that emerged in the interview data manifesting the instructors' current teaching practices and other inadequacies noted in the students are provided in a table structure followed by recommendations that can be implemented in the PSFC module.

Summary of Findings on the Students' Problem-Solving Skills

The level of the students' problem-solving skills in the context of this study was analysed from two research questions. The findings noted that: (1) the most popular strategy used by the group of respondents who were Culinary Arts students from various Community Colleges in the country was the argumentation strategy and the least popular strategy was the analogising strategy when involved with problem-solving practices; (2) students in the context of this study also exhibited medium use of cognitive skills in problem-solving; (3) students exhibited medium levels of problem-solving skills with students in semester four exhibiting the highest level and use of cognitive skills in problem-solving whereas students in the semester one exhibited the lowest level and use of cognitive skills in problem-solving.

From the results noted, it can be safely said that the needs analysis has provided the evidence which demonstrate that most students have medium level of problem-solving skills. The outcome of this needs analysis conducted highlight some aspects of the Culinary Arts students regarding their cognitive abilities for problem-solving. The finding of this study is significant because one of the Programme Learning Outcomes of the Culinary Arts programme in Community Colleges is for students to be able to solve problems creatively and innovatively. Hence, the emphasis on inculcating problem-solving skills using authentic problems during Culinary Arts instruction should be addressed.

Summary of Findings on FC Readiness

In terms of smartphone and tablets, using the Internet and doing online assignments, the findings noted the following: (1) majority of the students in Culinary Arts own smartphones which ran on Android platforms; (2) majority of the students have seamless and continuous access to the Internet, whether on their smartphones or computers at home; (3) majority of the students in Culinary Arts are skilled in using search engines to search for information, and they know how to conduct communication via social platforms; (4) majority of the students agree that they can complete assignments in different places using online technologies.

In terms of motivation, (1) majority of the students agreed that they will remain motivated without the presence of instructor; (2) majority of the students agreed that they could complete their work even when there are online distractions; (3) majority of students agreed that they could complete their work even when there are distractions at home.

Regarding online audio/video, the majority of the students agreed that: (1) they would be able to understand course-related information when it is presented in short videos (one to three minutes); (2) they will be able to take notes while watching a video on the computer.

As for Internet discussion, the majority of the students say that: (1) they will participate in online discussion using online tools; (2) they prefer to have more time to prepare responses to the questions posed.

In terms of Importance to your success, majority of the students claim that: (1) they will participate in online discussion using online tools; (2) being in regular contact with the instructor and the ability to immediately apply course materials is crucial for their success; (3) for FC to be successful, frequent participation is necessary.

Regarding FC readiness, the majority say that: (1) they were not aware of FC; (2) they prefer face-to-face interactions to be between 50% and 90% of the time compared to online learning; (3) they prefer materials to be delivered using *PowerPoint* with video explanations. The summary of the themes from the interview with instructors is shown in Figure 4.1.

Use of the traditional culinary pedagogical model

- Traditional lectures: Ineffective in retaining students' attention
- Modeling during hands-on practicum
- Scaffolding during hands-on practicum
- Coaching when students present end product
- Fading during hands-on practicum

Lack of instructional support

- Curriculum guides
- Instructional materials and resources
- Assessments

Students' preferences/needs

- Prefer active learning activities instead of boring lectures
- Use of visual media to deliver information
- Use of smartphones as a tool to deliver materials and resources at low-tech settings
- Use of smartphones as a platform to enhance communication between students and instructors

Students' skills Or their lack of it

- Poor content comprehension and knowledge retention to solve related problems
- Lack of language proficiency
- Not ready to join the industry
- Inability to solve problems caused by mistakes
- Inability to solve problems caused by changes in situations
- Inability to perform basic mathematical approach
- Poor articulation skills
- Lack of creativity and innovativeness

Challenges faced to develop problem-solving skills

- Students are mostly low achievers
- Students lack of interest in the field
- Lack of opportunities for students to practice problem-solving
- Lack of training on problem-solving approach to instruction
- Curriculum is not up-to-date
- Lack of instructional materials and resources related to develop problem-solving

Figure 4.1 Summary of themes from interviews with instructors.

Recommendations Based on the Needs Analysis of the Instructors

The findings from the interview provided themes that were summarised in Figure 4.1. Based on Figure 4.1, several recommendations were made to the design of the PSFC module. These will then be used as guidelines for designing and developing a new module for teaching problem-solving skills. (See Table 4.15 to Table 4.19). Instead of using the traditional culinary pedagogical model which consists of traditional lectures and hands-on practicum that consists of demonstration-replication, there is a need to shift to student-centred approaches and also include problem-solving activities using real-world problems. (See Table 4.15).

Table 4.15

Recommendation for Design and Development: Theme 1

Theme	Sub-theme	Findings	Recommendation
Use of the traditional culinary pedagogical model	Traditional lectures	Traditional lectures are ineffective in retaining students' attention	There is a need to shift teaching practice from traditional lecture to student-centred approaches
		Students get easily bored and prefer hands-on activities when learning	There is a need to use class time to include more hands-on learning experience
	Hands-on practicum components	Hands-on practicum consists of demonstration-replication inhibits student's ability to think innovatively which is needed when they join the workplace environment	There is a need to enhance hands-on practicum, to not only replicate but include problem-solving activities that are transferable to authentic professional problems to encourage problem-solving

Due to the lack of instructional support for problem-solving approach to instruction, it is recommended that lessons, instructional materials and resources be designed and developed for instructors to use in class. (See Table 4.16).

Table 4.16

Recommendation for Design and Development: Theme 2

Theme	Sub-theme	Findings	Recommendation
Lack of instructional support for problem-solving approach to instruction	Curriculum guides	Lack of uniformity and possible variation when conducting lessons especially concerning problem-solving	There is a need to design and develop lessons based on instructional models as a guide for instructors to use when conducting lessons concerning problem-solving

	Instructional material and resources	Lack of instructional materials and resources to use when conducting lessons concerning problem-solving	There is a need to design and develop instructional materials and resources to use when conducting lessons concerning problem-solving

Since students prefer active learning activities there is a need to use hands-on activities that involves student participation and emphasis on hands-on learning experience. Students' preference to visual media and smartphones suggests the use of visual media to present information and smartphones to access resources and materials. (See Table 4.17).

Table 4.17

Recommendation for Design and Development: Theme 3

Theme	**Sub-theme**	**Findings**	**Recommendation**
Student preferences/needs	Prefer active learning activities compared to boring lectures	Prefer active learning activities compared to boring lectures	There is a need to use class time more for the hands-on learning experience
	Use of visual media to deliver information	Use of visual media	There is a need to use visual media to present information
	Use of smartphones as a tool to deliver materials and resources in low-tech settings	Use of smartphones as a tool to deliver materials and resources in low-tech settings	There is a need to use smartphones/mobile supported setting to access resources and materials at low tech settings
	Use of smartphones as a platform to enhance communication between students and instructors	Use of mobile messaging apps as a platform to communicate	There is a need to use mobile messaging apps as a platform to enhance communication between students and instructors

To ensure better content comprehension and knowledge retention, there is a need to get students to actively participate in lessons which are interspersed with activities that connect theoretical concepts to real-world applications. (See Table 4.18).

Table 4.18

Recommendation for Design and Development: Theme 4

Theme	Sub-theme	Findings	Recommendation
Students' skills or the lack of it	Poor content comprehension and knowledge retention	Poor content comprehension and knowledge retention students do not come prepared for class Students are also unable to remember what they have learnt before.	There is a need to enhance content comprehension and knowledge retention by getting students actively participate in the learning process Instead of passive lectures, when using real-world scenarios, students are more likely to connect real-world applications of theoretical concepts which may seem abstract to students. There is a need to assess students' preparedness and understanding when they come to class by conducting of tests/quizzes or quick revision of the central concepts at the beginning of each class
	Lack of language proficiency	Low proficiency in both English and Malay language Culinary terms need to be maintained in their original language just like how it is being used in the industry without being translated into the national language	There is a need to use simple language There is a need to provide translations if resources in English are used There is a need to maintain culinary terms as original
	Not ready to join the industry	Employers are looking for employees that are able to communicate, perform tasks and be able to think and solve problems, and not only possess cooking skills Students are unable to think beyond and are at a loss for what to do not being able to find a solution.	There is a need to link the course content and pedagogy to industry needs can help in preparing students ready for the workplace by finding out what makes up industry expertise and then create modules that guide students through structured tasks.
	Inability to solve problems caused by mistakes	Inability to solve problems caused by mistakes	There is a need to use problems caused by mistakes to encourage problem-solving
	Inability to solve problems caused by changes in situation	Inability to solve problems caused by changes in situation	There is a need to use problems caused by changes in situations to encourage problem-solving
	Unable to perform basic mathematical operations	Unable to perform basic mathematical operations such as ratios or food cost control	There is a need to use algorithmic and mathematical problems that are transferable to authentic professional problems to encourage problem-solving
	Poor articulation skills	Students lack confidence when doing oral presentations	There is a need for students work in teams and practice oral presentations

Theme	Sub-theme	Findings	Recommendation
	Lack of creativity and innovativeness	Students lack creativity and innovativeness to create something new	There is a need to use design problems encourage creativity and innovativeness
	Students are mostly low achievers	Students have poor academic results	There is a need for low achievers to get more attention from instructors so that they will be more motivated to perform better
	Students lack of interest in the field	Students lack interest deters them from being able to solve problems	There is a need to stimulate students' interest

Among the challenges faced by instructors to develop problem-solving skills among students are the lack of opportunities to practice problem-solving due to the lack of resources and support. (See Table 4.19).

Table 4.19

Recommendation for Design and Development: Theme 5

Theme	Sub-theme	Findings	Recommendation
Challenges faced to develop problem-solving skills	Lack of opportunities for students to practice problem-solving	Instructors follow the syllabus and have budget constraints, and course content does not have "real-world" scenarios	There is a need to provide more opportunities for authentic and real-world problem-solving, with some prior content knowledge to activate learning.
	Lack of training on teaching problem-solving skills to students	instructors reported that they had not received any training on teaching problem-solving	There is a need to design a model of instruction for instructors to use
	Curriculum is not up-to-date	Students need to be exposed to more advanced skills that required the demonstration of relevant skills that were required in the industry at present. Maintain close ties with the industry	There is a need to get input from the industry when designing the module to ensure industry needs.
	Lack of instructional materials and resources related to developing problem-solving	Current syllabus does not provide examples of real-world problems to be used for instruction,	There is a need to design real-world problems that can be used for instruction

The implication of the findings that were retrieved from the students' cognitive skills in problem-solving was also used to develop a problem-solving pedagogical module for the Culinary Arts syllabus. This is presented in Table 4.20.

Table 4. 20

Recommendation for the Module Design and Development Based on the Findings of Students' level of Cognitive Skills Used in Problem-solving

Item	Findings	Recommendation
1	The most popular strategy used for problem-solving among students was argumentation, whereas the least popular strategy was analogizing when solving problems	The lack of exposure to real-world problems may have contributed to analogising being a less popular strateg
2	Students had medium levels of problem-solving skill	There is a need for a module to be designed and developed to develop students' problem-solving skills using r world problems
3	Students in the first-semester had the lowest level of problem-solving abilities	There is a need for the module to be implemented with first-semester students

The implication of the findings that were retrieved from the students' online skills and FC readiness was also used to develop a problem-solving pedagogical module for the Culinary Arts syllabus. This is presented in Table 4.21.

Table 4.21

Recommendation for the Module Design and Development Based on the Findings of Students' FC Readiness

Item	Findings	Recommendation
1	Most students owned smartphones which ran on *Android* platforms	Smartphones which run on Android platforms can be used to deliver the resources and materials in the module
2	Most students in the context have seamless and continuous access to the Internet on their smartphones and at their homes	The Internet could be used as a problem-solving and research tool
3	Students have adequate access to technology (i.e., computer with Internet connection, reasonably new computer, and adequate software).	Computers could be used in the module
4	Students have high online skills (i.e., basic skills of operating a computer, finding their way around the internet, communicating with others using online chatting platforms, completing assignments with students in different places using online technologies)	Online skills can be used in the module
5	Students have low agreement on scheduling time to provide timely responses to other students and the instructor when using online technologies	There is a need for the FC approach to be implemented in the module so that students will be able to schedule their time appropriately with the presence of the instructor.

Item	Findings	Recommendation
6	Students need the presence of instructor to remain motivated	Use of online chatting platform or mobile messaging app enables instructor to remain present
7	Students seem to be able to complete their work even when there are online distractions	Online resources/materials/platforms can be used in the module
8	Students seem to understand course-related content when it presented in short videos (one to three minutes)	Short instructional videos can be used as a resource for the module to deliver knowledge.
9	Students seem to be able to take notes while watching a video.	
10	Students need more time to prepare responses to a question	There is a need for an online platform for students to submit their responses anytime to their instructors and classmates in the module
11	Students need to participate in online discussion using online tools	
12	Students prefer regular contact with the instructor	
13	Students prefer to be able to apply course materials immediately.	Problem-centred instruction using real-world problems related to the Culinary Arts industry is needed in the module so that students can apply the knowledge learnt immediately
14	Students prefer to participate in lessons frequently	Engaging activities can be used in the module.
15	Most students were not aware of the FC approach	An orientation to the FC should be done to gain acceptance of this approach before implementation.
16	Most students prefer more than 50% instruction to be delivered face-to-face	FC implementation should have more face-to-face component than the online component.
17	Students prefer content to be delivered using *PowerPoint* with video explanations	*PowerPoint* with video explanations can be used in the module.

Summary

To conclude, the implications for the needs of the module arose from three areas: firstly, quantitative data regarding the cognitive skills used for problem-solving by students and students' FC readiness, followed by the findings of culinary instructors' current teaching practices (qualitative data). When the data are examined together, the quantitative data offers findings substantiated by the qualitative data.

The quantitative data emerging from this study revealed that on average respondents exhibited medium use of cognitive skills used in problem-solving. The qualitative data are consistent with this finding by revealing that participants who were instructors at Community Colleges suggested that students lack problem-solving skills especially concerning problems caused by mistakes and problems caused by changes in situations. The interviews with the instructors also showed that students were unable to think beyond and get stuck not being able to find solutions. Taken together, students were found not ready to join the industry as employers are looking for employees who not only possess cooking skills but are also be able to think and solve problems.

The quantitative data also reported that the least popular strategy when solving problems was analogising with other similar problems which have been encountered previously. The qualitative data substantiates this finding by instructors revealing that students had lack of opportunities to encounter real-world problems in current teaching practices. During interviews, instructors highlighted that the current syllabus does not provide examples of real-world problems to be used for instruction, nor were there guidelines to implement problem-solving instruction. The findings provide support for providing more opportunities for authentic and real-world problem-solving, with some prior content knowledge to activate learning which supports Merrill's principles.

About FC readiness, the majority of students were unaware of the FC approach. However, students have high online skills which can be used on the module which display readiness for the FC approach. Quantitative data revealed that face-to-face instruction should account for between 50% and 90% of course delivery. The qualitative data substantiates this finding by revealing that there is a need to use class time to include more hands-on learning experience so that students actively participate in the learning process. This means that there is a need to design a model of instruction to shift teaching practice from traditional lecture to student-centred approaches.

Moreover, the need to enhance content comprehension and knowledge retention can be achieved using active learning strategies.

Thus, the needs analysis phase has provided findings on the background of both instructors and students at Community Colleges and their needs. As argued by Salavuo (2008), these findings are especially useful when designing socially and culturally relevant technology-mediated instruction. These findings indicate a pressing need to improve students' level of problem-solving skill and that instructors need guidance on implementing problem-solving instruction to facilitate the FC approach in a Culinary Arts classroom. The findings also indicate a need for a pedagogical module for problem-solving using real-world problems using the FC approach.

CHAPTER 5

FINDINGS OF PHASE II: DESIGN AND DEVELOPMENT

Introduction

This chapter discusses the research findings that had emerged from the second phase of the study: the design and development phase. The first part (Part I) of the chapter focuses on the design of the module based on consensus achieved from the Fuzzy Delphi Method (FDM hereafter). The second part (Part II) comprises the module development. To be able to design and develop a module that can enhance students' problem-solving skills, it is also necessary to investigate what elements the module should comprise. In this attempt, semi-structured interviews were conducted with six experts to design the Fuzzy Delphi (FD hereafter) Instrument. Subsequently, the FD Instrument was distributed to a panel of 19 experts to obtain a consensus of opinions concerning the elements for inclusion in the PSFC module where experts' opinions on weights and ratings on the list of items are mathematically derived using FDM (Chang et al., 2011). In that regard, the attempt portrayed in this chapter aims at answering the following research questions:

1) What are experts' views on the elements that should be incorporated into the PSFC module for Culinary Arts at Community Colleges in terms of objective, content to develop real-world problems, instructional strategies, resources/media, and assessment?
2) Based on experts' consensus, how should the elements be included in the development of the PSFC module?

Designing the Fuzzy Delphi (FD) Instrument

A semi-structured interview was conducted with six experts to design the FD Instrument. The experts had expertise and experience in the following areas: Problem-solving, Flipped Classroom, Pedagogy, Technology in Education, TVET, Culinary Arts and Instructional Technology. See Table 5.1 for details of the experts.

Table 5.1

Expertise of Experts for Semi-Structured Interview to Design the Fuzzy Delphi Instrument

Position	Sex	Expertise							Experience (Years)
		Problem-solving	Flipped Classroom	Pedagogy	Technology in Education	TVET	Culinary Arts	Instructional Technology	
Culinary Educator - Community College	M			√	√	√	√		12
Culinary Educator - Private University	M					√	√		18
Culinary Educator - Private University	M	√	√	√	√		√		28
Chef Restaurateur and Former Executive Sous Chef of a Five-star Hotel	M						√		30
Professor-Public University	M	√	√	√	√				28
Professor-Public University	F	√		√		√		√	30

The interview with the experts was conducted to determine the elements required in the PSFC module. Eight themes emerged from thematic analysis of the data, namely: module objectives, content for designing the real-world problems, instructional strategies (before, during and after), student characteristics, the role of instructors, resources and platform to deliver the module, and assessment strategies suggested to be in the PSFC module. Next, the FD instrument was developed based on the themes suggested by the panel of experts. These themes were used to form the six items for the "objective", 13 items for the "content", eight items for "before class activities", 15 items for "during face-to-face" activities, ten items for "during practical class" activities, 11 items for "after class activities", 14 items for "resources", eight items for "platform to deliver the module" and 11 items for "assessment strategies".

Description of the Panel of Experts for the FDM

The experts comprised of 13 males and six females. Their expertise was in Problem-solving, FC, Pedagogy, and Technology in Education, TVET, Culinary Arts and Instructional Technology. Specifically, there were six University Lecturers (Public Universities), seven Culinary Lecturers (Private and Public Universities), three Kitchen Supervisors (two Executive Sous Chefs and one Director of Culinary, Restaurant, and Bar, all were employed at 5-star hotels), two Instructional Designers and one Stakeholder/Policymaker from DCCE. The experts interviewed to develop the FD Instrument also became the experts to respond to the FD Instrument. This ensured consistent findings for the elements using the FDM. The experts had a minimum of 10 years and a maximum of 39 years of experience in their field of expertise. See Table 5.2.

Table 5.2

Expertise of Experts for FDM

Expert	Position	Sex	Expertise								Years of experience
			Problem-solving	**Flipped Classroom**	**Pedagogy**	**Technology in Education**	**TVET**	**Culinary Arts**	**Instructional Technology**	**Other (s)**	
1	Professor- Public University	M		√		√		√		Food Technology	23
2	Professor- Public University	M	√	√	√	√					28
3	Professor- Public University	M	√	√	√	√					30
4	Professor- Public University	M	√	√		√			√		21
5	Senior Lecturer – Public University	F	√	√			√				10
6	Professor- Public University	F	√	√			√		√		30
7	Culinary Arts Lecturer- Community College	F						√			12
8	Culinary Arts Lecturer - Community College	M			√	√		√			12
9	Senior Lecturer – Public University	F			√		√	√		Home Economics Education	18
10	Culinary Arts Professor - Public University	M	√					√			39
11	Culinary Arts Lecturer - Private University	M					√	√			18

12	Culinary Arts Lecturer - Private University	M	√	√	√	√		√			28
13	Culinary Arts Lecturer - Private University	M					√	√			30
14	Executive Sous Chef, 5-star hotel	M						√			16
15	Executive Sous Chef, 5-star hotel	M	√					√			22
16	Director of Culinary, Restaurant, and Bar, 5-star hotel	M						√		Food and Beverage	22
17	Instructional designer	F				√			√		10
18	Instructional designer	M	√	√	√	√			√	Massive Open Online Courses (MOOC), Gamification, Open Educational Resources (OER)	15
19	Policymaker	M				√	√			Curriculum Development	20

Consensus of Experts on the Importance of the Objective element of the PSFC module based on FDM

The Objective element contains items to design the learning objectives of the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.3.

Table 5.3

Experts' Views on the Importance of the Objective Element of the PSFC Module Based on FDM

No.	Objective	Triangular Fuzzy Number Process: Threshold value (*d*)	Triangular Fuzzy Number Process: Percentage of Expert Consensus, %	Defuzzification Process: m_1	Defuzzification Process: m_2	Defuzzification Process: m_3	Defuzzification Process: *Fuzzy* Score (A)	Results: Expert Consensus	Results: Ranking
1	Apply fundamental professional knowledge to solve real-world industry issues and/problems/new situations.	0.157	95	.526	.726	.926	.726	**ACCEPTED**	**1**
2	Identify problems and come up with possible solutions to handle problems caused by mistakes in various situation.	0.183	95	.474	.674	.880	.674	**ACCEPTED**	**4**
3	Identify problems and come up with possible solutions to handle problems caused by changes in situation (crisis).	0.168	95	.484	.684	.884	.684	**ACCEPTED**	**2**
4	Develop decision-making skills to solve real-world industry issues and/or problems.	0.186	89	.484	.684	.884	.684	**ACCEPTED**	**2**
5	Develop reasoning skills when solving real-world industry issues and/or problems.	0.175	53	.463	.663	.863	.663	REJECTED	-
6	Develop argumentation skills when solving real-world industry issues and/or problems.	0.177	42	.411	.611	.811	.611	REJECTED	-

Note.

Conditions to be met: Triangular Fuzzy Numbers: (1)Threshold value (d) ≤ 0.2, (2)Percentage of expert consensus ≥ 75%

Defuzzification Process: Fuzzy score (A) ≥ α –cut value of 0.5

Item 1, Item 2, Item 3 and Item 4 from the Objective element were accepted as the percentage of expert consensus was more than 75%, and the *d*-values were less than 0.2. Majority of the experts agreed with the first item in the objective element with a defuzzification value of 0.7226. This shows that the objective stated in Item 1: "Apply fundamental professional knowledge to solve real-world industry issues and/problems/new situations" is ranked the highest. This is followed by the Item 3 and Item 4 which received similar defuzzification value of 0.684, thus ranked the second, followed by Item 2 in the fourth rank, with the defuzzification value of 0.674. Item 5 and item 6 of the Objective element received the lowest percentage of consensus among experts; thus, they were rejected.

Consensus of Experts on the Importance of Content element of the PSFC module based on FDM

The content element contains items to map out the content areas that can be used to develop real-world problems in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus are shown in Table 5.4. Majority of the experts agreed on the first topic with the defuzzification value of 0.779. This shows that all the experts strongly agree that the Standards of Professionalism: Work Behaviour and Personal Qualities topic is the most important to be used to develop real-world problems for the PSFC module. This was followed by two other topics; Food Safety and Kitchen Safety with the defuzzification value of 0.758, which were ranked second. The ranks for each item in the content element according to expert consensus is shown in Table 5.4.

Table 5.4

Experts' Views on the Content element of the PSFC module based on FDM

No.	Objective	Triangular Fuzzy Number Process		Defuzzification Process				Results	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	**Thres hold value (*d*)**	**Percentage of Expert Consensus, %**	**Ranking**
1	Standards of Professionalism: Work Behaviour and Personal Qualities (*e.g., Discipline, Responsibility, Teamwork, Work Ethics, Personal Hygiene/Appearance, Punctuality, Listening to Instructions, Chef identity, Personal attire, Communication, Passionate about job, Following Instructions, Dealing with Customer Complaints, Dealing with Food Service Complaints*)	0.056	89	.579	.779	.979	.779	**ACCEPTED**	**1**
2	Career and employability (*e.g., Career paths, Professional Opportunities, Kitchen Organization, Realities of the Food Service Industry, Entrepreneurial mindset*)	0.165	53	.453	.653	.853	.653	REJECTED	-
3	Kitchen Fundamentals (*e.g., Tools and Kitchen Equipment, Cost management, Menus*)	0.141	100	.526	.726	.926	.726	**ACCEPTED**	**4**

4	Food Safety: Hygiene and Sanitation (*e.g., Personal hygiene, Temperature Control for food safety, cross contamination, prevention of foodborne illness, potentially hazardous food* (*TCS foods*), *Rodent and Insect Control, The Hazard Analysis and Critical Control Point (HACCP) System*)	0.100	79	.558	.758	.958	.758	**ACCEPTED**	**2**
5	Kitchen Safety (*e.g. Preventing and dealing with kitchen accidents*)	0.117	79	.547	.747	.947	.758	**ACCEPTED**	**2**
6	Nutrition (*e.g. Suggested meals for vegetarians, Identify common food allergies and determine substitutions*)	0.162	95	.474	.674	.874	.674	**ACCEPTED**	**7**
7	Breakfast Preparation: Handling common problems during preparations	0.154	95	.474	.674	.874	.674	**ACCEPTED**	**7**
8	Salad and Salad Dressing: Handling common problems during preparations, arrangement and presentation	0.136	100	.463	.663	.863	.663	**ACCEPTED**	**6**
9	Stocks: Handling common problems during preparation	0.141	100	.474	.674	.874	.674	**ACCEPTED**	**7**
10	Sauces: Handling common problems during preparation	0.141	100	.474	.674	.874	.674	**ACCEPTED**	**7**

11	Soups: Handling common problems during preparation	0.141	100	.474	.674	.874	.674	**ACCEPTED**	**7**
12	Pasta and Starches: Handling common problems during preparation	0.141	63	.453	.653	.853	.653	REJECTED	-
13	Cooking Methods and Temperature Control (*e.g., Heat transfer, moist-heat cooking and dry-heat cooking for various foods, seasoning and flavouring ingredients, using herbs and spices*)	0.152	100	.505	.705	.905	.705	**ACCEPTED**	**5**

Note.
Conditions to be met:
<u>Triangular Fuzzy Numbers</u>
1) Threshold value (d) $\leq$ 0.2
2) Percentage of expert consensus $\geq$ 75%
<u>Defuzzification Process</u>
1) Fuzzy score (A) $\geq$ α –cut value of 0.5

Consensus of Experts on the Importance of Instructional Strategies: Before Class element of the PSFC module based on FDM

The Instructional Strategies: Before Class element contains items to plan the before class approaches in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.5. Majority of the experts agreed with the first item with a defuzzification value of 0.674 is the most important to be included in the PSFC module. All the other items were rejected by experts.

Table 5. 5

Experts' Views on the Instructional Strategies: Before Class Element of the PSFC Module Based on the FDM

No.	**Instructional Strategies Before Class**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Students access supportive content materials *(e.g. videos, lecture notes, problems, stimulus materials for problems)* shared on platform to link before class activities with during class problem-solving activities	0.183	85	.474	.674	.874	.674	**ACCEPTED**	**1**
2	Students do web search to solve task based on given guidelines	0.176	55	.389	.579	.779	.582	REJECTED	-
3	Students complete entry behaviour assessment (graded) (*e.g. quiz to test comprehension*)	0.144	55	.379	.579	.779	.579	REJECTED	-
4	Students use graphic organizer to model professional knowledge information delivered before class (*e.g., concept map, flowchart, comparison*	0.166	50	.347	.547	.747	.547	REJECTED	-

	table) after pre-class activity								
5	Students do note taking	0.193	35	.400	.600	.800	.547	REJECTED	-
6	Students record their self-reflection after completing pre-class activity based on given guidelines	0.135	65	.432	.632	.832	.632	REJECTED	-
7	Students share completed tasks on platform for instructors to plan face-to-face session	0.132	65	.463	.663	.863	.663	REJECTED	-
8	Students plan *mise-en-place* (e.g., according to recipe and menu, plating for recipe and menu, work space organization) for Culinary Arts practical class	0.176	50	.463	.663	.863	.663	REJECTED	-

Note.
Conditions to be met:
Triangular Fuzzy Numbers
1) Threshold value (d) ≤ 0.2
2) Percentage of expert consensus $\geq$ 75%
Defuzzification Process
Fuzzy score (A) $\geq \alpha$ –cut value of 0.5

Consensus of Experts on the Importance of Instructional Strategies: During Face-to-face Class element of the PSFC module based on FDM

The Instructional Strategies: During Face-to-face Class element contains items to devise the face-to-face class strategies in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.6. Both item 1 and item 10 were ranked the most important instructional strategy during face-to-face class, with the defuzzification value of 0.695. This is followed by item 9 and item 13 with the defuzzification value of 0.684 and 0.600 respectively. The other items were rejected by experts.

Table 5.6

Experts' Views on the Instructional Strategies: During Face-to-face Class of the PSFC Module Based on the FDM

No.	**Instructional Strategies: During Face-to-face Class**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Students participate in whole class discussion/review of before class tasks shared on platform	0.169	95	.495	.695	0.895	.695	**ACCEPTED**	**1**
2	Students' content knowledge based on before class tasks is assessed	0.122	63	.411	.611	.811	.611	REJECTED	-
3	Students find solutions to case study/scenarios using game elements (*e.g., challenges, earning points, fun, engaging, rules*)	0.183	47	.411	.611	.811	.611	REJECTED	-
4	Students find solutions to case study/scenarios using small group discussion	0.183	53	.400	.589	.789	.593	REJECTED	-
5	Students complete problem-solving task worksheets	0.122	63	.389	.589	.789	.593	REJECTED	-

6	Students share solutions of problem-solving tasks on platform	0.144	58	.421	.621	.821	.621	REJECTED	-
7	Student's problem-solving skills assessed using rubrics	0.169	47	.432	.632	.832	.632	REJECTED	-
8	Students articulate problem-solving steps used to solve scenario of real-world industry issues and/or problems in groups to instructor	0.108	74	.432	.632	.832	.632	REJECTED	-
9	Students receive feedback from instructor (which fades over time)	0.168	95	.484	.684	.884	.684	**ACCEPTED**	**3**
10	Students receive coaching from instructor	0.152	100	.495	.695	.895	.695	**ACCEPTED**	**1**
11	Students use metacognitive strategies such as questioning when solving problems	0.154	58	.463	.663	.863	.663	REJECTED	-
12	Students record their self-reflection to connect between what was learned before class to new knowledge learned when solving problems in class	0.142	63	.453	.653	.853	.653	REJECTED	-

13	Students view demonstration/modeling of common mistakes that may arise during food preparation	0.064		79	.400	.600	.800	.600	**ACCEPTED**	**4**
14	Students view demonstration/modeling of common crisis/changes in situation that may arise	0.135		63	.432	.632	.832	.632	REJECTED	-
15	Students view demonstration/modeling of problem-solving steps to solve problems	0.144	58		.421	.621	.821	.621	REJECTED	-

Note.

Conditions to be met:

<u>Triangular Fuzzy Numbers</u>

i. Threshold value (d) ≤ 0.2
ii. Percentage of expert consensus ≥ 75%

<u>Defuzzification Process</u>

Fuzzy score (A) ≥ α –cut value of 0.5

Consensus of Experts on the Importance of Instructional Strategies: During Practical Class element of the PSFC module based on FDM

The Instructional Strategies: During Practical Class element contains items to plan the instructional strategies during the hands-on practicum session in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.7.

Table 5.7

Experts' Views on Importance of Items for Instructional Strategies: During Practical Class of PSFC Module Based on FDM

No.	**Instructional Strategies: During Practical Class**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Students watch instructors demonstrate technical skills	0.166	95	.510	.710	.910	.710	**ACCEPTED**	**3**
2	Students perform technical skills	0.125	79	.550	.750	.750	.750	**ACCEPTED**	**1**
3	Students assigned to solve mistakes in various situation	0.169	95	.500	.700	.900	.700	**ACCEPTED**	**6**
4	Students assigned to handle crisis/changes in situation	0.166	95	.510	.710	.910	.710	**ACCEPTED**	**3**
5	Students assigned to produce a similar end product (without any guidance)	0.239	84	.490	.680	.880	.683	**ACCEPTED**	**10**
6	Students articulate their problem-solving process and strategies that can be used to solve problems	0.166	95	.510	.710	.910	.710	**ACCEPTED**	**3**
7	Students receive feedback from instructor which fades over time (e.g., during practical task assessment)	0.169	95	.500	.700	.900	.700	**ACCEPTED**	**6**

8	Students receive coaching from instructor	0.141	100	.530	.730	.930	.730	**ACCEPTED**	**2**
9	Students participate in Question and Answer session over problems that had occur	0.150	100	.490	.690	.890	.690	**ACCEPTED**	**9**
10	Students record their self-reflection to connect between what was learnt during face-to-face class to new knowledge learnt when solving problems in practical class	0.153	100	.500	.700	.900	.700	**ACCEPTED**	**6**

Note.

Conditions to be met:
Triangular Fuzzy Numbers

1) Threshold value (d) $\leq$ 0.2
2) Percentage of expert consensus $\geq$ 75%

Defuzzification Process :Fuzzy score (A) $\geq$ α –cut value of 0.5

All the items in the Instructional Strategies: Practical Class were ranked as important to be included in the PSFC module by the experts. The item with the highest defuzzification value is item 2: *Students perform technical skills*, with *d*-value of 0.750, whereas the item with the lowest defuzzification value is item 5: *Students assigned to produce a similar end product (without any guidance)*, with *d*-value of 0.683.

Consensus of Experts on the Importance of Instructional Strategies: After Class element of the PSFC module based on FDM

The Instructional Strategies: After Class element contains items to plan the after-class approaches in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.8. Among the items in the Instructional Strategies: After Class element, item 2, item 3, item 5 and item 10 were accepted as their respective percentage of expert consensus were more than 75%, and their respective *d*-values were less than 0.2. Majority of the experts agreed with the third item in the Instructional Strategies: After Class element with a defuzzification value of 0.726. This shows that the instructional strategy of students receiving individualised feedback based on their responses on the platform is very important for the PSFC module. Thus, this instructional strategy is ranked the first according to the consensus of experts for after class sessions.

Table 5.8

Experts' Views on Importance of the Instructional Strategies: After Class of the PSFC Module Based on the FDM

No.	**Instructional Strategies: After class**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Frequently encountered problems summarised during debriefing	0.166	53	.453	.653	.853	.653	REJECTED	-
2	Students create portfolio with photos and comments of tasks	0.152	100	.505	.705	.905	.705	**ACCEPTED**	**2**
3	Students receive individualised feedback based on their responses on platform	0.142	100	.526	.726	.926	.726	**ACCEPTED**	**1**
4	Students discuss with peers on platform on new ideas for using the new knowledge and skills	0.154	58	.463	.663	.863	.663	REJECTED	-
5	Students are assigned tasks during real-world performance of field experts during field trips (*e.g., Executive Chef and Master Butcher at hotels, local entrepreneurs*)	0.180	89	.474	.674	.874	.674	**ACCEPTED**	**3**

6	Students are assigned tasks during Fire Safety Demonstration by Fire Department	0.127	68	.442	.642	.842	.642	REJECTED	-
7	Students are assigned tasks during field trips to various institutional kitchens (*e.g.: international schools, hospitals, airlines, military*)	0.160	53	.442	.642	.842	.642	REJECTED	-
8	Students are assigned tasks during field trips to various food service suppliers (*e.g., factories, wet market, poultry farm, cattle farm, agriculture farm*)	0.127	68	.442	.642	.842	.642	REJECTED	-
9	Students are assigned tasks during career talks	0.115	68	.379	.579	.779	.579	REJECTED	-
10	Students are assigned tasks during team building activities	0.061	84	.411	.611	.811	.611	**ACCEPTED**	**4**
11	Students are assigned project-based team tasks (*e.g., Small-scale food catering for homeless, set-up buffet*)	0.152	58	.442	.642	.842	.642	REJECTED	-

Note.
Conditions to be met:
<u>Triangular Fuzzy Numbers</u>
1) Threshold value (d) ≤ 0.2
2) Percentage of expert consensus ≥ 75%

<u>Defuzzification Process:</u>
Fuzzy score (A) ≥ α –cut value of 0.5

Consensus of Experts on the Importance of the Resources element of the PSFC module based on FDM

The resources element contains list of items specifically lesson plans, stimulus materials and videos as resources in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.9. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the Resources element according to expert consensus is shown in Table 5.9. Majority of the experts agreed with Item 4: Stimulus material for the problem-based task which was ranked as the highest (*d* value: 0.747), followed by Item 1: Lesson plans for instructors (*d* value: 0.726). Sharing the third rank was both Item 4: Stimulus materials for problem-solving group task discussion and Item 11: Videos of problem-solving steps to solve problems (*d* value: 0.674).

Table 5.9

Experts' Views on the Importance of the Resources of the PSFC Module Based on the FDM

No.	**Resources**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Lesson plans for instructors	0.154	95	.530	.730	.930	.726	**ACCEPTED**	**2**
2	Stimulus material for problem-based task (*e.g., scenario and related information such as newspaper articles, graphs, tabulation of studies, scholarly articles, videos, emails, maps, other forms of written and visual media, assessment rubrics*)	0.118	75	.550	.750	.950	.747	**ACCEPTED**	**1**
3	Stimulus material for game-based problem-solving task (*e.g., real-world scenarios, challenges, rules*)	0.254	21	.440	.640	.840	.642	REJECTED	-
4	Stimulus material for problem-solving group task discussion (*e.g., List of main concepts, suggested responses, questioning strategies, assessment*	0.183	89	.480	.680	.880	.674	**ACCEPTED**	**3**

	criteria, *rubrics*, K-W-L table: Table of *Know What*, *Know How*, *Want to Know*, *Learned information*)								
5	Stimulus material for self-reflection task (*e.g.*, *structured guide, sample of good reflection, sample of poor reflection*)	0.203	42	.440	.640	.840	.642	REJECTED	-
6	Text-based content material (*e.g., articles, web links, e-books, scholarly articles, lecture notes)* with guiding questions to complete before class	0.182	42	.420	.620	.820	.621	REJECTED	-
7	Instructional videos to view with guiding questions to complete before class	0.166	53	.460	.660	.860	.653	REJECTED	-
8	Recipes videos to view with guiding questions to complete before class	0.142	63	.460	.660	.860	.653	REJECTED	-
9	Videos of common mistakes that may arise during food preparation	0.178	53	.440	.640	.840	.642	REJECTED	-
10	Videos of common crisis/changes in situation that may arise	0.162	53	.440	.640	.840	.642	REJECTED	-
11	Videos of problem-solving steps to solve problems	0.167	95	.470	.670	.870	.674	**ACCEPTED**	**3**

12	Visual-based resources for professional knowledge information *(e.g., images, infographics)*	0.157	58	.430	.630	.830	.621	REJECTED	-
13	Mind mapping materials (*e.g., Tools, techniques, videos, handouts)*	0.127	68	.450	.650	.850	.642	REJECTED	-
14	Mobile application related to content *(e.g., measurement app, converter app, food cost calculation app)*	0.156	63	.390	.590	.790	.589	REJECTED	-

Note.

Conditions to be met:

<u>Triangular Fuzzy Numbers</u>

1) Threshold value (d) ≤ 0.2
2) Percentage of expert consensus ≥ 75%

<u>Defuzzification Process</u>

Fuzzy score (A) ≥ α –cut value of 0.5

Consensus of Experts on the Importance of Platform/Technology element of the PSFC module based on FDM

The Platform/Technology element contains items to plan the platform and technology to deliver the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.10. Only Mobile Instant Messaging received agreement as the most important platform for delivering the PSFC module with 89% expert consensus and *d* value 0.674.

Table 5. 10

Experts' Views on the Importance of the Platform/Technology Element of the PSFC Module Based on the FDM

No.	Platform/Technology	Triangular Fuzzy Number Process		Defuzzification Process				Results	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	LMS (*e.g., Schoology, Edmodo*)	0.176	47	.463	.663	.863	.663	REJECTED	-
2	Stand-alone mobile application	0.198	47	.347	.547	.747	.547	REJECTED	-
3	Mobile Instant Messaging (*e.g., Telegram, WhatsApp*)	0.183	89	.474	.674	.874	.674	**ACCEPTED**	**1**
4	Content curation tool (*e.g., Blendspace*)	0.122	63	.411	.611	.811	.611	REJECTED	-
5	Microblogs (*e.g., Twitter, Facebook*)	0.205	47	.389	.579	.779	.582	REJECTED	-
6	Smartphone	0.198	37	.463	.663	.863	.663	REJECTED	-
7	Tablet	0.146	63	.368	.568	.768	.568	REJECTED	-
8	Blogs	0.162	53	.368	.568	.768	.568	REJECTED	-

*Note.*Conditions to be met:

Triangular Fuzzy Numbers

1) Threshold value (*d*) ≤ 0.2
2) Percentage of expert consensus ≥ 75%

Defuzzification Process. Fuzzy score (A) ≥ α –cut value of 0.5

Consensus of Experts on the Importance of Assessment Strategies element of the PSFC module based on FDM

The Assessment Strategies element contains items to devise the assessment strategies to assess content knowledge and problem-solving skills in the PSFC module. The threshold value (*d*), the percentage of expert consensus, defuzzification value and ranks for each item in the element according to expert consensus is shown in Table 5.11. Majority of the experts agreed with Item 11: Assessment of Performance of Practical task which was ranked as the highest (*d* value: 0.695). In the second rank was Item 1, Item 3 and Item 10, all with the *d* value of 0.674.

Table 5.11

Experts' Views on Importance of Assessment Strategies of the PSFC Module Based on the FDM

No.	**Assessment Strategies**	**Triangular Fuzzy Number Process**		**Defuzzification Process**				**Results**	
		Threshold value (*d*)	**Percentage of Expert Consensus, %**	**m_1**	**m_2**	**m_3**	***Fuzzy* Score (A)**	**Expert Consensus**	**Ranking**
1	Participation mark as incentive for completing before class work	0.183	89	.474	.674	.874	.674	**ACCEPTED**	**2**
2	Assess content knowledge: *Quiz*	0.142	63	.474	.674	.874	.674	REJECTED	**-**
3	Assess content knowledge: *Presentation*	0.162	95	.474	.674	.874	.674	**ACCEPTED**	**2**
4	Assess content knowledge: *Mindmap*	0.096	79	.400	.600	.800	.600	REJECTED	**-**
5	Assess content knowledge: *Short answers*	0.118	68	.411	.611	.811	.611	REJECTED	**-**
6	Assess problem-solving skill: Individual performance of articulation of problem-solving process using rubric	0.128	63	.421	.621	.821	.621	REJECTED	**-**
7	Assess problem-solving skill: Team performance on problem-solving task using rubric	0.127	68	.453	.653	.853	.653	REJECTED	**-**

8	Assess problem-solving skill: Portfolio	0.178	47	.442	.642	.842	.642	REJECTED	**-**
9	Assess problem-solving skill: Project-based team tasks (e.g., Small-scale food catering for homeless, set-up buffet)	0.152	58	.442	.642	.842	.642	REJECTED	**-**
10	Assess problem-solving skill: Self-reflection on problem-solving process	0.162	95	.474	.674	.874	.674	**ACCEPTED**	**2**
11	Assess problem-solving skill: Performance of Practical Task (e.g., Making mayonnaise, vegetable cutting, mystery basket)	0.169	95	.495	.695	.895	.695	**ACCEPTED**	**1**

*Note.*Conditions to be met:

Triangular Fuzzy Numbers

1) Threshold value (d) ≤ 0.2
2) Percentage of expert consensus $\geq 75\%$

Defuzzification Process

Fuzzy score (A) $\geq \alpha$ –cut value of 0.5

Summary of the findings of the FDM

The overall result of this phase was to select the elements to design and develop the PSFC module. The elements used to develop the PSFC module were selected based on gaining experts' consensus by adopting the FDM, which is an established decision-making approach that relies on experts' opinions to make decisions when forecasting. In this study, FDM was applied to select the PSFC module elements as well as to identify the ranking of the selected components of the elements used to guide the PSFC module development. The findings of the FDM can be summarised as shown in Table 5.12.

Table 5.12

Summary of the FDM Findings

	Elements of the PSFC Module	Rank
OBJECTIVE		
i.	Apply fundamental professional knowledge to solve real-world industry issues and/problems/new situations.	**1**
ii.	Identify problems and come up with possible solutions to handle problems caused by changes in situation (crisis).	**2**
iii.	Develop decision-making skills to solve real-world industry issues and/or problems.	**2**
iv.	Identify problems and come up with possible solutions to handle problems caused by mistakes in various situation.	**4**
CONTENT AREA TO DESIGN PROBLEMS		
i.	Standards of Professionalism: Work Behaviour and Personal Qualities	**1**
ii.	Food Safety: Hygiene and Sanitation	**2**
iii.	Kitchen Safety	**2**
iv.	Kitchen Fundamentals	**4**
v.	Cooking Methods and Temperature Control	**5**
vi.	Salad and Salad Dressing: Handling common problems during preparations, arrangement, and presentation	**6**
vii.	Breakfast Preparation: Handling common problems during preparations	**7**
viii.	Nutrition	**7**
ix.	Stocks: Handling common problems during preparation	**7**
x.	Sauces: Handling common problems during preparation	**7**
INSTRUCTIONAL STRATEGIES: BEFORE CLASS		
i.	Students access supportive content materials shared on platform to link before class activities with during class problem-solving activities	**1**

	Elements of the PSFC Module	Rank
INSTRUCTIONAL STRATEGIES: DURING CLASS		
i.	Students participate in whole class discussion/review of before class tasks shared on platform	**1**
ii.	Students receive coaching from instructor	**1**
iii.	Students receive feedback from instructor (which fades over time)	**3**
iv.	Students view demonstration/modeling of common mistakes that may arise during food preparation	**4**
INSTRUCTIONAL STRATEGIES: DURING PRACTICAL CLASS		
i.	Students perform technical skills	**1**
ii.	Students receive coaching from instructor	**2**
iii.	Students watch instructors demonstrate technical skills	**3**
iv.	Students assigned to handle crisis/changes in situation	**3**
v.	Students articulate their problem-solving process and strategies that can be used to solve problems	**3**
vi.	Students assigned to solve mistakes in various situation	**6**
vii.	Students record their self-reflection to connect between what was learnt during face-to-face class to new knowledge learnt when solving problems in practical class	**7**
viii.	Students receive feedback from instructor which fades over time (e.g., during practical task assessment)	**7**
ix.	Students participate in Question and Answer session over problems that had occur	**9**
x.	Students assigned to produce a similar end product (without any guidance)	**10**
INSTRUCTIONAL STRATEGIES: AFTER CLASS		
i.	Students receive individualized feedback based on their responses on platform	**1**
ii.	Students create portfolio with photos and comments of tasks	**2**
iii.	Students are assigned tasks during real-world performance of field experts during field trips	**3**
iv.	Students are assigned tasks during team building activities	**4**
RESOURCES/MEDIA		
i.	Stimulus material for problem-based task	**1**
ii.	Lesson plans for instructors	**2**
iii.	Stimulus material for problem-solving group task discussion	**3**
iv.	Videos of problem-solving steps to solve problems	**3**
PLATFORM		
i.	Mobile Instant Messaging	**1**
ASSESSMENT STRATEGIES		
i.	Assess problem-solving skill during practical class: Performance of Practical Task (e.g., Making mayonnaise, vegetable cutting, mystery basket and its variation)	**1**
ii.	Assess content knowledge: Presentation	**2**
iii.	Assess problem-solving skill: Self-reflection on problem-solving process	**2**
iv.	Participation mark as incentive for completing before class work	**2**

The results indicate that the PSFC module should consist of nine elements based on the consensus of experts. (See Table 5.12). For the Objective element, four objectives were considered important, whereas, for the Content element, 11 content areas to develop real-world problems were considered important. The instructional strategies element had four sub-elements, where one item was considered important, during face-to-face class (four items), during practical class (10 items) and after class (four items). For the resources element, four resources were considered important, one platform/technology was considered most important and four assessment strategies were considered important based on expert consensus.

Design of the PSFC Module

The design and development of the PSFC module took into account the input from FDM and the information gathered from expert reviews. The PSFC module design followed the elements for which experts achieved consensus for incorporation into the PSFC module.

Description of the PSFC module. The aim of the PSFC module is to develop students' problem-solving skills and improve their knowledge using problem-solving activities that are transferable to authentic professional problems. The instructional module consists of instructional materials that provide examples or guidelines for teaching real-world problems to students and instructional strategies to be used by instructors as a guideline for implementing the FC. The module consists of nine elements which have achieved a consensus of a panel of 19 experts for implementation during the module design. Following this, the module was developed based on the elements that the experts considered important in FDM. This chapter will detail the module development.

Elements in the PSFC model. The items that reached expert consensus were coherent with the principles of FC, the four phases of the First Principles of Instruction (Activation, Demonstration, Application and Integration) (Merrill, 2007) and the six methods of Cognitive Apprenticeship (Modeling, Coaching, Scaffolding, Articulation, Reflection and Exploration)(Collins et al., 1990).

Since it is advisable to convert part of a course, instead of the whole course when implementing the FC for the first time(Lee et al., 2014; Mok, 2014; Sharma et al., 2015), in this study, only few units were selected for students to experience initially (Hao, 2016). Among the selected topics achieving the highest consensus in FDM as being the most important topic to teach problem-solving not existing in the existing syllabus but unique to the PSFC module was "The Standards of Professionalism: Chef Identity and Work Ethics". The other selected topics were "Kitchen Safety, Food Safety and Kitchen Fundamentals" which is also included in the existing syllabus of the "Introduction to Western Cooking" module in the Basic Western course offered to first-semester Culinary Arts students at Community Colleges.

It is not surprising that the Kitchen Safety, Food Safety, and Kitchen Fundamentals were ranked higher than the rest as those topics expose students to the fundamentals needed for an entry-level job in the culinary industry (Reezlin Abdul Rahman et al., 2011). Thus, lessons were designed based on the themes that reached expert consensus and mapped to the existing curriculum. Since the Culinary Arts course at Community Colleges consists of both theoretical and hands-on practicum components, the lessons were planned to include both these components. Based on the topics selected, five lessons were designed to deliver the theoretical component, whereas the other four lessons were designed to deliver the hands-on practicum component. In all lessons, there is a "Before class" session and "After class" session.

It should be noted that the PSFC module replaced the traditional classroom entirely during the intervention.

The “Before class” session focuses on the delivery of professional knowledge that students will need to apply to solve real-world industry issues and problems or new situations during the face-to-face sessions. The only element which achieved expert consensus for “Before class” session is “Students access supportive content materials shared on the platform to link before class activities with during class problem-solving activities.” This means students access videos, lecture notes and other stimulus materials for problem-solving before class. This is to ensure that they come prepared before class and have prior knowledge which is aligned to the FC principles.

The objective achieving the highest consensus in FDM is “to apply fundamental professional knowledge to solve real-world industry issues and/problems/new situations”. This objective was consistent with the First Principles of Instruction (Merrill’s First Principles hereafter). Thus, this objective was incorporated in all the nine lessons by designing real-world issues and problems/new situations closely related to the students’ needs for future professional development or everyday life. To design the tasks, the cases, stories or scenarios were based on the content areas deemed suitable for problem-solving activities that could be incorporated into the module as suggested during the interview with instructors (needs analysis phases) and interview with experts (design phase).

The next step in the module development is to develop the lesson plans which serve as a guide for directions on activities for the instructor. The lesson plans were developed in the Malay language for four units: Standards of Professionalism Unit, Hygiene and Sanitation and Kitchen Safety and Kitchen Fundamentals. Based on the needs analysis findings, technical terms were still maintained in English and French without being translated into the national language. A summary of the elements selected by experts which were included in the PSFC module is summarised in Table 5.13.

Table 5.13

Elements Used to design the PSFC module based on expert consensus in FDM

Elements of the PSFC Module	Ranking	Rationale
OBJECTIVE		
Apply fundamental professional knowledge to solve real-world industry issues and/problems/new situations.	**1**	Use of real-world problems for instruction (Merrill,2002)
CONTENT TO DEVELOP REAL-WORLD PROBLEMS		
Standards of Professionalism: Work Behaviour and Personal Qualities	**1**	Partial flip (Only a few topics were selected: the most crucial topics to be mastered by students)
Food Safety: Hygiene and Sanitation	**2**	
Kitchen Safety	**2**	
Kitchen Fundamentals	**4**	
INSTRUCTIONAL STRATEGY: BEFORE CLASS		
Students access supportive content materials shared on platform to link before class activities with during class problem-solving activities	**1**	FC principle
INSTRUCTIONAL STRATEGY: DURING FACE-TO-FACE CLASS		
Students participate in whole class discussion/review of before class tasks shared on platform	**1**	Activation
Students receive coaching from instructor	**1**	Coaching
Students receive feedback from instructor (which fades over time)	**3**	Fading
Students view demonstration/modeling of common mistakes that may arise during food preparation	**4**	Modeling Demonstration
INSTRUCTIONAL STRATEGY: DURING PRACTICAL CLASS		
Students perform technical skills	**1**	Application
Students receive coaching from instructor	**2**	Coaching
Students watch instructors demonstrate technical skills	**3**	Modeling Demonstration
Students assigned to handle crisis/changes in situation	**3**	Application
Students articulate their problem-solving process and strategies that can be used to solve problems	**3**	Articulation
Students record their self-reflection to connect between what was learnt during face-to-face class to new knowledge learnt when solving problems in practical class	**7**	Integration - Reflection

Elements of the PSFC Module	Ranking	Rationale
INSTRUCTIONAL STRATEGY: AFTER CLASS		
Students receive individualized feedback based on their responses on platform	**1**	Coaching
RESOURCES		
Stimulus material for problem-based task	**1**	Demonstration phase – Relevant media
Lesson plans for instructors	**2**	Demonstration – Learner guidance
Stimulus material for problem-solving group task discussion	**3**	Demonstration phase – Relevant media
Videos of problem-solving steps to solve problems	**3**	Demonstration phase – Relevant media
PLATFORM		
Mobile Instant Messaging (e.g., *Telegram, WhatsApp*)	**1**	FC Principle
ASSESSMENT STRATEGIES		
Assess problem-solving skill during practical class: Performance of Practical Task (e.g., Making mayonnaise, vegetable cutting, mystery basket and its variation)	**1**	Application
Assess problem-solving skill: Self-reflection on problem-solving process	**2**	Reflection
Participation mark as incentive for completing before class work	**2**	FC Principle

The Framework of the PSFC design. The lessons in the PSFC model were not only designed based on expert consensus (achieved through FDM), but also integrate the design principles Merrill's First Principles (Merrill, 2012), Cognitive Apprenticeship (Collins et al., 1990) and the FC Model using the First Principles of Instruction (Lo & Hew, 2017). These principles provide a unique conceptual framework to implement the PSFC approach. See Figure 5.1.

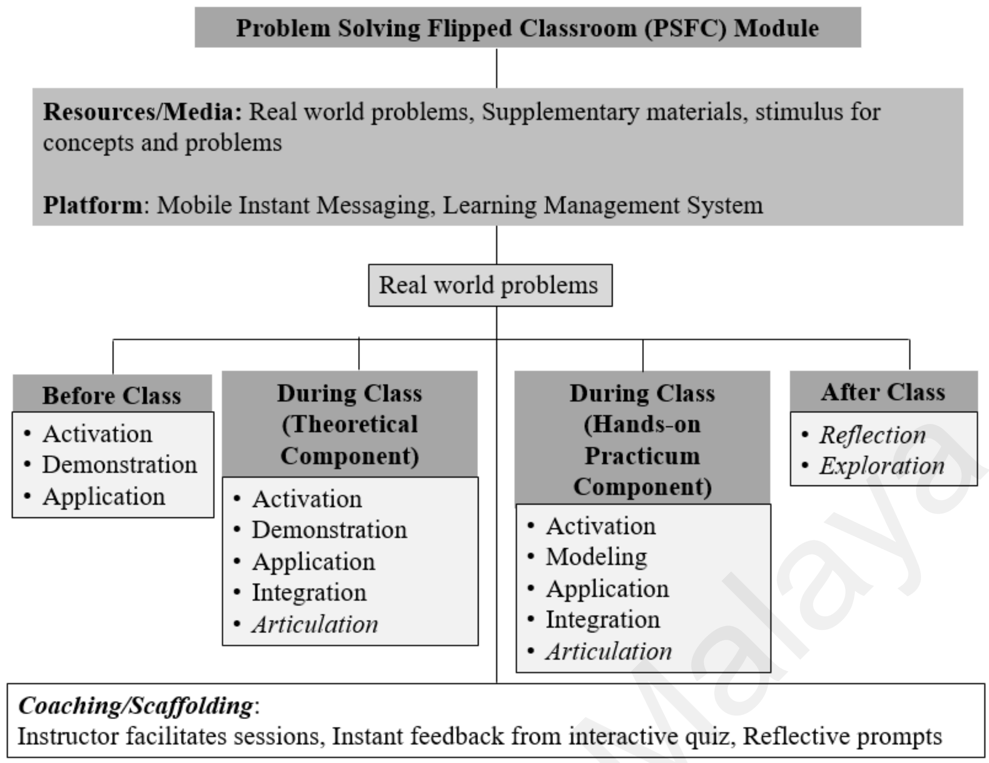


Figure 5.1 The PSFC design.

The "Before class" session in the PSFC module. In the PSFC module, low cognitive level objectives were selected for "before class" sessions (e.g., knowledge and comprehension) as students were required complete activities at their own pace (Gilboy et al., 2015; Khalil & Elkhider, 2016). During the "Before class" session, the Activation phase takes place to activate students' prior knowledge about the topic and prepare them for learning. During the Activation phase, instructor shares materials such as images or online polls to engage students or to assess their prior knowledge on the topic.

After the Activation phase is the demonstration (Modeling) phase to show students how to perform the real-world problem or task. Students will access various information resources such as instructional videos, interactive video quizzes, video presentation slides, related articles or cases, and notes. When watching instructional videos from the expert's perspective, students can pause at any time or playback the video. When watching interactive videos, they can test their understanding by answering simple quizzes embedded in the videos to assess low cognitive level objectives such as knowledge and comprehension to review the concepts learnt.

The "During class" session in the PSFC module. In the PSFC module, the activities focused on problem centred instruction which employs high-level objectives occurs during the face-to-face session (Gilboy et al., 2015; Khalil & Elkhider, 2016). In the Activation phase, the instructor initiates discussions regarding the before class tasks. In addition, students get to review the before class tasks by answering quizzes or watching more demonstrations consistent with learning goals. Demonstrations may consist of examples and non-examples (common mistakes), demonstration of procedures related to hands-on practicum tasks, visualisation of the process, and Modeling for behaviour.

After that, during the Application phase, students are given opportunities to apply the conceptual knowledge they have learned to solve real-world, relevant problems or tasks. During the theoretical component sessions, students sit in groups and practice solving authentic problems related to job contexts. More specifically, the problems designed to consist of potential problems in the culinary job context and how the problems can be solved or avoided. The problems designed are related to the students' needs for future professional development or immediate everyday life, authentic, and intrinsically motivating to the students.

During hands-on practicum sessions, instructors demonstrate the technical skills students need to perform. After replicating the technical tasks demonstrated by the instructor, students are also given the opportunity to solve more complex technical tasks related to job contexts. During problem-solving activities, the instructor provides feedback by sharing the cognitive and metacognitive processes when solving the problem by using metacognitive prompts supplied in the PSFC module. The instructor also gradually diminishes coaching, scaffolding, and feedback given to students, over time.

The "After class" session in the PSFC module. After lessons, students are encouraged to record their reflections so that they can link between what they have learned during the "before class" session to monitor their performance. Scaffolding is provided by providing students with reflective prompts to be used as guides when students articulate to describe their learning experience and challenges during the problem-solving process. Students are also given a task to explore what they have learned especially with regard to its integration to daily life and future careers. Figure 5.2 shows the flow of the teaching and learning activities in the PSFC module.

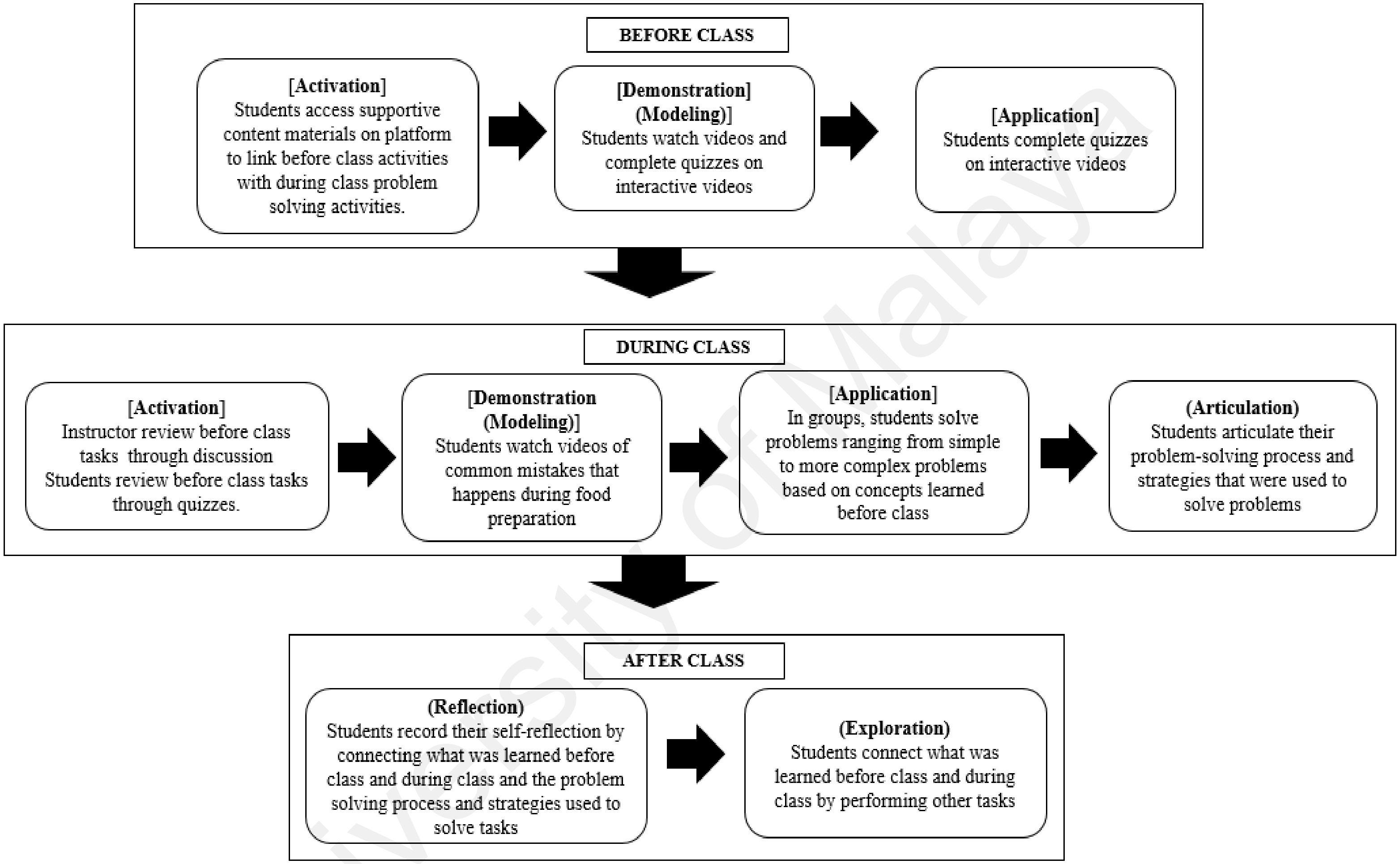


Figure 5.2 The flow of the teaching and learning activities in the PSFC module.

Expert review. A team of three experts was identified based on their experience and expertise in the field of FC, problem-solving and culinary arts. The educational technology expert, ET1, focused on the technical aspect and instructional design of the module, while SME1 and SME2 concentrated on the content of the module. See Table 5.14.

Table 5.14

Profile of experts during expert review

Expert	Position	Expertise	Years of Experience
ET1	Professor– Public University	Problem-solving, FC, Pedagogy, Technology in Education	29
SME1	Professor- Private University	Problem-solving, Culinary Arts	33
SME2	Senior Lecturer – Public University	Pedagogy, TVET, Culinary Arts, Home Economics Education	19

The experts evaluated the design documents of the lesson content. They provided comments and suggestions on module design during the meeting. The findings were reported based on the researcher's journal taken during the meeting. Three Researcher's Journals were kept for records: RJET1 for the meeting with ET1, RJSME1 for the meeting with SME1 and RJSME2 for the meeting with SME2. The experts expressed their concerns in the following areas: (a) number of lessons planned (b) the presentation of the lesson plans, and (c) the design and presentation of real-world problems.

Number of lessons planned. Both SME1 and SME2 were concerned about the number of lessons planned for the PSFC module implementation (RJSME1 and RJSME2). Experts suggested to only focus on critical aspects of the content area. Both experts were concerned that it might be challenging for the researcher to develop and implement so many lessons within the stipulated duration as lessons consist of both the theoretical component and the hands-on practicum component. The issue of the planned lessons for the PSFC module is valid as the researcher needs to develop a variety of instructional materials for all lessons. Thus, instead of 11 lessons planned initially, only nine lessons were retained as lesson 10-11 (involving meat cuts and seafood cuts) are quite similar to the way lesson 9 (poultry cuts) was planned.

Lesson Presentation.

Lesson plans are wordy and lengthy. ET1 and SME2 pointed out that the instructions in the lessons plans appeared too wordy and lengthy which may deter instructors from using the module (RJET1 and RJSME2). Thus, to enhance module readability, both ET1 and SME2 suggested the use of icons to represent the different phases in the module (RJET1 and RJSME2). SME2 suggested to simplify the sentences into shorter sentences and avoid long-winded sentences (RJSME2). SME2 also suggested that the rationale on why the lesson is being taught should be added at the end of the lesson plan so students can understand the relevance of the topic to their daily lives (RJSME2). So, it was decided that the instructions were made more concise to enhance readability and icons were designed to reduce the wordiness in instructions.

Lesson flow. SME1 suggested that the lesson flow be restructured. For example, the HACCP component should be taught as a separate lesson. Next, the Hygiene and Sanitation topic must be divided into two parts, Part 1: Personal hygiene can be taught separately in a single lesson, and part 2 should be on Food Handling and Preparation: Temperature Control, Cross contamination and Rodent and Insect Control. (RJSME1).

Grammar and sentences. Both ET1 and SME2 were meticulous in identifying and correcting the grammatical and spelling errors in the documents. It was observed that they evaluated the instructions given in the documents and suggested the use of more straightforward sentences and use of proper grammar to clarify instructions. For example, both experts highlighted that the term *pelajar* should be used instead of *pelajar-pelajar* and *masalah* instead of *masalah-masalah, imbas semula* instead of *reviu* and *di bahagian dapur* instead of *di dapur*. Accuracy in grammar was considered necessary to the experts. (RJET1 and RJSME2).

Need for additional facts and concepts for the first lesson. All three experts felt that the topic in Lesson 1 which concerns Standards of Professionalism is the most important topic in the PSFC module. The experts felt that the topic covers the attitudes and values that students must have and develop within themselves, thus boosting employability skills among students and preparing them to face the realities of the industry. (RJET1, RJSME1, and RJSME2).

However, SME1 voiced his concern that concepts on the historical aspect of modern food service were missing in lesson 1. SME1 believed that students must know the origins of classical and modern cuisine and the accomplishments of exceptional chefs revered by chefs such as Auguste Escoffier, the father of modern food service and Marie-Antoine Careme. The experts felt that students should be made familiar with the names and value the great contributions of great chefs. SME1 also suggested adding content on other kitchen organisations besides the hotel industry including as institutional kitchens such as airline catering. SME1 also suggested sharing success stories of Community College Culinary Arts alumni with students. Similarly, SME1 also suggested that students should be exposed to the Who's Who in the local culinary industry. SME1 also provided physical copies of two Beyond Culinary INNOCREATIVE Magazine Cookbook© which has details on the local culinary arts industry to be used by the researcher (RJSME1). Hence, additional content was added to lesson 1 to provide details on the culinary arts industry. The Beyond Culinary INNOCREATIVE Magazine Cookbook© was also available as an e-magazine (published online). Thus, students were required to subscribe to the e-magazine as a task for the exploratory phase of Lesson 1. Next, all the experts were of the opinion that the final module must be assessed by a Community College instructor to ensure the module feasibility (RJET1, RJSME1, and RJSME2).

Design and presentation of real-world problems. Both SME1 and SME2 provided valuable suggestions for designing real-world problems in the PSFC module. For instance, for lesson 2, SME1 suggested to not only include a sensorial test for herbs and spices which are in the market forms, but also include herbs and spices in powder form which is slightly more complex for students. So, it was decided to include a sensorial test for herbs and spices in powder form. Since problems need to be designed to progress from simple to complex as suggested by (Merrill, 2002), SME1 suggested that the instructor design a problem to create spice blends. SME 1 also suggested adding entrepreneurial aspects to some of the problems (RJSME1). So, it was decided that entrepreneurial aspects be embedded into certain problems whenever possible.

SME1 also suggested that titles should be given to the scenarios to make them more interesting, instead of labelling the scenarios as Problem 1.1 or Problem 1.2. which may be confusing for users (RJSME1). Instead of just using text-based scenarios, ET1 suggested that relevant images could be used to represent the scenario or used as a stimulus for the scenario. This will help less experienced learners to relate the scenario (in the text) to a useful pictorial representation (RJET1). The suggestions for improvement from experts were taken into consideration to effect the necessary improvisations before the module was developed and implemented. The next section covers the development of the PSFC module.

Development of the PSFC Module

The PSFC module development took into account the input from the FDM and the information gathered from expert reviews. The development of the PSFC module will be discussed according to the following: development of the platforms for module delivery, development of the resources and media for problem-solving tasks using existing materials and the development of the resources and media using real-world settings.

Development of the platforms for delivering the PSFC module. According to expert consensus, a mobile instant messaging app could be used to deliver the module. In this study, the *Telegram* platform was chosen to deliver the module as (a) it is available free of charge, (b) can be used not only to send/receive texts, images, audio and video but also documents in Microsoft Word (.docx), Excel (.xlsx) and portable document format (.pdf) which are the main document types used by lecturers to prepare notes, tutorials and assignments for sharing with students, (c) able to create a discussion group with a maximum number of 200 students), (d) can be installed in both smartphones and in laptop or desktop using *Telegram* for desktop application, (e) capability to synchronise any posted information among smartphone, laptop and desktop devices which enables messages to be read and replied in real time using these devices (Ibrahim et al., 2016).

In this study, *Telegram* was used to deliver “bite-sized” materials including *YouTube* links, interactive quiz links, images and links to online polls when facilitating the “Before Class” sessions. (See Figure 5.3). This method of presenting brief and precise information is less overwhelming for the learners and facilitates their learning (So, 2016). Instructors also used *Telegram* to post questions to students and answer students’ queries and post an announcement to students outside school hours. (See

Figure 5.4). Students also curate materials and share other media/resources on the Group *Telegram* to benefit their peers. (See Figure 5.5).

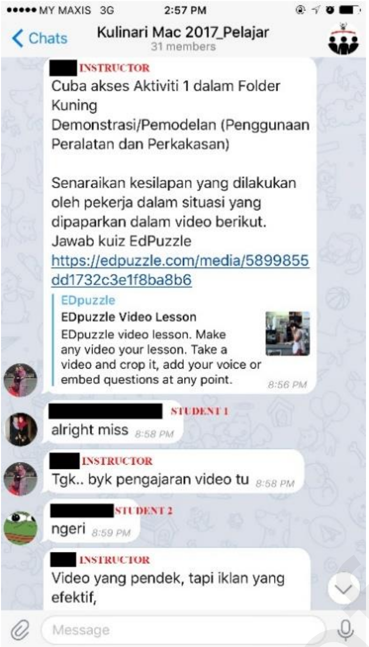


Figure 5.3 Instructors share links to students on the Group *Telegram.*

Figure 5.4 Instructor share images and announcements on the Group *Telegram*

Figure 5.5 Students share other media/resources with their peers on the Group *Telegram.*

Nevertheless, when using a mobile instant messaging app to deliver the module, the information is stored chronologically. Thus, a mobile instant messaging app may not be suitable as an administrative tool. Thus, to ensure a more organised implementation, the instructions and materials provided were also delivered using LMS. The use of LMS also ensures that instructors and students are aware of the required schedule during implementation. In this study, the *Schoology* platform was the LMS chosen to deliver the module as (a) it is available free of charge, (b) it has been created and is supported by a vast community of teacher practitioners, and (c) offers a very wide range of functionalities and affordances, comparable to commercial LMS (Flores et al., 2016). Both instructors and students could log in to the *Schoology* platform using the *Schoology iOS* or *Android* mobile application on their mobile devices to login to the mobile LMS. (See Figure 5.6).

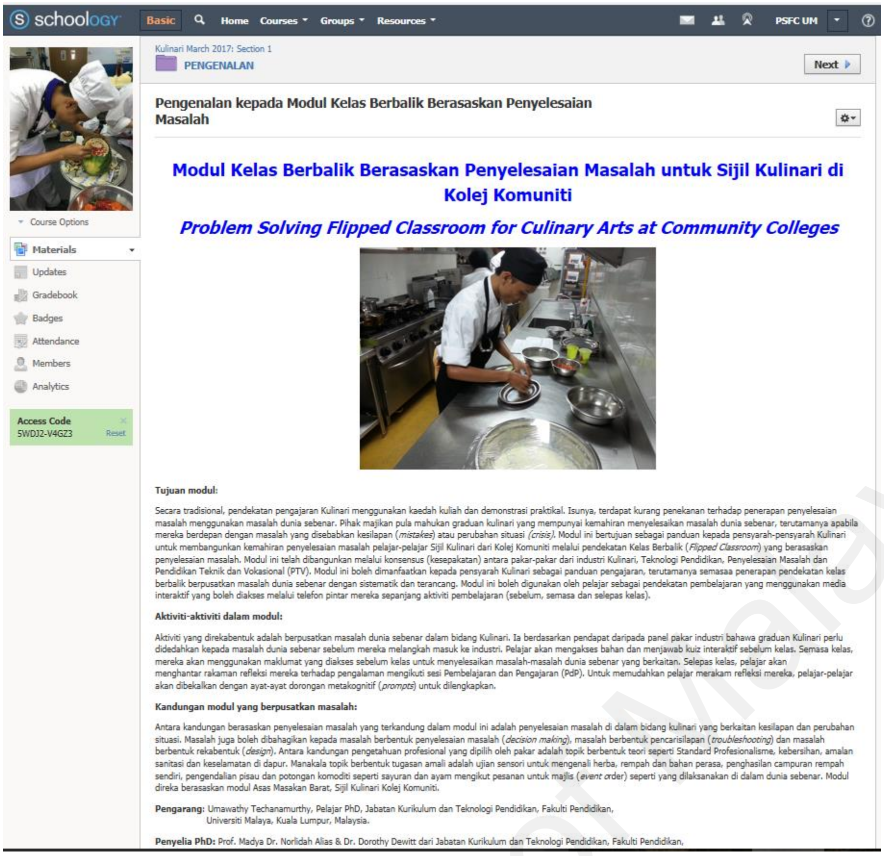


Figure 5.6 Screen capture of the introduction to the PSFC Module.

In the Cognitive Theory of Multimedia Learning (CTML), Mayer (2009) proposed design principles to enhance multimedia instruction. The two design principles used in this study were the Segmentation principle and the pre-training principle. The design principles in CTML state that learning is more effective when information is simultaneously transmitted through both pictorial and verbal channels. Using the Segmentation principle, a long and continuous lesson can be broken into small segments to improve learning. In the current study, instructions and materials were designed to be organised systematically into folders on the LMS, according to the nine lessons planned (See Figure 5.7).

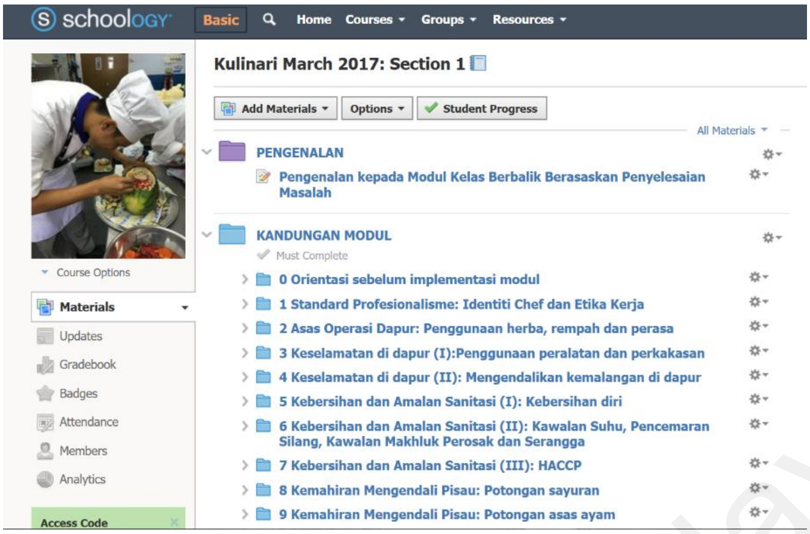


Figure 5.7 Screen capture of the list of lessons on PSFC module.

Each lesson folder was divided into three subfolders, namely "Before Class" session, "During Class" session and "After Class" session. Each lesson folder was further subdivided according to instructional materials for the different phases of instruction, namely: Activation, Demonstration/Modeling, Application, and Integration. As suggested by Maddux and Cummings (2007) the *Schoology* platform "could be described more accurately as a lesson plan format" (p. 120). Thus, in the current study, the *Schoology* platform was used to access instructions and materials systematically according to the seven major phases of instruction of the PSFC model in a lesson plan format. The seven major phases are as follows: Activation (*Fasa Pengaktifan*), Demonstration (*Fasa Demonstrasi/Pemodelan*), Application (*Fasa Aplikasi*), Integration: Articulation (*Fasa Integrasi:Artikulasi*), Integration: Exploration (*Fasa Integrasi: Eksplorasi*), Integration: Reflection (*Fasa Integrasi: Refleksi*), and Coaching and Scaffolding (*Bimbingan dan Maklum balas*). (See Figure 5.8 and Figure 5.9). To apply the segmentation principle, the lessons are broken into manageable parts. (See Figure 5.10).

Figure 5.8 Screen capture of the folders for the different phases of instruction.

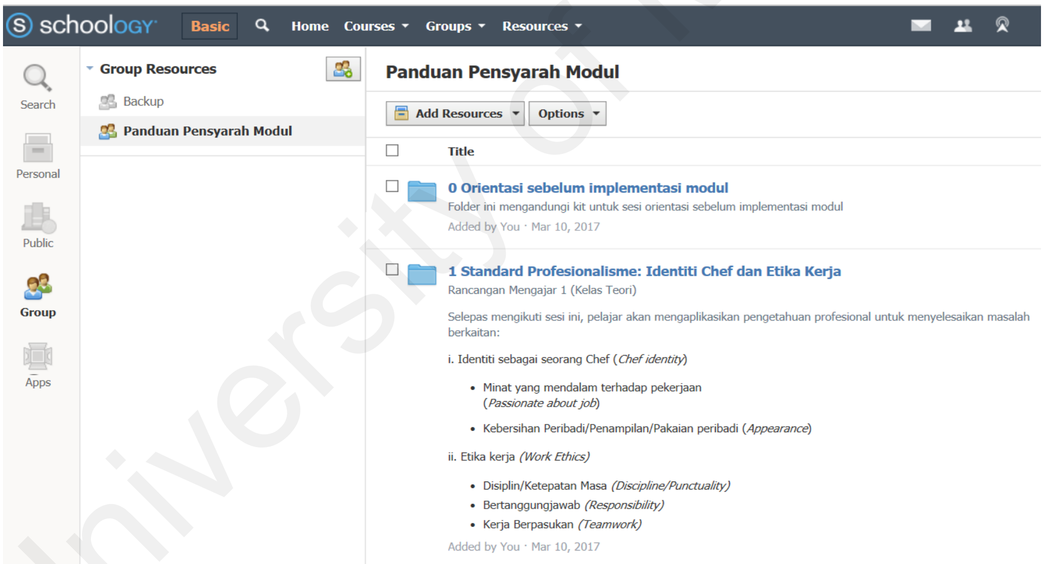


Figure 5.9 Screen capture of Instructors' guidance to the PSFC module arranged in a lesson plan format.

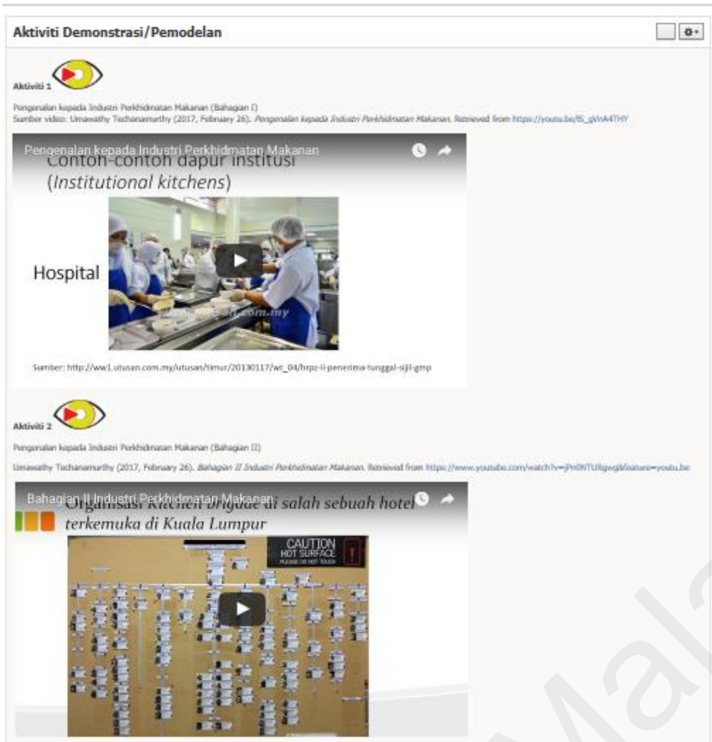


Figure 5.10 Screen capture of the segmentation principle where lessons are broken into manageable parts.

The next principle of CTML employed in the study is the pre-training principle: It is better that students are already familiar with the key concepts on which the lesson will rely. Using the PSFC module can be overwhelming for students and instructors. An orientation session at the start of the module implementation applies the pre-training principle. During orientation, I showed the different parts of the module, followed by some introductory videos and exercises during which each instructor and student used the PSFC module. Instructors were provided the Coaching/Scaffolding subfolder which consisted of step by step guidance on how to conduct the lesson systematically. (See Figure 5.11).

Figure 5.11 Screen capture of the pre-training principle for the orientation lessons with introductory exercises.

To apply the pre-training principle in lessons, the lesson shown in Figure 5.12 begins by students receiving pre-training in which they see pictures of how spices are sold locally and in a spice market in Istanbul. They then learn the names of the key herbs, spices, and seasonings such as allspice, paprika, oregano, basil, anise seed and cardamom using a Word Cloud. Following this portion of the lesson, students need to participate in a sensorial test to identify the names and characteristics of the herbs, spices, and seasonings used in a standard kitchen.

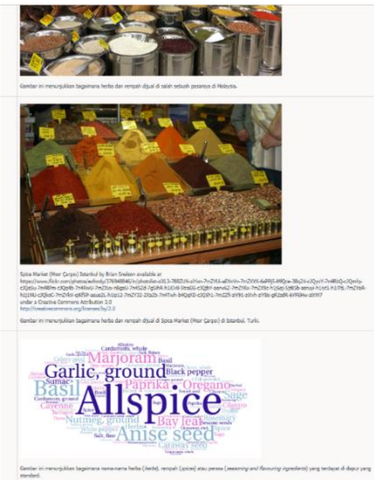


Figure 5.12 Screen capture of the pre-training principle for a lesson.

Development of real-world, relevant problem or task design for each lesson. In the FC, the understanding of concepts happens during the "before class" session whereas the knowledge of the principles that link theoretical concepts occurs when students solve tasks and problems during the face to face class or hands-on practicum class. Using authentic problems enables students to link concepts and practice. To design authentic problems, culinary arts instructors and chef practitioners from the industry were interviewed during the FDM phase to gather stories which contained background information, heuristics, real-world insights, and their identities (Jonassen, 2013; Schön, 1983). The stories were used to design problems based on the kitchen-related competencies and technical skills related to the job context issues, problem goals and expectations, the context of the problem, solution chosen/outcomes of solution/ lessons learned (Jonassen, 2013). Some real-world tasks were also designed based on the sample artefacts such as sample Hazard Analysis and Critical Control Points (HACCP) forms, menu, recipes, event orders, purchase orders, safety and hygiene posters provided by the chefs in the industry.

According to Soden (2013), problems in Culinary Arts can be characterised as problems caused by mistakes and problems caused by changes in situations. When mapped to the problem types outlined by Jonassen (2010), problems caused by mistakes as mentioned by Soden (2013) are similar to troubleshooting problems suggested by Jonassen (2010); whereas problems caused by changes in situations mentioned by Soden (2013) are similar to decision-making, design problems and dilemma problems suggested by Jonassen (2010).

In this study, the problem types covered during the face-to-face class of the theoretical component consists of problems caused by mistakes (troubleshooting problems) and problems caused by changes in situations (decision-making, dilemmas or design) solved through group discussions. Problem types covered during the hands-on practicum component were problems caused by changes in situations (design problems) which require performance of technical tasks such as inventing new spice blends and preparing vegetable cuts and poultry cuts according to event orders in groups. Instead of just one problem, a progression of problems was designed. Students start with a less complex problem that starts easy, and then gets harder and harder, and is relevant to their future careers or real-life. (See Table 5.15).

Table 5.15 *Design of Problems in the PSFC Module*

Lesson	Element	Task (Problem)	Problem Type Used
1	Standards of Professionalism: Work Behaviour and Personal Qualities	Task 1: Analyse job advertisements in the Food & Beverage industry Task 2 (a): Scenario: *Oh, team ku!* Task 2 (b): Create poster	Task 2 (a): Problems caused by changes in situations (Decision Making scenario) Task 2 (b): Design problem
2	Kitchen Fundamentals: Herbs, Spices, and Seasonings	Task 1: Sensorial test - Herbs, spices, and seasonings in market forms) Task 2: Prepare spice blends according to recipe Task 3: Create spice blend variation	Task 3: Design problem – entrepreneurial aspect
3	Kitchen safety (I): Use of Tools and Equipment	Task 1: Knife sharpening Task 2: Scenario: *Pisau oh Pisau* Task 3: Choose the right tools/equipment according to the recipe (quiz)	Task 2: Problems caused by mistakes (troubleshooting scenario) Task 3: Problems caused by changes in situations (Decision Making scenario)
4	Kitchen Safety (II): Preventing and dealing with kitchen accidents	Task 1(a): Preventing and dealing with falls Task 1(b): Preventing and dealing with fire accidents Task 1(c): Preventing and dealing with fire caused by unattended cooking Task 1(d): Reducing strain	Task 1(a): Problems caused by mistakes (troubleshooting scenario) Task 1(b): Problems caused by mistakes (troubleshooting scenario) Task 1(c): Problems caused by changes in situations (decision-making scenario) Task 1(d): Design problem scenario

5	Hygiene and Sanitation (I): Personal Hygiene	Task 1: Hands-on task: Handwashing Task 2: Personal hygiene quiz	Problems caused by changes in situations (Decision Making scenario)
6	Hygiene and Sanitation (II): Temperature Control for food safety, Cross contamination and Rodent and Insect Control	Task 1: Scenario: *Ahhchoo!* Task 2: Scenario: *Mmmm, sedapnya!* Task 3: Design problem – Hands-on task - Preparing a club sandwich for sale	Task 1: Problems caused by mistakes (troubleshooting scenario) Task 2: Problems caused by mistakes (troubleshooting scenario) Task 3: Design problem - entrepreneurial aspect
7	HACCP	Task 1: Scenario: Analysing Hazards using HACCP principles Task 2: Taking HACCP records using authentic forms	Task 1: Problems caused by mistakes (troubleshooting scenario) Task 2: Hands-on task: Taking HACCP records
8	Knife Handling: Vegetable Cutting	Task 1: Design problem (Prepare replica of vegetable cuts) Task 2: Hands-on task: Vegetable cutting Task 3: Design problem (Prepare vegetable cuts according to given event order)	Task 1-3: Design problem
9	Knife Handling: Poultry Cuts	Task 1: Design problem (Preparing poultry cuts according to given event order)	Task 1: Design problem

Development of resources and media based on pre-existing materials. According to the FDM, suitable resources and media need to be developed for problem-based tasks in groups. Considering that students prefer visual media (based on the needs analysis findings), instructional materials that aligned to each of the nine lessons in the module were gathered. Instructional materials can be pre-existing materials selected and then adapted or adopted to be incorporated into the module as well as materials developed specifically for the objectives.

However, with the use of pre-existing materials, one must take careful consideration in curating content specific to the audience. During the media selection process, the selection criteria outlined by Smaldino, Lowther, and Russell (2012) and Tucker (2013) were followed. All materials were reviewed to ensure the resources were used to their full potential and also to ensure students were not exposed to inappropriate content or foul language found in some videos or online or printed materials (Smaldino et al., 2012). Among the selection criteria used for evaluating were whether the instructional materials were alignment with objectives, information is accurate and up-to-date, comes from authoritative sources, and has good technical quality. When previewing the materials, the existing materials were ensured to present information using appropriate and understandable language in an organised manner with appropriate pacing so that students are likely to be interested and engaged. The videos also had to be easy to follow with cognitive learning aids such as overview, cues, and summary so that students can understand and process the information. (See Appendix M).

When selecting copyrighted materials, permission was obtained via e-mail to use copyrighted materials from government agencies (See Appendix N), scholarly articles (See Appendix O), online catalogue (See Appendix P), job search website (See Appendix Q) and food service establishments (See Appendix R) were obtained via e-mail. Table 5.16 shows the types of pre-existing materials selected as it fit the selection criteria and were used as instructional materials during the activation and demonstration (Modeling) phase.

Table 5.16

Types of Pre-existing Media and Materials Selected for Use

Source	Types of pre-existing media/materials	Purpose	Lesson #
YouTube	Instructional videos	Activation, Demonstration (Modeling)	All lessons
Government agencies	Posters, Brochures, Handouts, PDF copies of booklets downloaded from the provider's website, safety presentations, and materials, hygiene and sanitation presentations and materials	Activation, Demonstration (Modeling)	Lesson 5 Lesson 6
Food service establishments	Posters, Organization charts	Activation, Demonstration (Modeling)	Lesson 1, Lesson 5
Scholarly articles	Survey on Hygiene Practices of Food Handlers	Activation	
Newspaper articles	Newspaper articles on current issues (online version)	Activation	Lesson 2 Lesson 6
Catalogue	Catalog of Tools and Equipment used in a standard kitchen	Demonstration (Modeling)	Lesson 3
Job search website	Job advertisements related to Food, Beverage, Restaurant, Hotel	Demonstration (Modeling), Application	Lesson 1

Development of interactive quizzes based on existing *YouTube* videos.

The FC methodology has evolved with the development of advanced web tools, such as Interactive Video Learning Platforms (IVLP)(Leon, 2017). Unlike a typical video tutorial, interactive video quizzes allowed one to edit existing videos to meet learning needs. Users can select from a variety of features such as customised trimming, questioning to prompt reflection, and inserting source code to integrate another web content. The use of IVLPs adds a layer of interactivity missing in traditional distance video delivery, thus stimulating curiosity and increasing engagement (Leon, 2017; Tucker, 2013).

According to the needs analysis in Phase 1, students rarely came prepared for class. They also had poor content comprehension and knowledge retention to solve related problems. Thus, online quizzes were designed to check overall understanding of content and as a gatekeeper to ensure students came prepared before class. Hence, in the current study, *EdPuzzle* was chosen as the IVLP to deliver interactive quizzes based on existing *YouTube* videos to promote better content comprehension and knowledge retention after watching the videos. The *EdPuzzle* application was used to develop interactive video quizzes as it is a free application which integrates a layer of interactivity by allowing the user to trim videos and embed questions as knowledge checks. The quizzes help to ensure understanding of online instruction (Slomanson, 2014). To facilitate attentive viewing, each video starts by posing a signpost so that students know what to focus or what to look out for (Koumi, 2006). (See Figure 5.13).

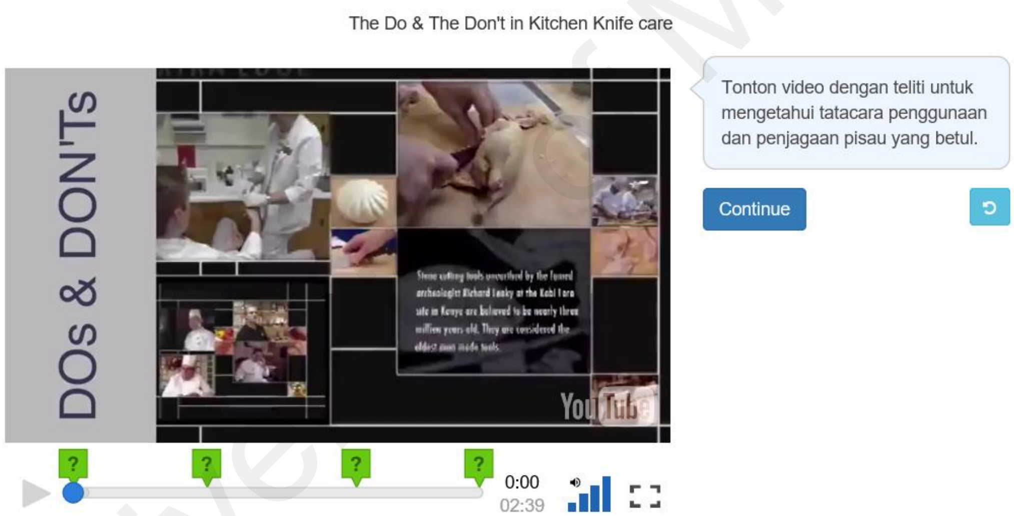


Figure 5.13 Screen capture is showing a signpost so that students know what to focus or what to look out for in the interactive quiz.

The knowledge check questions are shown as green squares with a question mark which students need to answer before they continue watching the video. (See Figure 5.14).

Figure 5.14 Screen capture of *EdPuzzle*'s Open Ended Question interactive quiz feature which embeds questions as knowledge checks.

Figure 5.15 shows the immediate feedback received after completing *EdPuzzle's* interactive quiz feature incorporated in the PSFC module.

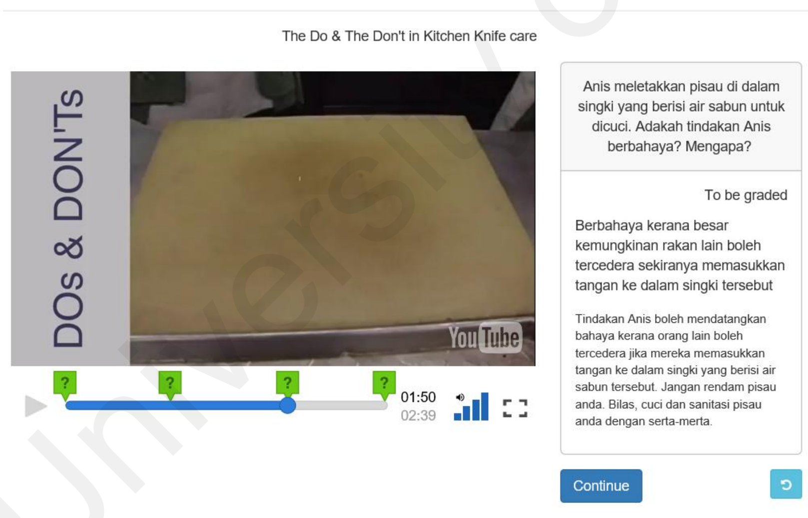


Figure 5.15 Screen capture of immediate feedback received after completing the quiz.

By using *EdPuzzle*, students' progress could be monitored. (See Figure 5.16).

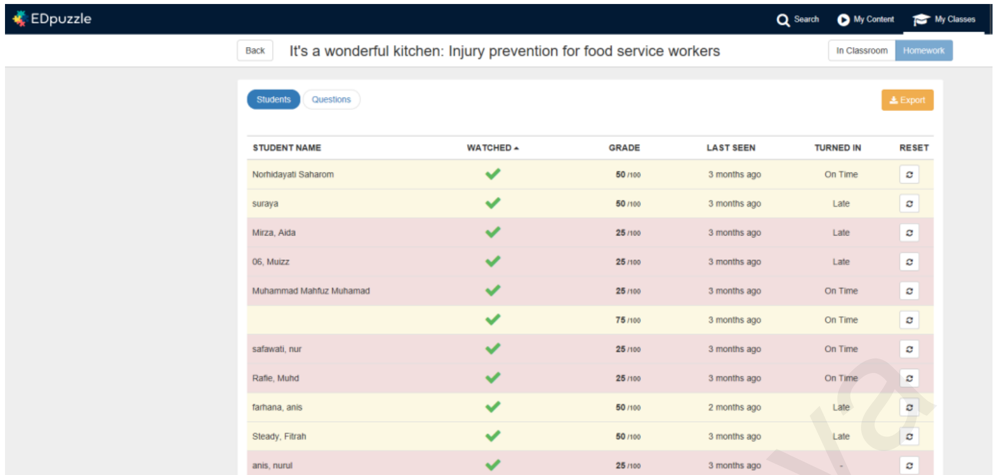


Figure 5.16 Screen capture of student progress in *EdPuzzle*.

Development of resources and media based on real-world settings. Despite the abundance of materials available online and offline, some resources and media did not quite align with the module objectives. In particular, there was lack of instructional materials and resources related to real-world problems and scenarios in the local context. This prompted me to gather relevant media, examples, and cases during the interviews with experts (Phase 2) and during multiple visits to the industry. After getting permission via e-mail from chefs from two five-star hotels in Kuala Lumpur (Hotel 1 and Hotel 2), arranged a meeting was arranged with the chefs at their respective restaurants to gather relevant instructional materials and resources. (See Appendix R).

Development of videos in real-world settings. A shooting plan consisting of a list of shots was planned to gather relevant media and materials that were used as a stimulus for designing the real-world problems based on the content area outlined in each lesson. The shooting plan was also used as a guide when shooting at the various locations in both the hotels, especially demonstrations of the performance of industry experts in the kitchens, in the receiving and storage area and the butchery department. See Table 5.17.

Table 5.17

List of Shots Planned for Developing Resources Taken at Real-world Settings

Date	**Location**	**Content Element**	**Scene/shot**
31/12/2016	Hotel 1: Kitchen	Work Behaviour and Personal Qualities	Chef Identity: Personal Hygiene/Appearance Work Ethics: Discipline/Responsibility/Teamwork/Punctuality Communication/ Passionate about job/Following Instructions/ Dealing with Customer Complaints, Dealing with Food Service Complaints
	Hotel 1: Kitchen Hotel 1: Kitchen	Kitchen Fundamentals	Tools and Kitchen Equipment
	Hotel 1: Kitchen	Food Safety: Hygiene and Sanitation	Personal hygiene practices Temperature Control for food safety practices in the industry The Hazard Analysis and Critical Control Point (HACCP) System practices in the industry
	Hotel 1: Storage area	Kitchen safety	Knife handling, Operation of machinery and equipment
03/01/2017	Hotel 1: Kitchen	Cooking Methods and Temperature Control	Heat transfer, moist-heat cooking and dry-heat cooking for various foods, seasoning and flavouring ingredients, using herbs and spices
		Kitchen Fundamentals	Tools and Kitchen Equipment
02/02/2017	Hotel 2: Kitchen	Work Behaviour and Personal Qualities	Chef Identity: Personal Hygiene/Appearance Work Ethics: Discipline/Responsibility/Teamwork/Punctuality

	Hotel 2: Kitchen		Communication/ Passionate about job/Following Instructions/ Dealing with Customer Complaints, Dealing with Food Service Complaints
	Hotel 2: Kitchen	Kitchen Fundamentals	Tools and Kitchen Equipment
		Kitchen safety	Knife handling, Operation of machinery and equipment
13/02/2017	Hotel 2 Receiving and Storage Area Hotel 2: Butchery Department	Food Safety: Hygiene and Sanitation	Personal hygiene practices Temperature Control for food safety Cross-contamination Rodent and Insect Control practices The Hazard Analysis and Critical Control Point (HACCP) System practices - when receiving items and storing items at the receiving bay, butchery department and at the restaurant

The basic equipment needed for producing media and materials in this study was the researcher's *iPhone 6S Plus* which could record HD video with 1920-by-1080-pixel resolution utilizing the 128GB storage space and 2GB RAM, a voice recorder, a laptop with built-in speaker, and multimedia editing software. Videos were edited directly on the *iPhone* using the *iMovie* application (see Figure 5.17) or using the *Adobe Premiere Pro CS6* software (see Figure 5.18).

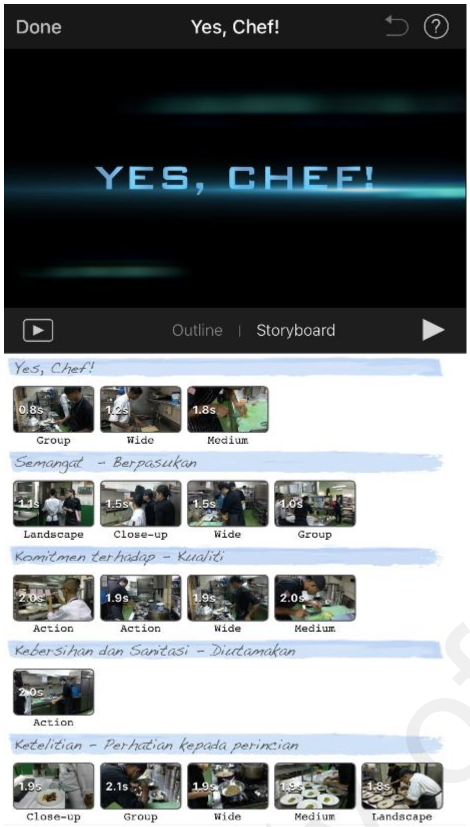


Figure 5.17 Video editing using *iMovie* application on *iPhone.*

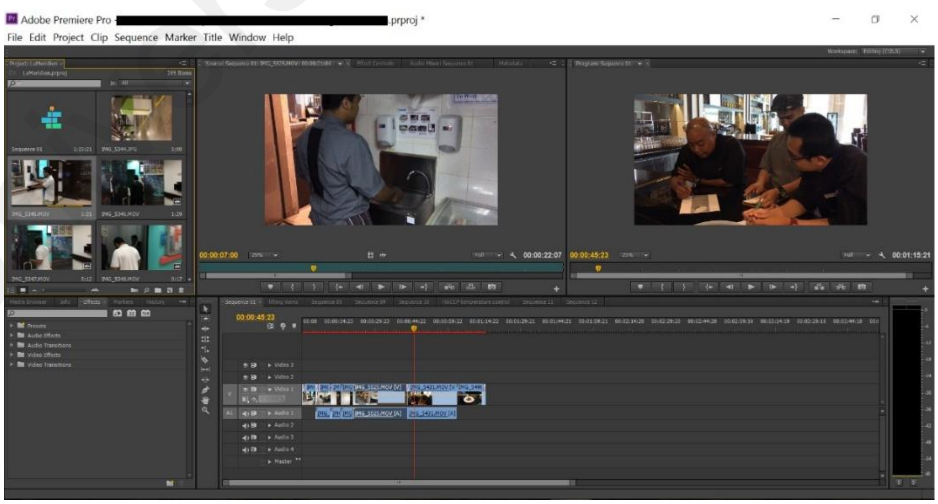


Figure 5.18 Video Editing using *Adobe Premiere Pro CS6.*

A total of more than 30 clips were developed by the researcher for inclusion in the module. The published videos were uploaded to the researcher's *YouTube* Channel (https://www.youtube.com/user/umabala1505). The students were able to access the videos on the PSFC module by watching the embedded *YouTube* video on the page on *Schoology*. (See Figure 5.19).

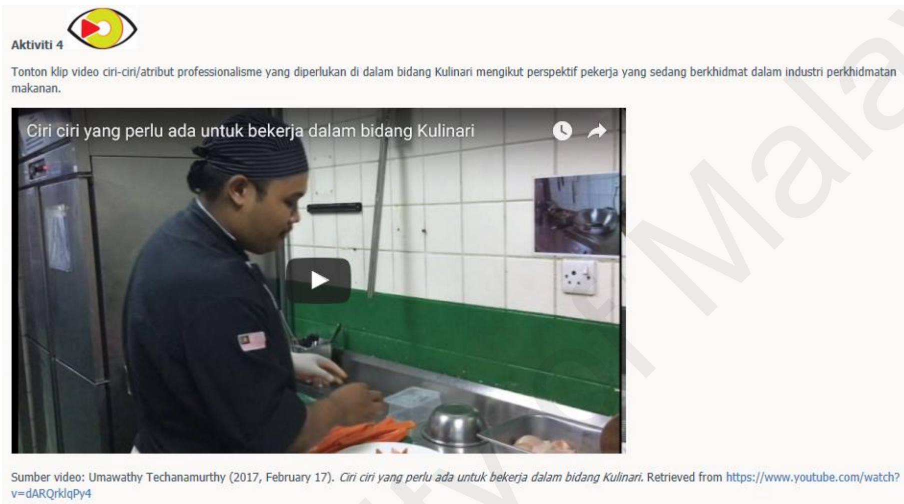


Figure 5.19 Screen capture is showing how videos are accessed from *Schoology.*

Development of quiz using Schoology's built-in quiz feature. Using *Schoology's* built-in quiz feature allowed for a variety of question types, namely, true/false, multiple choice, ordering, short answer, fill in the blank and matching types of questions. (See Figure 5.20).

Figure 5.20 Screen capture of Schoology's built-in quiz feature for a variety of question types.

Video clips and images captured at the workplace were used as stimulus materials to develop quizzes. See Figure 5.21.

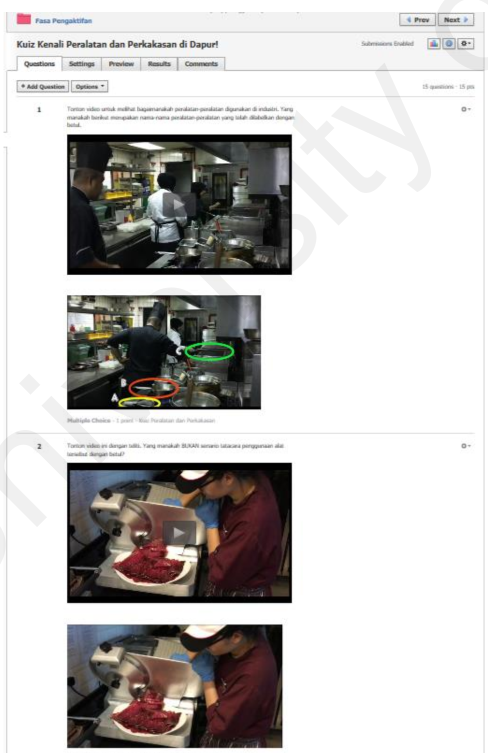


Figure 5.21 Screen capture of videos and images captured in the real setting used in *Schoology*'s built-in quiz feature.

The images captured were edited using graphics editing software such as Adobe Photoshop CS6 (to adjust the brightness, if necessary) or to remove confidential information. Images were also in the form of word clouds generated using *Wordle* (http://www.wordle.net/create/) based on text provided. Among the text used to generate word clouds were names of herbs, spices and seasonings, and words to describe the various herbs, spices, and seasonings which were then saved as images as used in Lesson 2. The captured still visuals were also used as activation or as stimulus materials for the lesson tasks. (See Figure 5.22).

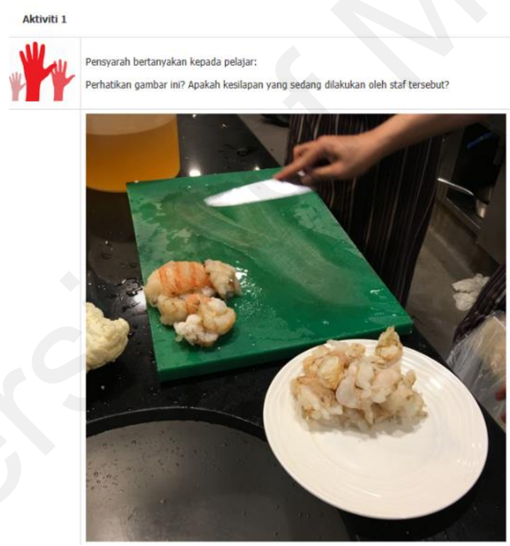


Figure 5.22 Use of image as a stimulus for Activation phase in the PSFC module.

Besides video and still visuals, the recorded audio clips of experts' opinions and personal experiences of interviewees were used as learning resources in the PSFC module. The audio clips were edited using a free audio editing software, *Audacity* (http://www.audacityteam.org/) to be used as a stimulus for tasks in the PSFC module. Figure 5.23 shows the use of audio clip as a stimulus for a task.

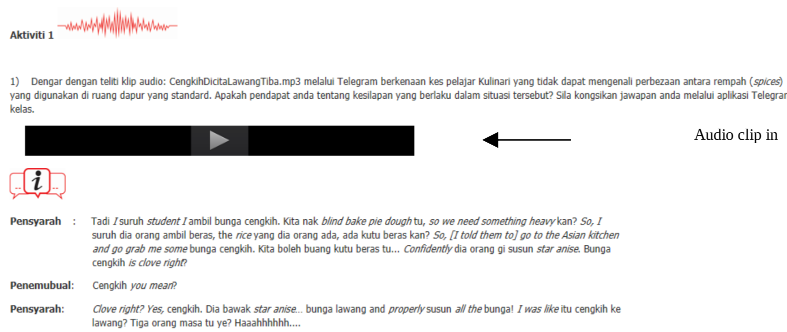


Figure 5.23 Use of audio clip as a stimulus for an activity in the PSFC module.

The other video resource I developed was one screencast made using the free version of the *Screencast-o-Matic* application. The screencast was used to demonstrate step-by-step how to complete a task in Lesson 1. It is observed that there was a yellow circle pointer movement during the screencast to guide students in following the steps. See Figure 5.24.

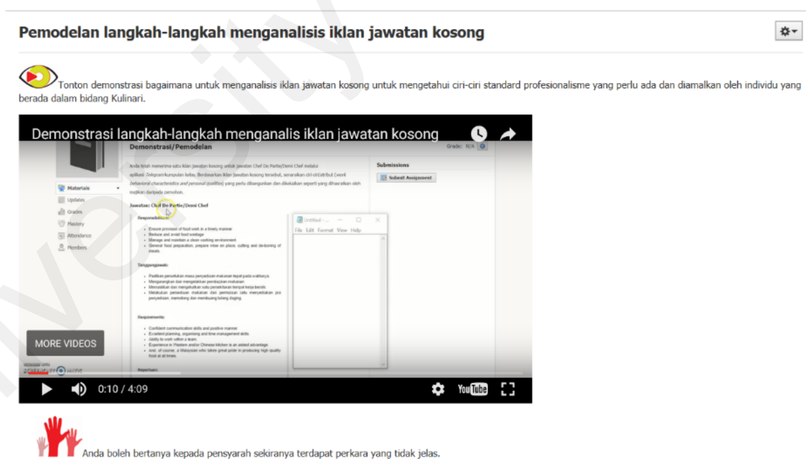


Figure 5.24 Screen capture of screencast to demonstrate step-by-step how to complete a task in Lesson 1.

In addition, two narrated video lectures were developed using *PowerPoint* slides in Lesson 1. The video lectures were a concise, informal narration of relevant graphics.

Using the pre-training principle, the content was sequenced to teach concepts before the process or procedure that is the focus of the lesson. An animated video was developed using *PowToon* to show problem-solving steps in Lesson 1. (See Figure 5.25). Music effect was added to increase students' attention when watching the animated video.

Figure 5.25 Screen capture of animated video created using *PowToon.*

Design of worksheets. Students' problem-solving steps were recorded on online worksheets designed using *Google Forms* application. *Google Forms* application is a free platform for creating surveys. (See Figure 5.26). The problem-solving steps followed the problem-solving stages suggested by Jonassen (1997) outlined the following problem-solving steps: articulating problem space and contextual constraints; identifying and clarifying alternative opinions, positions, and perspectives of stakeholders; generating possible problem solutions; assessing the viability of alternative solutions by constructing arguments; articulating personal beliefs; monitoring the problem space and solution options; implementing and monitoring the solution; and adapting the solution. Each group submits one worksheet to document the problem-solving process undertaken for the tasks.

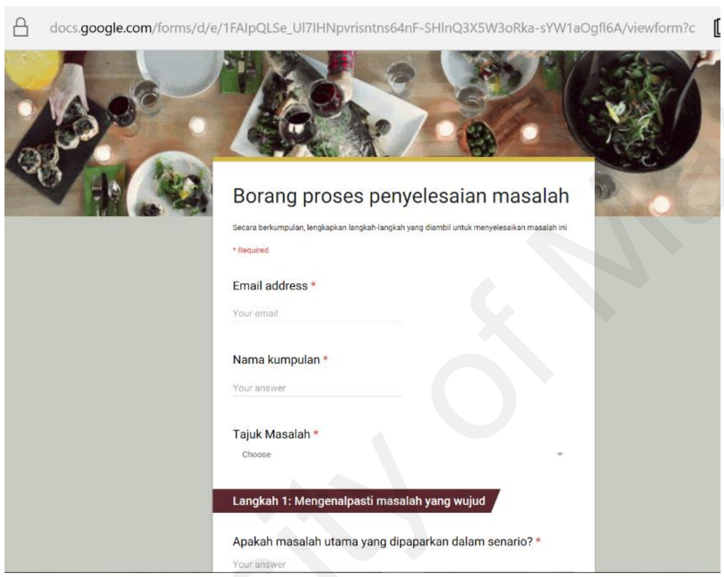
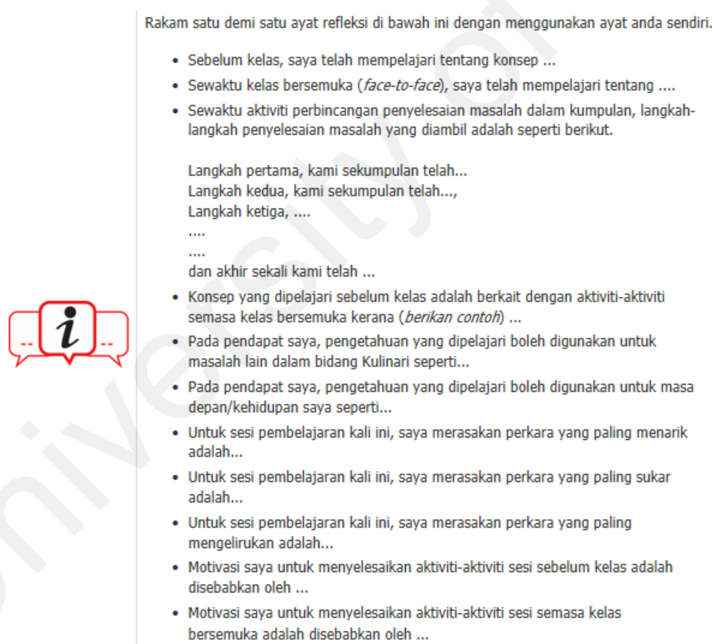


Figure 5.26 Screen capture of the problem-solving worksheet on *Google Forms.*

Design of reflective tasks for the Integration: Reflection Phase. In this study, the reflective prompts were used as a scaffold for students to verbally describe their understanding of concepts (before class), understanding of the principles that link concepts (during face to face class), and linking of concepts and principles to conditions and procedures for the application (during hands-on practicum class). (Gijbels, Dochy, Van den Bossche, & Segers, 2005), describe the problem-solving process (Jonassen, 1997) and their perception of their ability to do well on the task, the relative difficulty on the task and the relative attraction on the task (Sugrue, 1995). (See Figure 5.27). Next, in this study, existing rubrics from the current curriculum were adapted for assessing practical tasks such as knife sharpening, vegetable cuts, and poultry cuts. Instructors were also provided with metacognitive prompts for use when questioning students during their presentations. The metacognitive prompts were designed based on the problem-solving steps of Jonassen (1997). Model solutions were also provided in the platform as guidance for instructors in the *Bimbingan dan Maklumbalas* folder. Instructors can also accept any other acceptable answers.

Figure 5.27 Screen capture of reflective prompts.



Rakam satu demi satu ayat refleksi di bawah ini dengan menggunakan ayat anda sendiri.

- Sebelum kelas, saya telah mempelajari tentang konsep ...
- Sewaktu kelas bersemuka (*face-to-face*), saya telah mempelajari tentang ....
- Sewaktu aktiviti perbincangan penyelesaian masalah dalam kumpulan, langkah-langkah penyelesaian masalah yang diambil adalah seperti berikut.

  Langkah pertama, kami sekumpulan telah...
  Langkah kedua, kami sekumpulan telah...,
  Langkah ketiga, ...
  ....
  ....
  dan akhir sekali kami telah ...
- Konsep yang dipelajari sebelum kelas adalah berkait dengan aktiviti-aktiviti semasa kelas bersemuka kerana (*berikan contoh*) ...
- Pada pendapat saya, pengetahuan yang dipelajari boleh digunakan untuk masalah lain dalam bidang Kulinari seperti...
- Pada pendapat saya, pengetahuan yang dipelajari boleh digunakan untuk masa depan/kehidupan saya seperti...
- Untuk sesi pembelajaran kali ini, saya merasakan perkara yang paling menarik adalah...
- Untuk sesi pembelajaran kali ini, saya merasakan perkara yang paling sukar adalah...
- Untuk sesi pembelajaran kali ini, saya merasakan perkara yang paling mengelirukan adalah...
- Motivasi saya untuk menyelesaikan aktiviti-aktiviti sesi sebelum kelas adalah disebabkan oleh ...
- Motivasi saya untuk menyelesaikan aktiviti-aktiviti sesi semasa kelas bersemuka adalah disebabkan oleh ...

Development of online polls/survey. In this study, online polls were developed using the *Poll Everywhere* online system http://www.polleverywhere.com/. The *Poll Everywhere* website allows students to use their mobile devices to submit a response (Simonson, 2014) and add an element of interactivity to classes through audience participation (Said Abdul Fattah, 2015). In this study, the online poll was used to gather responses from students during the Activation phase to not only assess their prior knowledge but also to engage students in participating in the lesson. (See Figure 5.28).

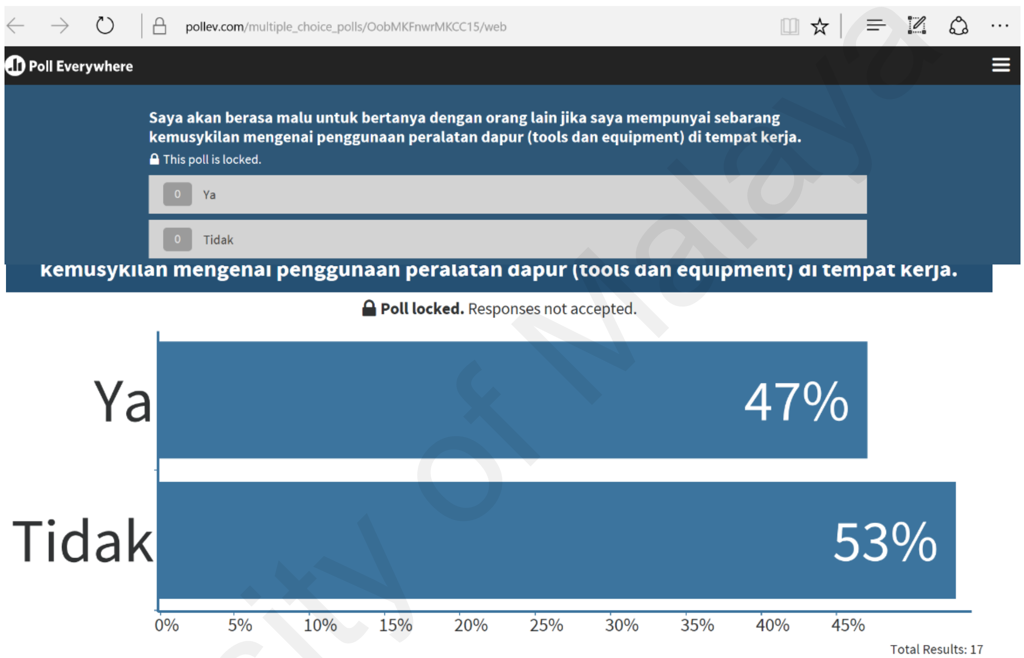
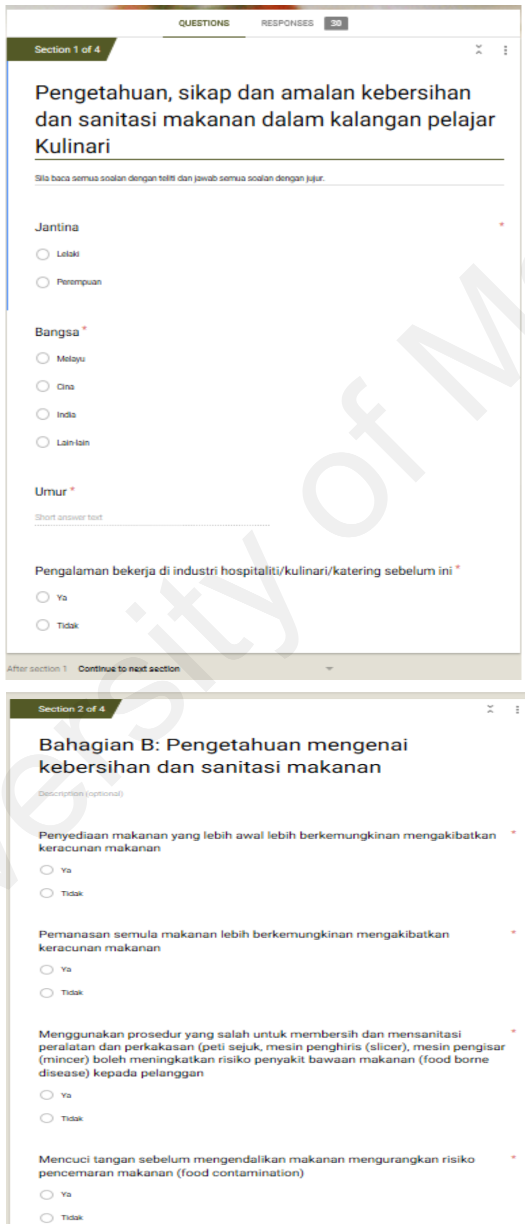


Figure 5.28 Screen capture of the *Poll Everywhere* online poll system used in the PSFC module.

A survey was also designed using *Google Forms* to gather students' prior knowledge of hygiene practices based on a scholarly article written by Abdul-Mutalib et al. (2012). (See Figure 5.29). Permission to use this survey was sought via e-mail from the corresponding author of the paper. (See Appendix N).


QUESTIONS RESPONSES 30

Section 1 of 4

Pengetahuan, sikap dan amalan kebersihan dan sanitasi makanan dalam kalangan pelajar Kulinari

Sila baca semua soalan dengan teliti dan jawab semua soalan dengan jujur.

Jantina *
- Lelaki
- Perempuan

Bangsa *
- Melayu
- Cina
- India
- Lain-lain

Umur *

Short answer text

Pengalaman bekerja di industri hospitaliti/kulinari/katering sebelum ini *
- Ya
- Tidak

After section 1 Continue to next section

Section 2 of 4

Bahagian B: Pengetahuan mengenai kebersihan dan sanitasi makanan

Description (optional)

Penyediaan makanan yang lebih awal lebih berkemungkinan mengakibatkan keracunan makanan *
- Ya
- Tidak

Pemanasan semula makanan lebih berkemungkinan mengakibatkan keracunan makanan *
- Ya
- Tidak

Menggunakan prosedur yang salah untuk membersih dan mensanitasi peralatan dan perkakasan (peti sejuk, mesin penghiris (slicer), mesin pengisar (mincer) boleh meningkatkan risiko penyakit bawaan makanan (food borne disease) kepada pelanggan *
- Ya
- Tidak

Mencuci tangan sebelum mengendalikan makanan mengurangkan risiko pencemaran makanan (food contamination) *
- Ya
- Tidak

Figure 5.29 Screen capture of the survey on *Google Forms.*

Table 5.18 shows a summary of the types of media and materials developed or adapted for the PSFC module.

Table 5.18

Summary of the Types of Materials Developed or Adapted for the PSFC Module

Developed materials	**Types of materials**	**Application/ Software used**	**Phase used**	**Lesson #**
Interactive video quiz	Adapt existing *YouTube* videos by embedding questions to create interactive quizzes	*EdPuzzle*	Activation, Demonstration (Modeling),	All lessons
Online Quiz	Create quiz using images, video, and notes	*Schoology*	Activation	Lesson 2, Lesson 3,
Videos	Real-world performance of experts Real-world scenarios at industry	Videos shot using an *iPhone* and edited using *iMovie,Adobe Premiere Pro CS6*	Activation, Demonstration (Modeling)	All lessons
Still visuals from food service establishments	Real-world performance of experts Real-world scenarios at industry Sample artefacts (event orders, HACCP forms, menu, purchase orders, safety posters)	*Adobe Photoshop CS6*	Activation, Demonstration (Modeling) Application	All lessons
Still visuals as stimulus for tasks	Job advertisements	*Adobe Photoshop CS6*	Application	Lesson 1
Word cloud based on text provided	Text: names of spices, herbs, and seasonings Text: words used to describe spices, herbs, and seasonings	*Wordle*	Demonstration (Modeling), Application	Lesson 2
Screencasts	Recording what is happening on the computer screen to model tasks	*Screencast-o-Matic*	Demonstration (Modeling)	Lesson 1
Video lectures	Narrated *PowerPoint*, *PowerPoint* with embedded videos	*Microsoft PowerPoint 2010*	Demonstration (Modeling)	Lesson 1
Animated video	Electronic presentations demonstrating problem-solving steps, step by step.	*PowToon*	Demonstration (Modeling)	Orientation module
Online Poll/Survey	Creating poll activities: multiple choice and clickable images for students to respond using their devices	*PollEverywhere* *Google Forms*	Activation	Lesson 3 Lesson 4 Lesson 5
	Online Survey on Hygiene Practices of Food Handlers (Abdul-Mutalib et al., 2012)	*Google Forms*	Activation (During Face-to-Face)	Lesson 5
Audio recordings	Experts' opinions Personal experiences of interviewees	Recorded using a *Sony IC Recorder*, then edited using *Audacity*	Demonstration (Modeling)	Lesson 1, Lesson 2

PDF documents	Translation of video to the Malay language as reference Brochures, notes	*Microsoft Word 2010*	Coaching and Scaffolding	All lessons
SRT files	For displaying subtitles on *YouTube* videos	*Notepad*	Coaching and Scaffolding	All lessons
Worksheets	Problem-solving worksheet based on Jonassen (1997)	*Google Forms*	Coaching and Scaffolding	All lessons

Activity/Task/Problem Design of One Theoretical Component Lesson

This section discusses an example of one theoretical component lesson (Lesson 3), designed using the PSFC model, which is divided into "before class", "during face-to-face", and "after class" sessions. The uniqueness of this lesson is the way it was designed to approach the concept of kitchen safety by enabling students to know the proper terms and proper use of tools and equipment used in a standard kitchen using authentic examples. The lesson flow also followed the framework shown in Figure 5.2.

Lesson 3 (Theoretical Component): "Before class" session.

Lesson Title: Kitchen safety (I): Use of Tools and Equipment

Learning Outcomes: At the end of this lesson, students will be able to:

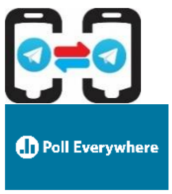
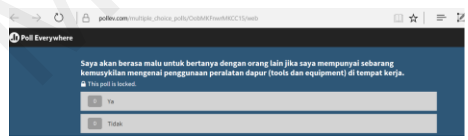
i. Identify the correct terms of the tools and equipment used in a standard kitchen

ii. Identify safe knife handling practices

The before class session starts with Topic 1: Tools and Equipment in a Standard Kitchen. (See Table 5.19). During the Activation phase, the instructor shares a poll on *PollEverywhere* (https://www.polleverywhere.com/) to gather students' responses if they would ask others if they had any queries on the use proper use of tools and equipment in the kitchen. This poll was designed as culinary instructors and experts have expressed their concerns that students rarely ask questions at the workplace. After getting the response from students, the instructor shares a poster based on the statistics of workplace accidents to create awareness on safety issues at the workplace.

Table 5.19

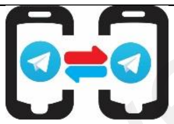
Before Class Session: Activation phase (Lesson 3: Topic I)

Phase	Steps	Task/Problem
Activation  	The instructor starts the session by sharing the online poll on *Poll Everywhere* through the class group *Telegram* for the Activation phase.	Online poll: *Alahai, malunya saya!* Would you feel shy to ask the others if you any queries/concerns/doubts regarding the use of tools and equipment in the workplace? Option: Yes/No Link: https://pollev.com/multiple_choice_polls/OobMKFnwrMKCC15/web
Activation 	Students answer poll by clicking the link provided.	
Coaching/ Scaffolding 	i. The instructor gives feedback based on students' responses. ii. The instructor encourages students to reduce shyness and ask if there are any inquiries or doubts relating the use of tools and equipment at the workplace as the implications may be serious.	Instructor shares the "ASK IF YOU DON'T KNOW" poster (TANYA JIKA TAK TAHU.jpg) with students. 
	Instructor informs students the learning outcomes of the lesson. Instructor informs students that they need to be able to identify the names of *tools and equipment* used in a standard kitchen to ensure safety at the workplace.	At the end of this lesson, you will be able to: i. Identify the correct terms of the tools and equipment used in a standard kitchen ii. Identify safe knife handling practices

The “before class” session continues with the Demonstration (Modeling) phase of Topic 1: Tools and Equipment in a Standard Kitchen. (See Table 5.20). The instructor shares a powerful advertisement on workplace accidents that serves as an example of the consequence when a new worker does not ask, especially when the person is unfamiliar with tools and equipment used at the workplace. Students are required to answer the interactive quiz on *EdPuzzle* to recognise information. After emphasising the proper use of tools and equipment in the kitchen, the instructor asks students to go through an online catalogue containing examples of different types of tools and equipment used in the standard kitchen. The catalogue is used with permission. Students are reminded to go through the catalogue as they need to answer a quiz on the types of tools and equipment used in a standard kitchen during the face-to-face session.

Table 5.20

Before Class session: Demonstration/Modeling Phase (Lesson 3: Topic I)

Phase	Steps	Task/Problem
  EDpuzzle	The instructor asks students to access the I *Demonstrasi/Pemodelan (Penggunaan Peralatan dan Perkakasan)* folder through *Schoology* to complete Activity 1. Refer to the translation script of the videos provided. (Click Info > View Attachments) Suggested Answers: i. A new employee does not recognize the name of spices like poppy seed ii. A new employee does not ask how to handle the slicer machine first.	**Activity 1** EDpuzzle Students answer the interactive quiz through *EdPuzzle* application Link: https://edpuzzle.com/media/5899855dd1732c3e1f8ba8b6 Source: WorkSafe Victoria (2011, August 16). *Young Worker -- Bakery TV Commercial.* Retrieved from https://www.youtube.com/watch?v=uMecBA_MHfA

Coaching/ Scaffolding 	The instructor provides feedback that students need to identify the names and usage of tools and equipment in a standard kitchen.	
Demonstration/ Modeling Activity 2 	The instructor asks students to access the I Demonstrasi/Pemodelan (Penggunaan Peralatan dan Perkakasan) folder through *Schoology* to go through the Kitchen Tools and Equipment catalogue (**Peralatan Dapur.pdf**)	Read the catalogue carefully, file name: **Peralatan Dapur.pdf**. You have to answer a short quiz to identify the tools and equipment used in a standard kitchen during the face-to-face class tomorrow. You will know more about the use of tools and equipment for food preparation during the group discussion activities at the face-to-face class. **Activity 2**  Access the EuroChef 2015 – 2016 catalog. Retrieved from http://www.eurochefworldwide.com/downloads/

The lesson is continued with the next topic titled "Safe knife handling practice." The instructor starts the Activation phase through the class group *Telegram* by asking students to describe the difference between the two images of a chef holding different types of knives. The instructor then provides feedback to the students based on their responses. (See Table 5.21).

Table 5.21

Before Class session: Activation phase (Lesson 3: Topic II: Safe Knife Handling Practice).

Phase	Steps	Task/Problem
Activation 	The instructor starts the next topic by sharing two images through the class group *Telegram* for the Activation phase.	 Chef holding a tourne knife  Chef holding a pair of Chef Knife
Activation 	Instructor poses the following questions to students:	Can you identify the difference between the knives shown in both the pictures? Knives are a Chef's best friend. What is the proper way of handling and taking care of a knife?
Coaching/ Scaffolding 	The instructor gives feedback based on students' responses. Instructor informs students that there are different knives used in the standard kitchen and each knife has its own purpose. The first image shows a *tourne knife* used to cut vegetables. The next image shows the Chef holding two Chef Knives. The Chef Knife is the most used knife as it can be used to cut most types of food.	

In this section, the students watch a lecture video created from a *PowerPoint* slide which covers the various example of knives used in a standard kitchen using still visuals from the catalogue (used with permission). (See Appendix P). To add authenticity to the content, the lecture video also includes short video clips of how experts sharpen knives, store their knives, and how they use knives for food preparation in local five-star hotels. The instructor provides feedback to students if they have any queries on the lecture videos. Students then complete an interactive quiz related to information on the example and non-examples of handling knives in a standard kitchen. When concluding the "before class session," the instructor explains the rationale of the lesson and reminds students to come prepared for the quiz on tools and equipment which will be held during the face-to-face session. See Table 5.22.

Table 5.22

Before Class Session: Demonstration (Modeling) Phase (Lesson 3:Topic II)

Phase	Steps	Task/Problem
	The instructor asks students to complete Activity 4 on *Schoology*.	**Activity 4** Access the *PowerPoint* slide to find learn about the different types of knives and knife handling in a standard kitchen.
Coaching/ Scaffolding	The instructor provides feedback if students have any queries on the use different types of knives and knife handling in a standard kitchen.	
Demonstration/ Modeling Activity 2	The instructor asks students to complete Activity 5 Refer to the translation script of the videos provided. (Click Info > View Attachments > The Do & The Don't in Kitchen Knife Care.pdf)	**Activity 5** EDpuzzle Students answer the interactive quiz through *EdPuzzle* application Link: https://edpuzzle.com/media/58903fee0c3a253e031ba704 Source: Arcane Chest. *The Do & The Don't in Kitchen Knife care.* (2014, April 24). [Video file]. Retrieved from https://www.youtube.com/watch?v=xCjNtlYldHg. Duration: 2:39
Coaching/ Scaffolding	1. Instant feedback from the interactive quiz. 2. Suggested answers for instructor guidance.	
Conclusion	1. The instructor asks students to conclude the concepts covered during the session. 2. Instructor informs students that they will learn more about the aspects of kitchen safety concerning the usage of tools and equipment and knife handling during the face to face session. 3. The conclusion is made by explaining the rationale the topic is learnt which is to provide exposure to students about the use of tools and equipment in a standard kitchen and the safe handling of knives so that students will be readier to join the workforce. 4. Instructor informs students that they need to prepare for a quiz on *Schoology* which will be conducted during the face-	

Phase	Steps	Task/Problem
		to-face class. The questions will be based on the catalogue of tools and equipment provided.
	5.	Students will receive participation marks for completing before the class task.

Lesson 3 (Theoretical Component): During face-to-face class. This next section focuses on the lesson plan for the "during class" session for Lesson 3: Theoretical Component for Kitchen Safety (Part 1). The first topic is the "Use of Tools and Equipment." The activities in this section require students to apply the concepts learned in the "Before class" session.

Lesson Title: Kitchen safety (I): Use of Tools and Equipment (Theoretical component)

Learning Outcomes: At the end of this lesson, students will be able to apply professional knowledge on kitchen safety to solve problem related to: tools and equipment used in a standard kitchen and safe knife handling practices

During the Activation phase, students are required to demonstrate the previously required knowledge by answering a quiz based on the tools and equipment catalogue they were asked to access during the "before class" session. However, the twist was the quiz contained images of the tools and equipment in the real workplace setting gathered by the researcher during the visits to the industry. Students were allowed to check the catalogue when answering the quiz. See Table 5.23.

Table 5.23

During Class Session: Activation phase (Lesson 3)

Phase	Steps	Task/Problem
Activation 	The instructor starts the session by asking students complete the online Quiz on *Schoology* : *Kenali Peralatan dan Perkakasan di Dapur!* So that they can recall what was covered during the "before class" session.	Students complete the online quiz: *Kuiz Kenali Peralatan dan Perkakasan di Dapur!* on *Schoology*

Next, in this phase, students watched demonstrations of the consequence of using two different knives, one blunt knife, and a sharp knife during food preparation. This was followed by demonstration of the knife sharpening procedure and knife care procedures by the instructor. (See Table 5.24).

Table 5.24

During Class session: Modeling Phase (Problem 1: Knife Sharpening)

Phase	Steps	Task/Problem
Activation 	The instructor shows two different knifes – the first knife is sharp and well taken care of, the other knife is blunt and slightly damaged.	What is the difference when the tomato is cut with both the different knives?
	Instructor calls a few students to come forward and explain the difference when cutting a tomato using both the different knives.	
Coaching/ Scaffolding 	Instructor provides feedback based on students' responses.	
	Instructor encourages students to take good care of their knives.	
Modeling	Instructor demonstrates how to sharpen the knife correctly	
	Instructor also demonstrates how to wash and care for knives.	

In this section, students are required to demonstrate their knife sharpening skills after watching the live demonstration by the instructor. Students also watch a lecture video which includes a local expert demonstrating knife sharpening skills. (See Table 5.25).

Table 5.25

During Class session: Application Phase (Problem 1)

Phase	Steps	Task/Problem
Application **(Practical Task 1)** 	Instructor gives marks according to the rubric for knife sharpening practical task.	Students sharpen knives using a wet stone or butcher's steel as demonstrated by the instructor. Students wash the knife with warm soapy water and wipe the knife properly before storing.
Integration (Articulation)	Instructor calls students randomly to present the problem-solving process during the knife sharpening practical task.	Articulate the problem-solving process during the knife sharpening practical task.
Coaching/ Scaffolding 	Instructor provides feedback based on students' knife sharpening techniques and the problem-solving process encountered. Instructor guides students in their problem-solving by providing appropriate feedback and coaching, including error detection and correction.	

In this section, learning is facilitated when students solve a real-world scenario designed based on problem caused by mistakes (troubleshooting problem) where they need to find the faulted conditions based on the concepts that they had learned before class. Learning is also facilitated as students are provided with an example of how to complete the task. (See Table 5.26).

Table 5. 26

During Class Session: Application Phase (Problem 2)

<table>
<tr><th>Phase</th><th>Steps</th><th>Task/Problem</th></tr>
<tr><td>Application Problem 2
</td><td>Instructor asks students to solve the scenario in groups.</td><td>Problem type: Problem caused by mistakes (Troubleshooting)
Adam just started his internship at a renowned restaurant in Melaka. Adam was assigned to slice tomatoes for a salad dish to be served during the buffet dinner…
1. What were the mistakes done by Adam?
2. What should have Adam done instead?
3. Why do you say so?</td></tr>
<tr><td>Demonstration/ Modeling</td><td>Students refer to the example provided which models how the answer should be.</td><td>Example of the answer:
<table><tr><th>Mistakes</th><th>Steps that should have been taken</th><th>Why?</th></tr><tr><td>Adam used a blunt knife</td><td>Adam should use a sharp knife instead</td><td>A sharp knife is safer to use and able to finish work faster (saves time)</td></tr></table></td></tr>
<tr><td>Coaching/ Scaffolding</td><td>Instructor guides students in their problem-solving by providing appropriate feedback and coaching, including error detection and correction.</td><td></td></tr>
</table>

In the Integration phase, learning is facilitated when students explore new ways to use their knowledge to choose the correct tools and equipment according to the recipes given. (See Table 5.27).

Table 5.27

During Class session: Integration (Exploration) Phase (Problem 3)

Phase	Steps	Task/Problem
Exploration 	Instructor asks students to complete a quiz on *Schoology* regarding the use of tools and equipment in a standard kitchen.	Fill in the blanks with the correct tools and equipment according to the following recipes and steps. Recipe 1: Mushroom *Au Jus* Recipe 2: Brown stock
Coaching/ Scaffolding 	After completing Problem 3, students get immediate feedback on the platform.	

In the integration (articulation) phase, students are required discuss their new knowledge. (See Table 5.28).

Table 5.28

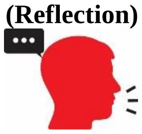
During Class session: Integration (Articulation) Phase

Phase	Steps	Task/Problem
Integration (Articulation) 	Instructor calls students to present the answers and problem-solving process that takes place when solving Problem 1-3	Articulate the problem-solving process during the task.
Coaching/ Scaffolding 	Instructor provides feedback based student responses and answer scheme provided.	
Coaching/ Scaffolding 	1. Instructor concludes on the tasks completed during the session. 2. Instructor announces the best group. 3. The conclusion is made by explaining the rationale the topic is learnt which is to provide exposure to students about the use of tools and equipment in a standard kitchen and the safe handling of knives so that students will be readier to join the workforce.	

In this section, learning is facilitated when learners can reflect on their new knowledge and skills. (See Table 5.29). A reflective prompt plays an instructional role to guide students to reflect on the tasks.

Table 5.29

After Class Session: Integration (Reflection Phase)

Phase	Steps	Task/Problem
Integration (Reflection) 	Instructor asks students to record reflections using the reflective prompt provided.	1. Record your audio reflections based on your experiences in the PSFCsession. 2. Duration of the recording should only be between 3 to 7 minutes only. *3.* Use the default voice recording app on your phone. For example, for Android platform users, use the Smart Voice Recorder app, whereas iOS platform uses can use the Quick Recorder app. Make sure you record your reflection in a quiet place.
Coaching/ Scaffolding 	1. Students record their reflections using the reflective prompts provided. 2. Students submit their reflections through the platform	

Activity/Task/Problem Design of Lesson 8 Hands-On Practicum Component

This section discusses the hands-on practicum component (Lesson 8), designed using the PSFC model, which is divided into three sessions, namely "before class", "during hands-on practicum" and "after class". The uniqueness of this lesson is the way it was designed to approach the concept of knife handling especially for vegetable cutting where learners solve a progression of problems that are explicitly compared to one another.

Lesson 8 (Hands-on Practicum component): Before class

Lesson Title: Knife Handling: Vegetable Cutting

Learning Outcomes:

At the end of this lesson, students will be able to:

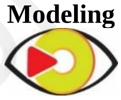
i. Identify basic vegetable cuts

ii. Demonstrate different types of basic vegetable cuts according to the correct sizes

The “before class” session starts with the Activation phase, where the instructor poses a question so that students can relate knowledge from relevant past experience in terms of preparing vegetables for cooking. After giving feedback based on the responses, the instructor shares a video on how vegetables are prepared in the industry based on event orders. (See Table 5.30). Preparing vegetables based on an event order is also the task that learners will need to solve as a result of completing the lesson.

Table 5.30

Before Hands-On Practicum session: Activation phase

Phase	Steps	Task/Problem
Activation 	Instructor starts the session by asking questions to assess students’ prior knowledge through the class group *Telegram* for the Activation phase.	What are the steps that must be taken when preparing vegetable before consumption?
Coaching/ Scaffolding 	Instructor gives feedback based on students’ responses **Suggested responses:** Soak vegetables in salt solution, wash vegetables correctly, ensure that the correct vegetable is prepared (e.g., able to identify the difference between zucchini and Japanese cucumber)	
Modeling 	Instructor shares the video of how vegetables are prepared for consumption at the industry based on event orders.	Watch a video clip on how vegetables are prepared for consumption in the industry. Source: Umawathy Techanamurthy (2017, February 3). *Memotong sayur-sayuran.* [Video file]. Retrieved from https://youtu.be/Pb428lNnZy0

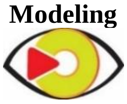
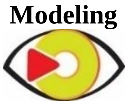
In this section, the “before class” session continues with the Demonstration (Modeling) phase. Firstly, the instructor shares relevant information on preparing vegetables using videos and brochures of the different types of fruits and vegetables used in a standard kitchen. Knowing the correct names of fruits and vegetables in

English will be helpful so that students can reduce mistakes in the workplace. Learning is also facilitated by watching multiple videos of demonstrations of vegetable cutting procedures which plays an instructional role so that students can visualise the multiple vegetable cutting techniques that they need to perform during the hands-on practicum session. This is then followed by providing students with a sample menu, and the vegetable purchase order form for the menu which is real artefacts gathered from the industry so that students can visualize the process better. (See Table 5.31).

Table 5.31

Before Hands-On Practicum session: Demonstration (Modeling) Phase

Phase	Steps	Task/Problem
Modeling 	The instructor asks students to access the *Demonstrasi/Pemodelan (Pengenalan kepada Sayuran)* folder through *Schoology* to complete the activities. Refer to the translation script of the videos provided.	**Activity 1** Watch a video on how to clean different types of vegetables correctly. Source: Escoffier Online. (2014, January 30). *How To Clean Vegetables*. [Video file]. Retrieved from: https://www.youtube.com/watch?v=qsSYL-b230s Duration: 5:06
Activation (Assigned reading) 	The instructor ask students to read short notes on Vegetable cutting.	**Activity 2** Read notes on Vegetable Cutting
Activation (Assigned reading) 	The instructors ask students to go through brochures of different vegetables and fruits used in the industry attached.	**Activity 3** Can you differentiate the different fruits and vegetables? Go through all the brochures carefully.

Modeling 	The instructor asks students to access the *Demonstrasi/Pemodelan (Potongan Asas Sayuran)* folder. While watching the videos in Activity 1, instructors remind students to take note on the knife cut dimensions for each cut. Refer to the translation script of the videos provided.	Watch the following videos on vegetable cutting as a preparation for your hands-on practicum session. Take note on the knife cut dimensions for each cut shown. **Activity 1** Source:LeCordon Bleu. (2015, June 23). *Proper Knife Slicing*. [Video file]. Retrieved from https://www.youtube.com/watch?v=w0fdOlLZ60o&t=18s Duration: 1:24 Escoffier Online. (2014, May 21). *Classic Knife Cuts*. [Video file]. Retrieved from https://www.youtube.com/watch?v=5wSUMQCgCbQ&t=2s Duration: 3:18 Escoffier Online. (2014, May 21). *Advanced Knife Cuts*. [Video file]. Retrieved from https://www.youtube.com/watch?v=hZbgVQT_7O4 Duration: 4:02
Modeling 	The instructor asks students to access the *Demonstrasi/Pemodelan (Menu and Purchase Order) folder* to go through a sample menu and vegetables purchase order.	**Activity 1** Look at a sample menu and the vegetable purchase order form from a hotel in Kuala Lumpur.

In this section, learning is facilitated when students need to recall the different vegetable cuts by recognizing the different sizes in each cut based on the concepts that they had learned to prepare for the hands-on practicum session. (See Table 5.32).

Table 5.32

Before Hands-On Practicum session: Application Phase

Phase	Steps	Task/Problem
Application (Practical Task 1) 	Instructor informs students that they need to bring along the replica of vegetable cutting with them during the vegetable cutting hands-on practicum session.	**Problem 1** Individually, create a replica for each of the following basic vegetable cuts: *julienne*, *batonnet*, *brunoise*, *chiffonade*, *paysanne*, *chateau*, *rondelle*, *tourne*, *mirepoix* and *Concassé* using sugar paper or coloured paper according to the correct dimensions. Use a ruler and sharp scissors. Paste each replica onto a manila card and label them accordingly.

Phase	Steps	Task/Problem
Coaching/ Scaffolding 	1. Instructor informs students that they will learn more about the aspects of kitchen safety concerning the usage of tools and equipment and knife handling during the hands-on practicum session. 2. The instructor asks students to conclude the concepts covered during the session. 3. The conclusion is made by explaining the rationale the topic is learnt which is to provide exposure to students about vegetable cutting which is a critical task in a standard kitchen so that students will be readier to join the workforce. 4. Students will receive participation marks for completing "before class" task.	

Lesson 8 (Hands-on Practicum component): During hands-on practicum class

Lesson Title: Knife Handling: Vegetable Cutting

Learning Outcomes: At the end of this lesson, students will be able to apply professional knowledge on effective knife handling skills to solve problems related to basic knife cuts for vegetables. In this section, the "before class" session starts with the Activation phase, where the instructor shares an image for students to spot the demonstrated in it. This is to enable students to recall knowledge from the Hygiene and Sanitation topic which is a foundation for this topic. This is followed by sharing a short clip Modeling the behaviour of the various cutting technique used by famous Chefs. (See Table 5.33).

Table 5.33

During Hands-On Practicum session: Activation phase

Phase	Steps	Task/Problem
Activation 	The instructor asks students to access the *Fasa Pengaktifan - Masalah Praktikal 2 (Potongan Asas Sayuran)* folder through *Schoology* to complete the activities. Instructor assesses students' prior knowledge using Activity 1. **Suggested response:** In the industry, chopping boards follow colour codes. A green chopping board is used to cut only vegetables. Cutting both seafood and vegetables using the same chopping board may cause cross contamination.	**Activity 1** Observe this picture carefully. What is the mistake the staff is doing in the picture? 
Coaching and Scaffolding	Instructor asks students to watch the video on Activity 2.	**Activity 2** Watch video of the various cutting technique used by famous Chefs. Source: FineLivingVideos. (2008, April 15). *Iron Chef Japan --Kitchen Skills.* [Video file]. Retrieved from: https://www.youtube.com/watch?v=ZAG_HrXufug Duration: 1:00

In this section, learning is facilitated with live demonstrations of knife cut techniques and the finished expectation of each cut by the culinary instructor. Instructor models the thinking process involved by briefing students on the task. The instructor provides feedback based on the "before class" task completed which is the replica of the knife cut techniques from Problem 1 with the original knife cuts demonstrated by the instructor. (See Table 5.34).

Table 5.34

During Hands-On Practicum session: Demonstration (Modeling) Phase

Phase	Steps	Task/Problem
Demonstration/ Modeling 	The instructor prepares materials for vegetable cutting demonstration	
	Instructors show demonstrations of the different knife cut techniques	Students watch demonstration of the following knife cut techniques and the finished expectation of each cut
Coaching and Scaffolding 	Students compare the replica of the knife cut techniques from Problem 1 with the original knife cuts demonstrated by the instructor. Instructor identifies the gap between students' product. Instructor models the thinking process involved by briefing students on the task.	

In the Application phase, students are required to solve a sequence of varied problems. In Problem 2, students are required to practice the knife cuts by recalling what they have learned. (See Table 5.35).

Table 5.35 *During Hands-On Practicum session: Application phase*

Phase	Steps	Task/Problem
Application 	Students clean the work area and prepare the mise-en-place. Students place a damp cloth below the cutting board to prevent movement. Students prepare separate portion cups to put in the waste and the usable product.	**Problem 2** Students are required to produce the following basic vegetable cuts: julienne, batonnet, brunoise, chiffonade, paysanne, mirepoix (Small, Medium, Large for Onions, Celery, Carrots, and/or Mushrooms), Tomato Concasse and others
Coaching and Scaffolding 	Instructor monitors students and provides coaching whenever needed	

In Problem 3, learning is facilitated when students are required to apply the knowledge learned by listing out the vegetable cuts and then preparing the vegetable cuts required for each menu in the event order. Learning is facilitated when learners are guided in their problem-solving by appropriate feedback and coaching, including error detection and correction. (See Table 5.36).

Table 5.36 *During Hands-On Practicum session: Application phase*

Phase	Steps	Task/Problem
Application 	i. Students choose the *Chef of the Day* and *Supervisor of the Day*. ii. Each group receives an event order. Click Info-> View Attachment -> Event_Order_Vegetarian.pdf iii. Students analyse the event order and list out the vegetable cutting for each menu in the event order in groups. iv. The Chef of the Day will meet with each group leader to list the vegetable cuts required for four different menus. v. Students will need to work together in groups and delegate tasks.	**Problem 3** Students are required to list and prepare the vegetable cuts required for each menu in the event order.
Coaching and Scaffolding 	Instructor monitors students and provides coaching whenever needed.	

In this section, students are given an opportunity to articulate and discuss their new knowledge and skill. (See Table 5.37).

Table 5.37

During Hands-On Practicum session: Integration phase (Articulation)

Phase	Steps	Task/Problem
Articulation 	Students present the practical tasks conducted	
Coaching & Scaffolding 	After the presentation, instructor provides feedback based on students' practical tasks. Instructor advises students to practice their vegetable cutting more. The conclusion is made by explaining the rationale the topic is learnt which is to provide exposure to students about vegetable cutting which is a key task in a standard kitchen so that students will be readier to join the workforce.	

In this section, learning is facilitated when learners can reflect on their new knowledge and skills. (See Table 5.29). A reflective prompt plays an instructional role to guide students to reflect on the tasks.

Evaluation of the PSFC module

Once the module was developed after the suggested improvisations, six experts evaluated it (Refer to Chapter 3). The experts validated the module using a checklist listing the elements present in both the Cognitive Apprenticeship and First Principles which formed the theoretical foundations of the study. The checklist was based on the elements of task centred learning principles developed by Francom and Gardner (2014) and module validity criteria by Sidek Mohd. Noah and Jamaludin Ahmad (2005). (See Appendix G). On the whole, based on the checklist, experts agree that all the elements present in both the Cognitive Apprenticeship and First Principles were incorporated in the module. All experts also agreed that the module meets the target population and can be implemented successfully. (See Table 5.38).

Table 5.38

Checklist of Elements of Cognitive Apprenticeship and First Principles of Instruction Incorporated in the Module

Elements	**Agreement**	**Not of agreement**	**Not applicable**	**Needs improvement**
Learning tasks				
Base problems on real-world performance	100%	-	-	-
Use "whole problems"	100%	-	-	-
Progress problems from easy to difficult	100%	-	-	-
Fade support for problem completion over time	100%	-	-	-
Vary problems to support transfer of learning	100%	-	-	-
Show learners a completed problem before they learn	100%	-	-	-
Activation				
Address learning gaps	100%			
Begin with a first problem that learners can complete	100%			
Have learners recall/describe prior knowledge	100%			
Demonstration/Modeling				
Demonstrate how to perform the problem	100%			
Provide supportive information relevant to the problem	100%			
Provide procedural information relevant to the problem	100%			
Point out important aspects of the problem	100%			
Show how examples relate to concepts/categories	100%			
Use relevant media for demonstration	100%			Add still visual to the video in Lesson 2
Application				
Learners do tasks as part of the learning experience	100%			
Provide coaching and feedback to learners	83%			Provide interactive feedback
Fade coaching and feedback to learners	100%			
Have learners monitor personal performance	100%			
Have learners explain thought processes	100%			
Integration/Exploration				
Learners transfer new knowledge/skill to everyday life	100%			
Learners explore new ways to use knowledge/skill	100%			

Module validity	
The module meets the target population	100%
The module can be implemented successfully	100%
The module is compatible with the allotted time.	83%
The module can improve student's problem-solving skills.	100%
The instructional materials provided are interesting.	100%

Based on the open-ended question at the end of the checklist, some experts expressed their views and comments on the PSFC module. The panel of experts also provided their views and comments on whether the learning materials covered the learning objectives, if the module was overloaded or if any limitation existed. They also examined the module for the alignment and allocation of both the online portion and face-to-face portion of each lesson. One expert was sceptical if the module is compatible with the allocated time as there was a lot of content to cover. Despite efforts at content reduction, an expert felt that the content was still a lot. Nevertheless, the positive comments received about the PSFC module outweighs the only negative comment received about the amount of content covered. Experts also agreed that the module could improve students' problem-solving skills and the instructional materials provided are interesting. Among the comments received are as follows:

According to SME1, "It could be better if the content is reduced and concentrate on the critical areas." SME2 said the "Module is suitable with the objective of the study. Provide interactive feedback to students." According to SME3, "Module is holistic as it covers not only knowledge areas, but also problem-solving and teamwork aspects." Meanwhile, according to SME4, "This module is very interesting and helps to simplify the Teaching and Learning session and captures students' interest so that they can master the knowledge taught. Congratulations!"

According to IND1, “Problem-solving skills are the fundamental aspect of day to day operation in the industry. Providing students such skill is an advantage as students will be more prepared to enter the industry. Thus, the module is hoped to provide a platform for students to achieve problem-solving skills in due time.”

Summary of the Development Phase

The development phase of this study involved the design of the PSFC module for Culinary Arts. The FDM was employed with 19 experts who achieved consensus with regard to the objective, content, instructional strategies, resources and media and assessment strategies to be included in the PSFC module. The module design and development were not only based on expert consensus (achieved through FDM) but also integrate the First Principles (Merrill, 2007), Cognitive Apprenticeship (Collins et al., 1990) and the FC Model using the First Principles of Instruction (Lo & Hew, 2017). After the module was developed, six experts validated the PSFC module before implementation. The module was delivered on a mobile platform using *Telegram* and *Schoology* with a selected group of participants and discussed in the next chapter.

CHAPTER 6

FINDINGS OF PHASE III: IMPLEMENTATION AND EVALUATION

Introduction

This chapter discusses the research findings that had emerged from the final phase of the study. Labelled as the implementation and evaluation phase, the final phase of the study comprises evaluation of both the PSFC module effectiveness and its usability. As mentioned in previous chapters, this study is quasi-experimental in nature. It focused on just one group of students. The pre-test/post-test model was designed for assessing the students' learning gains and their problem-solving skills after the PSFC module implementation, as another measure to evaluate the PSFC module effectiveness. Following this evaluation of the module effectiveness and usability, a questionnaire survey on the students' perception of their learning experience while using the PSFC module was administered to all participants. This survey gathers their perception of the PSFC module effectiveness and usability. Then, a semi-structured interview aimed at gathering more insights about the technical and pedagogical usability of the PSFC module was conducted with the participating instructor to help strengthen the findings.

The findings will be reported in three parts. To evaluate the effectiveness of the intervention, paired sample *t*-test was used to compare the difference between the pre-test mean and the post-test mean scores. The measure of the normalised gains in the students' learning was given by the pre-test/post-test scores. This is discussed in the first part of the chapter. The quantitative findings of the students' perception in using the PSFC module, based on the survey, are discussed in the second part. Finally, the qualitative findings drawn from the participating instructor's view about the usability of the PSFC module, in terms of the technical and pedagogical usability, are provided in the last part. The interview data will be drawn to substantiate the quantitative findings noted in the first part of the chapter.

Module Implementation

Once the PSFC module was evaluated and improvised according to the suggestions of the experts, it was implemented on a group of students and one participating Culinary Arts instructor, at one Community College in the Klang Valley. The process of the PSFC module implementation is shown in Table 6.1.

Table 6.1
Implementation of the PSFC module

Implementation phase	Duration
Orientation workshop	3 hours
Pre-test	1 hour
Intervention	9 “before class” sessions (30 minutes to 1 hour per session) through mobile messaging app and LMS 9 “during class” sessions (minimum 2 hours face-to-face sessions per day)
Post-test	1 hour

Effectiveness of the PSFC Module

To assess the PSFC module effectiveness, it is necessary to investigate whether students have acquired any significant gains in the knowledge of the lessons tested in this study. It was also necessary to investigate whether the students’ problem-solving skills improved. In that regard, the discussion provided in this section of the chapter attempts to answer the following research questions:

1. Is the PSFC module effective in improving students’ cognitive knowledge (learning gains)?

2. Is the PSFC module effective in developing students' problem-solving skills?

To answer the research questions, the following null hypotheses were formulated based on the research questions.

1. There is no significant difference between pre-test and post-test scores in terms of cognitive knowledge (learning gains) following the implementation of the PSFC module.
2. There is no significant difference between pre-test and post-test scores in terms of problem-solving skills following the implementation of the PSFC module.

This study is quasi-experimental in nature. It was designed to assess the effectiveness of the PSFC module. The focus of this study looks at the pre-test/post-test scores of one group of participating students. Paired-sample *t*-test was used to compare the pre- and post-test scores. These scores will determine the effectiveness of the module on the students' learning gains as well as their problem-solving skills. The outcomes will be discussed in the next section. Before the discussion, it is apt to reiterate that this study had used the exploratory-implementation approach as a research design and development (DeWitt, Alias, Ibrahim, et al., 2015). As usually done in such an exploratory study, a module was designed to test its implementation. The first semester students who were studying Culinary Arts at the Community College were used as a single group for this participation. In turn, no control group was assigned.

The pre-test was administered three days before implementation of the PSFC module whereas the post-test was carried out three weeks after the intervention. This is because there were nine lessons in the PSFC module and these lessons had to be conducted over three weeks with three lessons conducted in each week. The time span used for the implementation was considered to be too short for maturation, but it was well spaced for fatigueness. Although both the external and internal threats could cause some minor effects in the current study, both threats cannot be used to generalise the findings of an untested population (Creswell & Clark, 2011; Shadish et al., 2002) such as the population used in this study.

The findings of the PSFC module, after implementation, were interpreted using both descriptive and inferential analysis. The descriptive analysis involved the mean and standard deviation of the PSFC module whereas the inferential analysis involved the *t*-test. Paired sample *t*-test and the measure of normalised gains seen in the students' learning were both used to compare the difference between the pre-test mean and the post-test mean. The difference between the pre-test/post-test scores is noted as it would show the PSFC module's effectiveness.

Normality test

All the 30 students participated in the pre-test and post-test. The normality measure in this study was performed for the group. There are two ways to test for normality: by using graphical methods and/or numerical method. Graphical methods visualise the distributions of random variables between an empirical distribution and a theoretical distribution. Numerical methods use summary statistics such as skewness and kurtosis, or statistical tests of normality such as the Kolmogorov-Smirnov and Shapiro-Wilk test. As there are only 30 observations in this study, the Shapiro-Wilk test was interpreted as it exhibits more statistical power in situations with small sample sizes (Mooi & Sarstedt, 2011). Because the *p*-value for pre-test (0.568) is much larger than 0.05, the null hypothesis that the pre-test data are normally distributed should not be rejected at the 5% level. Consequently, the pre-test data are normally distributed.

Similarly, the *p*-values for post-test (0.246) are much larger than 0.05; the null hypothesis that the post-test data are normally distributed should not be rejected at the 5% level. Consequently, the post-test data are normally distributed. (See Table 6.2).

Table 6.2
Tests of Normality

Test	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.107	30	.200*	.971	30	.568
Post-test	.136	30	.167	.956	30	.246

The analysis of the findings, as shown in Table 6.2, indicate that there was an increase of scores in the post-test, there was an increase in the scores of the post-test among the majority of the students when compared to the pre-test. Table 6.3 shows the comparison of the two tests and the paired *t*-test is used to evaluate the students' cognitive knowledge (learning gains) score after the implementation of the PSFC module.

Table 6.3
Results of paired samples t-test for Cognitive Knowledge (Learning Gains)

	Paired Differences					
Test	Mean	N	*SD*	*T*	*df*	Sig (2-tailed)
Pre-test	13.40	30	5.15	12.458	29	0.000
Post-test	30.80	30	4.91			
Gain	17.4					

*$p < 0.05$

Table 6.4 shows the difference in the students' cognitive knowledge (learning gains) score after PSFC module implementation. Hypothesis 1 states that there is no significant difference between the pre-test and post-test scores in terms of cognitive knowledge (learning gains), following the PSFC module implementation. The *t*-test analysis indicates a statistically significant difference in the scores obtained in cognitive knowledge (learning gains) for pre-test (*M* = 13.40, *SD* = 5.15) and post-test (*M* = 30.80, *SD* = 4.91) conditions; *t* (29) = 12.458, and *p* = 0.000. Based on this outcome, it can be concluded that there was a significant gain in the students' cognitive knowledge (learning gains) after using the PSFC module. Table 6.4 further illustrates.

Table 6.4

Results of paired samples t-test for Problem-solving Skills

	Paired Differences					
Test	Mean	N	SD	*T*	*df*	Sig(2-tailed)
Pre-test	17.63	30	7.92	17.943	29	0.000
Post-test	50.40	30	6.97			
Gain	32.77					

*$p < 0.05$

Hypothesis 2 states that there is no significant difference between the pre-test and post-test scores in terms of problem-solving skills, following the PSFC module implementation. The *t*-test analysis indicates a statistically significant difference in the scores obtained in problem-solving for pre-test (*M* = 17.63, *SD* = 7.92) and post-test (*M* = 50.4, *SD* = 6.97) conditions; *t*(29)= 17.943, *p* = 0.000. Based on this, it can be concluded that the students had gained significantly in problem-solving skills after using the PSFC module.

Since this study is only focusing on a single instance of the FC with a small population of students, the next step is to measure the normalised gains in the students' learning; this is measured by the pre-test/post-test scores (Talbert, 2014). The use of the single-student normalised gains and the related calculations has been empirically justified as an easy-to-use measure of course effectiveness among hundreds of classroom teaching instances, and various types of courses taught, involving different instructors and student populations (Colt et al., 2011). Based on that, the PSFC module's effectiveness was established through the pre-test/post-test model. This is further complemented by the calculations of the various measures of learning gains including the measures of class-average and single-student normalized gains.

The outcomes noted can be justified. Firstly, individual's actual gains G_i (where G_i = post-test core – pre-test score) were tabulated in order to calculate the percent absolute gain (where Δ = average G_i/maximum score achievable) and the percent relative gain which is expressed as a percentage (where C = average G_i/pre-test score) for the class. As a measure of the module effectiveness, the class average normalized gain ‹g› was calculated (Colt et al., 2011; Hake, 1998; Hill et al., 2015). The ‹g› which is defined as the average actual gain is divided by the maximum possible gain where G is the actual gain ‹%post› and ‹%pre› is the final (post) and initial (pre) class average; the angle brackets "‹…›" indicates the average of the students taking the tests:

$$\langle g \rangle = \langle \%G \rangle / \langle \%G \rangle_{max}$$

$$\langle g \rangle = [\langle \%\text{post-test} \rangle - \langle \%\text{pre-test} \rangle]/[100\% - \langle \%\text{pre-test} \rangle]$$

A pre-defined target ‹g› of 30% was taken as the defining minimum value at which the educational intervention could be regarded as effective (Colt et al., 2011; Hake, 1998; Hill et al., 2015). In addition, the single-student's normalized gains (gi) were calculated for all the students, and these were then averaged as g(ave) = $[\sum_1^N (g_i)]/N$, where N is the number of students taking both the pre- and post-tests.

Statistics show that the mean test scores of the students' cognitive knowledge had improved significantly, from 33.5% (13.4/40 ± 5.15) to 77% (30.8/40 ± 4.91) (p = 0.000). The absolute gain was 43.5% while the relative gain was 21.3%. No negative gains were noted. The class average normalized gain ‹g› was 65.4%, and the average of the single-student normalized gains g (ave) was 17.4% (*SD* ± 7.65). Results also indicate that the mean test scores of the students' problem-solving skills had improved significantly, from 29.4% (17.63/60 ± 7.92) to 84% (50.4/60 ± 6.97) (p = 0.000). The absolute gain was 54.6% while the relative gain was 40.3%. No negative gains were noted. The class average normalized gain ‹g› was 34.1%, and the average of the single-student normalized gains g(ave) was 32.6% (SD ± 10.0). Table 6.5 presents the findings.

Table 6.5

Pre- and Post-test Scores and Learning Gain (N =30)

	Pre-test scores	Post-test scores	*p* value	Absolute gain	Relative gain	‹g›	g(ave)
Cognitive knowledge (learning gains)	13.4 ± 5.15 33.5%	30.8 ± 4.91 77%	0.0000	43.5%	21.3%	65.4%[a]	17.4% ± 7.65
Problem-solving skills	17.63 ± 7.92 29.4%	50.4 ± 6.97 84%	0.0000	54.6%	40.3%	34.1% [a]	32.8% ± 10

Note. ‹g› is the class average normalized gain: ‹g› = [‹%post-test› - ‹%pre-test›]/[100% - ‹%pre-test›]
g(ave) is the average single-student normalized gain: g(ave) = $\left[\sum_1^N (g_i)\right]/N$, *p< 0.05
[a]Robustness of educational intervention defined if ‹g› is greater than 30%

To diminish the skewing effect of the outlier students with very high or very low pre-test scores, the single-student's normalised gain (where g_i = [%post-test - %pre-test]/100% - %pre-test], where the actual gain is divided by the maximum gain achievable by each student) was calculated. The use of the single-student's normalised gain and the related calculations have been empirically justified as an easy-to-use gauge of course-effectiveness among hundreds of classroom teaching instances as well as various types of courses involving different instructors and student populations

(Colt et al., 2011). Based on these findings, it is thus concluded that the effectiveness of the PSFC module was established through the pre-test/post-test model which was complemented by the calculations of various measures of learning gains including measures of the class-average and single-student normalised gains.

Evaluation of Perceptions toward the PSFC Module

A questionnaire survey extracting students' perception of their learning experience using the PSFC module was administered to all the participating students to gather more input which can be used to support the quantitative data. The research question to be answered in this section thus includes: "What are the students' perceptions of their learning experience using the PSFC module?"

Respondents' profile. All the 30 students who used the PSFC module during the intervention completed the questionnaire survey after the intervention had ended. The respondents comprised 56.7% females and 43.3% males. This ratio is also found to be consistent with the respondents' profile which was collected during the needs analysis phase. About 80% of the students were *SPM* school leavers below age 20 years. Table 6.6 presents the profile of the respondents.

Table 6.6

Profile of Respondents (n = 30)

Demographics	Frequency	Percentage (%)
Gender		
Male	13	56.7
Female	17	43.3
Age		
Under 20	24	80
20-24	5	16.7
30-34	1	0.2

Ownership and usage of smartphone and tablet computers. The use of mobile device among the 30 respondents was also noted as a measure to gauge their perceptions about their learning experience using the PSFC module. From the following Table 6.7, it can be seen that all the respondents owned smartphones.

Table 6.7

Ownership and Access to Mobile Technologies (n =30)

Mobile Technology Usage	Frequency	Percentage
Own Smartphone		
Yes	30	100
No	0	0
Smartphone Brand		
Apple	10	33.3
Samsung	3	10
Lenovo	6	20
Asus	2	6.7
Oppo	2	6.7
Others	7	23.3
Own Tablet		
Yes	6	20
No	24	80
Tablet Brand		
iPad	5	16.7
Android	1	3.3
Experience using Internet (years)		
Less than one year	4	13.3
Three to five years	9	30.0
Six to 10 years	11	36.7
More than 10 years	6	20
Time spent on Internet in a day		
None	1	3.3
Less than an hour	2	6.7
One to five hours	7	23.3
Six to ten hours	7	23.3
11 to 15 hours	3	10
16 – 20 hours	4	13.3
More than 20 hours	6	20
Mobile data plan subscribers		
Yes	27	90
No	3	10
***Wi-Fi* access available at home**		
Yes	18	60
No	12	40

Most of the smartphone owners (66.7%) used the *Android* operating system with only 33.3% using the *iOS* operating system. The use of tablet computers seemed to be less popular among the respondents as only 20% of them owned tablet computers. Nonetheless, the majority of the tablet computer owners used *iPads* (5) instead of *Android* tablets (1). Among these respondents, 33.3% were *iPhone* users followed by 23.3% who used *Android* phones followed by 20% *Lenovo* users and only 10% *Samsung* smartphone users. Among these respondents, 9.9% owned *iPads* followed by 9.7% who owned *Android* tablets. This gap may be attributed to the availability of the *Android* operating system in both the high-end and cheaper smartphones, thereby making smartphones more affordable. In contrast, the *iOS* is only accessible to the more affluent individuals who used, the more expensive Apple high-end smartphones.

The survey indicates that the majority of the respondents have been using the Internet for six years or more, with 36.7% of the respondents using the Internet between six to 10 years, and 20% of the respondents using the Internet for more than 10 years. About 23.3% of the respondents used the Internet between one to five hours or six to ten hours on a daily basis. Taking into consideration that 90% of the respondents have mobile Internet subscription services which allow a seamless and continuous Internet access and that 60% of the respondents have access to *Wi-Fi* in their homes, it was found that 20% of the respondents in total, used the Internet for more than 20 hours on a daily basis. Table 6.7 further illustrates.

Students' perception of their learning experience using the PSFC module. Having outlined the background of the participants and their smartphone ownership cum daily habits of using the Internet or *Wi-Fi*, this section presents the findings on the respondents' perception of their learning experience using the PSFC module. In the survey, respondents were asked about four areas that helped them to improve their learning. The first area focused on course content and delivery. This area includes questions on how the students accessed the relevant media and resources for their teaching and learning materials in the PSFC module. It also asked how satisfied they were in using these media and resources. The second area includes the use of mobile-based communication tools for communication and collaboration. This includes the LMS (*Schoology*) and the mobile messaging app (*Telegram*) which enabled communication among students as well as between students and the participating instructor. The third area looks at the tools used for evaluating and assessing student performance, and this includes an LMS, interactive quizzes, online worksheets, and other relevant resources. The fourth area concentrates on student learning strategies and personal learning experience when using the PSFC module. This includes a self-assessment report on how much students have learned with real-world applications of the learning activities during the face-to-face session and outside of class.

As Table 6.8 indicates, all the student participants' average scores which were relative to the different dimensions ranged from 3.93 to 4.70, on a five-point Likert-type rating scale. This is because many of the participants selected 'strongly agree' or 'agree' for the statements noted in the survey. This indicates that, on average, these participants exhibited high levels of positive perception towards their learning experience when using the PSFC module. The descriptive statistics drawn from the respondents' level of agreement, based on the questions that asked their perception of learning experience using the PSFC module, are shown in Table 6.8.

Table 6.8

Results of the students' perception of learning experience (n=30)

	Item	Frequency of use % (n) Strongly disagree 1	2	3	4	Strongly agree 5	*M*	*SD*
1	The availability of content course materials, communication, and assessment tools helped me improved my learning.	-	-	-	30 (9)	70 (21)	4.70	.466
2	I communicated a lot with other students	-	-	13.3 (4)	50 (15)	36.7 (11)	4.23	.679
3	I had more communication with the instructor	-	3.3 (1)	10 (3)	53.3 (16)	33.3 (10)	4.17	.747
4	I found that I learned a lot in this course.	-	3.3 (1)	3.3 (1)	26.7 (8)	66.7 (20)	4.57	.728
5	I had to work harder for this course	3.3 (1)	3.3 (1)	3.0 (10)	56.7 (17)	26.7 (8)	4.00	.910
6	The learning activities (e.g., assignment and projects) I worked on deal with real-life applications and information in this course.	-	-	-	30 (9)	70 (21)	4.57	.504
7	I applied my out-of-class experiences and learn from its practical applications.	-	-	23.3 (7)	43.3 (13)	33.3 (10)	4.57	.504
8	I explored my own strategies for learning.	-	-	26.7 (8)	50 (15)	23.3 (7)	3.97	.718
9	I needed technical assistance for this class.	3.3 (1)	-	30.0 (9)	36.7 (11)	30.0 (9)	3.93	.868

	Item	Frequency of use % (n) Strongly disagree 1	2	3	4	Strongly agree 5	*M*	*SD*
10	Availability and access to technical support and resources helped me improved my learning	-	-	6.7 (2)	15 (15)	13 (13)	4.37	.615
11	I would choose to take another flipped course.	-	-	10.0 (3)	46.7 (14)	43.3 (13)	4.27	.785
12	Overall, I considered taking this flipped course.	-	-	10.0 (3)	66.7 (20)	23.3 (7)	4.13	.571

Course content and delivery. From the perspective of course content and delivery, results show that all the students (100%) agreed or strongly agreed that the availability of the course content materials, communication, and assessment tools helped to improve their learning. In the PSFC module, students were able to access a wide variety of media and materials, communicate by using the Mobile Instant Messaging apps and complete their quizzes online. This result was verified by the responses noted for item 13, a multiple-choice question which asked respondents which part of the PSFC module was preferred the most and which part had helped them to improve their learning. Table 6.9 illustrates the outcome.

Table 6.9

Student Preference for Technology to Improve Learning

Module delivery format	Frequency (*n*)	Percentage (%)
Availability and access to online content and course materials	22	73.3
Enhanced communication using Mobile Instant Messaging app and LMS	24	80
Online testing and evaluation	26	86.7
Evaluation and feedback using interactive quiz and grade tools	21	70
Ease-of-use of the mobile environment	17	56.7
Group discussion	21	70

Group collaboration	21	70
Working on the assignment and class work individually	11	36.7

As the results of the survey (Table 6.9) show, the highest preference was for online testing and evaluation (e.g., interactive quiz on *EdPuzzle* and online quiz on *Schoology*) which was provided in the PSFC module (86.7%). This finding is consistent with the result indicating that 70% of the students surveyed prefer the interactive online test and evaluation which enabled them to receive immediate feedback.

The next area of high preference was the enhanced communication using the LMS (*Schoology*) and the mobile messaging app (*Telegram*) (80%). The messaging component was used by the participating instructor to provide guidance to students before class activities. Such a session allowed the students to communicate with their instructor and peers simultaneously. While communicating or discussing through this channel of communication, students were also engaged in their learning. Thus, it can be seen that communication is also a crucial skill to be developed by students in the Culinary Arts industry. It seems important that students have the opportunity to talk with their instructor on a regular basis.

In contrast, the student respondents had indicated the lowest preference for the ability to work on the assignments and class work individually (36.7%). This outcome is also consistent with the results where 70% of students surveyed also showed a preference for group discussions and collaborative activities. From this finding, it can thus be deduced that group discussions and collaborations should be a key component in the problem-solving FC.

Use of mobile communication tools. Items two and three of the questionnaire survey asked about the respondents' use of electronic communication tools in the

PSFC module. It is hereby noted that the LMS (*Schoology*) and the mobile messaging app (*Telegram*) were used to enable online communication in the module. Results shown in Table 6.8 indicate that 86.7% of the students surveyed ‘agree or ‘strongly agree’ that they communicated more with their peers and their instructors through this communication.

Assessment and evaluation tools. Results shown in Table 6.9 also indicate that 86.7% of the students stressed that evaluation and feedback using online testing and grading tools helped them to improve their learning.

Student learning experiences. In rating how much was learned from the module, 93.4% students noted that they did learn. Since a FC also requires students to be prepared and to participate during face-to-face sessions, more than half of the students (83.4%) ‘agree’ or ‘strongly agree’ that they had to work harder when following the PSFC module.

The central component of the PSFC module aims at bringing real-world examples into the classroom. Item six and seven of the questionnaire survey addressed this component. Statistics show that no students had indicated ‘disagree’ or ‘strongly disagree’ for both items. All the 30 students agreed that the learning activities (e.g., assignments and projects) provided in the PSFC module were related to real-life applications and information. Similarly, 43.3% ‘strongly agree’ and 33.3% ‘completely agree’ that they were able to apply out-of-class experiences and learn from the practical applications. They rated highly the use of authentic learning materials involving local contexts and tasks that go beyond the concepts usually found in books. Results also indicate that they tend to use the media and resources in the PSFC module by using learning strategies that worked best for them at their own pace. About 50%

‘strongly agree’ and 23.3% ‘completely agree’ to item eight - “explore my own strategies for learning.”

Items 11 and 12 reflected a similar theme with positive results when students were asked if they would like to use the PSFC module again. In this context, 27 out of 30 students (90%) ‘agree’ or ‘strongly agree’ that they would take another flipped course (Item 11) and they would continue with this module (if possible) (Item 12).

Of the 30 respondents surveyed, more than half or 56.7% found the module easy to use on a smartphone. They also indicated experiencing some technical difficulties during the initial stages of module implementation but these subsequently improved with the continuous technical support. The results displayed in Table 6.8 indicate that 66.7% students ‘agree’ that they needed technical assistance when using the PSFC module. Similarly, more than three quarters (93.3%) of the students also ‘agree’ that the technical assistance and technical resources helped them to improve their learning.

Analysis of open-ended question. In the survey administered, Item 14, an open-ended question was provided as a measure to examine the students’ suggestions or their comments for improving the module – “Do you have any suggestion for improving the FC experience or any other general comments about the module?” The responses were noted, coded and analysed through themes. Findings showed two responses: positive comments about the PSFC module and negative comments or challenges faced when using the PSFC module.

Positive responses. The positive responses comprise students’ enjoyment. They pointed out that they enjoyed using the module because it was comprehensive and enjoyable; it offered a more detailed information about Culinary Arts especially through videos provided, and this made learning more fun, particularly, the interactive quizzes embedded into the videos used in the PSFC module. The evidence is traced to the responses: "I think there is no need to (improve) as it covers a lot and I enjoyed using it." (Student 13). "It has more detailed information on basics of culinary arts using videos". (Student 25), and "Increase the [interactive] quiz videos... because it is fun". (Student 19).

Negative responses. In addition to the positive responses, the students also provided some negative responses which relate to their challenges in their applications but not the PSFC module itself. This includes the lack of high-speed *Wi-Fi* access in the campus: "*Wi-Fi* [should be] made available everywhere and the *Wi-Fi* [should be] fast enough to access the applications being used." (Student 4); "I suggest that *Wi-Fi* is made available everywhere [in campus]" (Student 1, Student 3); "*Wi-Fi* (should be) faster everywhere in campus" (Student 2, Student 4).

In summary, findings showed that students have a positive perception of the PSFC module. Despite the limited *Wi-Fi* availability on campus, students were able to overcome that limitation by accessing the *Wi-Fi* from homes and their mobile Internet subscription service. This allowed for seamless and continuous Internet connectivity. However, technical assistance may be required in the initial stages. In addition, students showed a preference for the mobile instant messaging component as a communication channel with their instructor and peers. They also explored their own learning strategies when accessing the materials on the module thereby, enjoying the online test and assessments (e.g., interactive quiz on *EdPuzzle* and online quiz on *Schoology*).

Usability of the PSFC Module

Upon completion of the intervention, the single participating instructor's perspective on the technical and pedagogical usability of the PSFC module was explored. The technical usability of the PSFC was first evaluated for its ease-of-use, efficiency, technical design and accessibility, and navigability (Hadjerrouit, 2012; Nielsen, 1999). Next, it was evaluated for its pedagogical usability in terms of the teaching and learning process including user control, learner activity, collaborative learning, added value, motivation, flexibility and feedback (Hadjerrouit, 2012; Nokelainen, 2006). To answer the research question which looks at the usability of the PSFC module, "Is the PSFC module technically and pedagogically usable?" data were collected from the semi-structured interviews with the participating instructor. These were then coded and analysed according to themes.

Pedagogical usability. The pedagogical aspects of usability were considered alongside the technical aspects. In this study, the themes for the pedagogical usability include user control, learner activity, motivation, added value, collaborative learning, valuation of previous knowledge, flexibility in diverse learning and feedback.

User control. The participating instructor indicated that the module's added value lay in the easy to follow flow of the learner activity. By adhering to the flow of the FC approach, students were able to acquire some basic knowledge especially by accessing videos and completing tasks before entering the face-to-face "during class" sessions. The participating instructor also indicated that it is beneficial for students to come to class by completing the before-class tasks so that they were more prepared for the "during class" sessions. In the needs analysis phase, the participating instructor had lamented that students did not come prepared before class. This was confirmed by one instructor who found the current batch of students to be more knowledgeable about the contents of the class; they also understood the contents better and comparatively, they were better than those in the previous semester.

> …what I see is students from this semester compared to the previous semester, are more knowledgeable, this is because before they enter the kitchen, they have already learnt on Schoology… in this module… and they have already watched videos, so they have seen the [overall] picture, so when they enter the kitchen it is easier to understand! That's what I can see… (Line 125-129)

Learner activity: Problem-Centred Instruction. The teaching of real-world problems and knowledge presented in a real-world setting based on the realities of the careers within the PSFC module may prepare students for their future career in the culinary industry. This theme encapsulates the instructor's belief that the real-world problems depicted in the module are relevant and reflect the most current industry trends. It is important that students know what to expect when they enter the culinary industry, as highlighted:

> [the problems] are relevant. Because the problems given in the module… those are the realities in the industry actually… those are the realities in the industry actually…. So, if possible, we want to train our students according to the trend of what is happening in the industry now. (Line 179-181)

It was also proposed that the traditional method of teaching should be modified to ensure that lessons taught are relevant to the industry. In addition, it was also proposed that the PSFC module should meet employer requirements.

> We don't want to be too traditional in our ways of teaching. So, we really want to follow the industry's requirement… We also have a few collaborations with the industry and the problems given are the realities that students will face when they are in the industry. So, it does match what we want from our students and what the industry wants from us… (Line 181-185)

Motivation: More engaged in their lessons. Resources and materials used in the PSFC module were also noted to be sufficient, and the materials had adequately motivated students to be more prepared before entering the class and before being engaged during the hands-on practicum session. It was also reported that students seemed more eager in learning as they were asking more questions as compared to students of the previous semester. Another comment also mentioned that students seemed more motivated and the evidence can be traced to their intrinsic values to research and read more materials. Consequently, these motivations enabled them to have a better understanding of the lessons covered during the face to face class or practicum session. A comparison was drawn by the instructor who mentioned that previous semester students were only exposed to the content area for the first time during lectures. Since the traditional teaching practice in Culinary Arts involves demonstration and replication, students would usually replicate what they have viewed in class, and they tend to accept what is being taught without much criticism nor further exploration. This limited their creativity. The evidence is traced to the following excerpt.

> Before this, if we showed A to students, it is A that they would do, if you show B, B is what they would do, so they can't think more creatively, so, now… "Ooo... OK, so miss in this video, it is like this… like this… what's this? They are more eager to know about things. This is really good to me!" (Line 129-132)

Added value: Learning beyond curriculum. The participating instructor also expressed that the module content was complete; the curriculum was more than the original curriculum. This provided students with more exposure to the contents. The following excerpts illustrate: "…to me… if they are interested… just open it… everything is already there…" (Line 41); "OK, actually the content of the module is related to our curriculum, it is just that what I see in the module is… actually, we have given them MORE, compared to the original curriculum.” (Line 63-65)

Added value: Relevance to professional practice. The instructor also mentioned that the emphasis on certain topics seemed to add value to the module. It was explained that this would be beneficial in the long run. With this implementation, students would not be experiencing culture shock when they encounter new things such as the HACCP principles which are widely used in the industry. The following excerpt supports:

> For example, in sanitation, we limit it to personal hygiene, sanitary practices at the workplace, storage… that’s all… FIFO… even that… just a little… but this module has included examples of how HACCP is [being practiced], so it is rather advanced for them, but to me, this is good, so that when they are at the industry they would not be culture shocked, shocked… like “what’s HACCP?” So, to me that is good, so the module is more than the existing curriculum (Line 70-75)

It was also mentioned that by covering the fundamental aspects of the culinary arts, the module thus carried an added value. This is because the module offers all students an understanding of the basic knowledge of Culinary Arts before they enter the workforce. Moreover, even though the module was built based on the existing curriculum as a guide, the valuable input and consensus given by the experts during FDM provide the additional support that endorses the module design. For example, “The Standards of Professionalism: Chef Identity and Work Ethics” content area achieved the highest consensus in the FDM, being the most important content area to teach problem-solving. The content area is unique to this module because it does not exist in the existing syllabus. It was found to be very helpful in developing students’ professionalism. The other three content areas namely, Kitchen Safety, Food Safety and Kitchen Fundamentals which map the topics in the existing syllabus are also part of the fundamental knowledge in the field of Culinary Arts that students need to be well versed in before entering the workforce.

The following excerpt illustrates:

> But this module is very helpful in terms of professionalism, in terms of sanitation, hygiene, all the topics are very helpful because if they do not understand what is food danger zone, if they don't understand what is FIFO, right…if they don't understand why they need to wash their hands, what bacteria…that would be difficult… cross-contamination if they don't understand too… if they enter the kitchen and [despite] having good skills would still be difficult, because, no matter what hygiene and sanitation is important right? And the professionalism as a chef… that is important… So, to me, this module fits the criteria well! (Line 232-239)

Added value: Authenticity of learning materials. Describing how the PSFC module and the materials in it were utilised, the participating instructor expressed that the module contents were authentic as knowledge was presented in a real-world setting based on the realities of the culinary arts field. She provided some examples of videos used in the PSFC module which were recorded in real situations. This aspect is crucial in exposing students, especially those in the first semester, to the realities of the industry.

> So, with this module, it is easy for me, I just follow the flow, more interesting is… there are quizzes… there are videos shot in real places, and one more thing, the videos shown is the reality and not reenacted videos! That is crucial, so students in the first semester, when they have chosen the Culinary Arts course, when they see what is happening in the industry, hopefully, it will motivate them to study right? So, it is easy. (Line 248-252)

The participating instructor also provided some examples to illustrate her point on how the tasks provided in the PSFC module were close to the realities of the industry and could help develop students' problem-solving skills. The participating instructor cited the real-world problems students had to solve in lessons eight and nine. The tasks assigned to the students in lessons eight and nine required them to think, for example, on which commodity cuts to be considered when preparing for the different menus outlined in the event order document provided. According to the participating instructor, the aforementioned task is an example of a real-world problem that students need to solve when they join the workforce. By completing a real-world task such as this, the instructor hopes that students will be able to think independently, as required by employers.

> Of course, yes *lah*! Because if you look at the tasks that are given requires students to solve the problems. For example, the question of event order, right? Let's say that they are on duty that day, and there are no other Chefs around. Hopefully they will be able to think for themselves… So, they need not just wait for instructions… That's what we hope for… [I'm referring to the] event order problem for commodity cuts *lah*. (Line 173-177)

Added value: Module provides instructional guidance. Even though the module included slightly advanced contents, instructional guidance was given to the instructors thereby easing the teaching process. This is noted in the folder called Coaching and Scaffolding (*Bimbingan dan Maklum balas*) which was referred to as the "purple folder" as it appears in *Schoology*. The following excerpt shows.

> Easy, because if I am not clear about the topic, I just have to read [what is in] the purple coloured folder, it already mentions what to do… so I just follow the instructions, and all the materials are inside the module, so it is easy" (Line 56-58)

In the interview data, it was noted that the curriculum materials provided in the module contained much-needed guidance on how to cover the topics provided in the curriculum in a more detailed manner, unlike the existing curriculum which only outlined the topics but not the process. As a result of the lack of guidance provided for instructors, it seems likely that different instructors may take different routes to teaching the same topic. This lack of uniformity was a concern among the instructors since a lack of uniformity can affect how learning takes place. An excerpt is provided to support this claim.

> The current curriculum only gives topics in general… it is not detailed, so it is the instructor's initiative to cover how much, but with this FC module, it is more (detail) than what the curriculum outlines… to me it's good! (Line 65-68)

Added value: Maximize quality class time. Another added value of the PSFC module is traced to the comparison of the current to the teaching practice of the previous semesters. It was mentioned that conventional Culinary Arts expect students to learn through lectures and passive listening during the theory class and following this, students were expected to replicate the live demonstrations of their lecturers which were performed during the practical classes. Recalling her previous semester's teaching practices, the instructor mentioned that she did not know how to utilise the long hours scheduled to deliver the theoretical component efficiently, before using the PSFC module.

> For instance, on the first week, if we follow our curriculum we will learn the theory part of sanitation and personal hygiene, those topics become quite boring if we were to give a lecture like we usually do, right? So, when there is this [module on] *Schoology*, to me it is very interesting, so I will use it for the next semester. And I feel students will enjoy it, for example, their class is from 8 a.m. to 4 p.m. For instance, personal hygiene topic, so what do you think I am going to talk for 8 hours, right? (Line 243-248)

Added value: Reusable. The added value of the PSFC module is also traced to the participating instructor's intention to reuse the same module in a subsequent semester. This was extended to the researcher by the participating instructor who asked if she could reuse the module the following semester as it would facilitate teaching and learning. "Lastly, I would like to ask your permission to use the module in the next semester, because to me, it makes it easier for me [to teach]" (Line 242 -243).

Added Value: Access to experts. Not only were the materials and resources in the PSFC module authentic, but it also provided access to guest lectures especially leaders in the same discipline such as other Chefs in the culinary industry. To make the experience in the module more authentic for students, an Executive Sous Chef, who was also one of the panel of experts involved in the module design and development, was invited to give a talk to the students. This was also highlighted. “Even that day, we invited a Chef to give some motivating thoughts to our students, so our students will be in high spirits.” (Line 252-254).

Collaborative learning. In a teaching and learning process, it is more beneficial to collaborate and work together on tasks as the social learning environment created through the module activities allows students to contribute to each other’s learning. By using the PSFC module, the collaboration among students also increased when in group activities. Discussions were rampant, and the teamwork was lively. This ability to work as a team is pivotal and necessary since the industry will require students to work as a team. This claim is supported by the following excerpt.

> It seems that in these three weeks, it has been very encouraging because it is more interesting when they work in groups actually, so they get to brainstorm among themselves… individual tasks can be boring, isn’t it? This is because when they get into the kitchen, in the industry, they have to work in teams, so to me, the module encourages them to collaborate (Line 166-170)

Valuation of previous knowledge. Another benefit of the PSFC module is that it helped students to use their prior knowledge to build up their new knowledge. In doing so, the instructor is able to gauge where they come from since the students came from different backgrounds and had different experiences before starting lessons. This is exemplified by the following excerpt:

> … there are things they already know, some of our students have worked in the industry, and some might have worked part-time before, so they might know a little bit, but may not be too sure, so when we do the Activation phase we can gauge their level, some might know, some might not know [something]. To me, that’s a good thing… (Line 157-160)

Flexibility in diverse learning opportunities. The flexibility in the PSFC module was also noted as an added value. For instance, it was highlighted that the multiple activities available in the module enabled students to have a better understanding of the context during the hands-on practicum class. Their understanding was increased because they had already watched the interesting videos on *YouTube* during the "before class" session. Because of this exposure, the ability of the students was also observed to be different. For instance, during the demonstration session in the hands-on practicum, some students demonstrated the same technique as demonstrated live by their instructor whereas some students demonstrated the same techniques as the one they had watched in the instructional video during the "before class" session. Both techniques produced the same end product. Hence, the instructor felt glad that students were given more exposure when using the PSFC module. This was expressed as:

> It is sufficient, for example, the module on commodity cuts… so there were interesting videos on *YouTube* related to the trussing the chicken, right? The videos show how to do chicken trussing… When I did the demonstration in the kitchen, students could understand more easily as they had already watched the video before class… Next, the method shown in the video was different from the one I showed in the kitchen. Indirectly, students learnt two different trussing methods, to produce the same end product. For instance, in their module, they begin from up, but the one I showed in the kitchen begins from below. Thus, they can apply both techniques, so our students get to learn two different techniques for chicken trussing! That is what I can see! and when I was demonstrating, they were asking, "in that video, it was done this way… this way…", so I explained to them *lah*… they were like "Oh, OK!" . So, there were certain groups who followed the technique shown in the video and some students did the way I taught them, and the cuts are similar, so they were seen learning among themselves, so they get to learn two different techniques, so it is good *lah*! It is not like they fully depend on us, right? (Line 98-113)

Flexibility: Students' contribution to the learning resources. The PSFC module also had the added value of flexibility which involves sharing the responsibility of identifying appropriate additional learning resources as well as making contributions to the learning resources (Collis & Moonen, 2002). This was observed on the *Telegram* chats where students were seen sharing other videos such as vegetable cutting. There were also incidences of students sharing images which were deemed important for the benefit of their peers. For instance, on the *Telegram* chats, some students shared a screenshot of a video summary to be used as a reminder for other students. They were also sharing screenshots of online polls (especially when their classmates were unsure if they had clicked on the right link) and screenshots of images that can be used as guidance for completing a task.

Technical usability of the module. The second theme that captured the PSFC module's technical usability was also noted from the participating instructor's perspective. Technical usability is crucial as it enables users to easily focus on the learning materials without having to worry about other issues that can prohibit access to the module (Hadjerrouit, 2010). In this study, the PSFC module can be accessed via the LMS (*Schoology*) and the mobile messaging app (*Telegram*).

The learning materials provided in the PSFC module was also systematically organised into separate folders, according to the nine lessons designed on *Schoology*. Following Maddux and Cummings (2007), the *Schoology* platform in the study "could be described more accurately as a lesson plan format" (p. 120). Thus, in this study, the *Schoology* platform was used by the participating instructor and students to access the instructions and materials systematically, according to the major phases of instruction noted in the PSFC model.

Ease-of-use. The participating instructor agreed that the module was easy to use. The ease-of-use of the module delivery platform may be explained by the fact that the instructor had to follow a sequence according to the phases of instruction. The following response illustrates: "OK, in my opinion, this module is easy to use. Next, it is arranged in an orderly manner, so I can access (the module) easily, I just follow the flow, its sequence… just follow… so to me, it's easy (to use)" (Line 6-8)

The essential point is that the module was easy to use. As long as the participating instructor followed the sequence of use and adhered to the phases of instruction, it would be easy to use. This is because the module was arranged like a lesson plan format for each topic covered.

Efficiency: Practicality of the module. Compared to the ease-of-use of the module, the efficiency criterion of the PSFC module received mixed reactions. The participating researcher expressed a few concerns regarding the module practicality. Firstly, the instructor found it hard to commit to the "before class" sessions which were conducted the night before the face to face session, on the mobile messaging app or *Telegram*. The instructor cited family commitments and other problems that may disrupt the lesson flow. Based on the researcher's journal, the participating instructor had postponed two before class sessions during the implementation phase, citing unavoidable circumstances due to family commitments. Thus, the instructor suggested that students should be able to learn at their own pace, especially about the before class sessions. The following quote illustrates:

> Practical in terms of time, is it? It is only that… to me… if it is possible, [while referring to before class session] should not be outside office hours… but if it should be done outside office hours… to me… we should not specify the time… [for instance], from this time to this time, because I'm afraid I can't give the full commitment, right? Because we are humans, right? I'm afraid there may be problems, other commitments, family problems or other problems that can't be avoided which disrupts the lesson flow. It's only that if we want to do that, we just get students to come online, and we only monitor… if it is like that, then it's okay. If we want to guide them from A to Z in an hour, I'm afraid I… time doesn't permit…
> (Line 14-22)

When describing the practical use of the PSFC module, the participating instructor also observed that over time, students seemed to be more committed to their lessons. The instructor described how learning was initiated by the learner, especially during the second and third week of the module implementation. The instructor shared how she need not alert the students to come online to follow the before class session. She noted that other more committed students were able to remind their classmates to do so.

> Practical… we can definitely see improvement in students', isn't it? From the first week to the third week… can really see (the improvement)
> (Line 24-25)
>
> For example, during the first week, we had to work slightly harder, to call them to come online, teach step by step, go to this folder… this folder… but once [we] entered week two and week three, they already know the flow, so they already understand, so when we entered week two and there… they… when it is 8.30[pm] they would already get ready to go online… we do not need to remind them; it is just that to get 100% commitment from students is challenging, that might take more time because it is not yet a culture in our Teaching and Learning, right? So, I feel, later on… I feel it will be OK *lah*… But, it is very practical. (Line 27-34)

Over time, with support from instructors, students began to understand the value of being prepared before coming to class and assuming more responsibilities in their own learning. In this study, students had slowly improved their commitment to being prepared before coming to class; this showcased the practicality of the PSFC module.

Nonetheless, there were some negative reactions from the instructor. It was mentioned that getting 100% commitment from all the students during the individual tasks was difficult. Based on the field notes of 15 March 2017 (Module 2), disappointment was expressed because only eight to nine students appeared online simultaneously on *Telegram* between 8:30 pm – 9:30 pm when the "before class" sessions were conducted. It was reported that some students were unable to join the session due to personal matters (i.e., attending a funeral, went to the clinic/hospital, etc.). The following quote illustrates:

> Erm… that is quite challenging for me, to ensure that they work on their individual tasks individually, so we have to monitor, isn't it? Did they submit their assignment? Were they online or not? That is quite a challenge, we have to ensure everyone is involved is quite challenging, it is difficult (Line 78-81)

I also observed that one student had also mentioned to the instructor that she was still in the midst of completing the online task later in the night after she had returned from the funeral which was around midnight. Thus, it was proposed that the "before class" session be conducted right after the face-to-face lessons had concluded to ensure higher student participation.

Technical design and navigability. The instructor mentioned that the technical design of the PSFC module was simple and that it was easy to navigate through the module. The following response is provided as support: "The design is attractive…. interesting and easy to use" (Line 37)

The participating instructor further added that the module is easy to use as the student needs to just follow the flow. "Easy… if you follow the flow... to me, it's easy, just that the student… whether they want to use it or not…" (Line 39 -40).

Accessibility. Next, the participating instructor was concerned about the lack of facilities such as seamless *Wi-Fi* access around the campus. She also noted that problems might arise since students were not using the most sophisticated smartphones. The excerpts are provided to support the comments:

> It is just that our problem seems to be Internet access and our gadgets, that's the problem…if our *Wi-Fi* connection is steady… is good… our students' corner is good… [there are] more [*Wi-Fi* hotspots], and our *Wi-Fi* connection is good, I think it (implementation of the module) will be more interesting". (Line 43-45)

> For now, the problem is *Wi-Fi* and gadgets, we can expect all the students to have the most sophisticated phones, sometimes they are using simple

> smartphones, so it may be slow to access, due to the memory size… content is too heavy to support… or the phone hangs (Line 47- 50)

A similar observation was also recorded in the researcher's field notes taken during the students' orientation to the module conducted on 10 March 2017.

> After the pre-test ended, I gave personal attention to every student regarding their access to *Schoology* and *EdPuzzle*. Students mostly had troubles installing the *Schoology* app and the *EdPuzzle* app on their phone. Since the orientation was conducted at the lecture hall and more than 25 students were trying to connect using the campus *Wi-Fi*, many students complained that the *Wi-Fi* signal was slow. Thus, students opted to use their own mobile data plans, and not many depended on the campus *Wi-Fi* connections. (Line 55-60: Field notes: 10th March 2017)

In this study, students were urged to bring their own device to be used during the intervention. Since the campus *Wi-Fi* connection was not that stable, the situation was promptly addressed by the instructor. The instructor assured the students that the face-to-face sessions for the PSFC module would be conducted in a room equipped with its own *Wi-Fi* connection. This can help to speed up students' accessibility to the module while using their own smartphone devices. An observation regarding smartphone use was also recorded in the researcher's field notes taken during the students' orientation to the module on 10 March 2017.

> The instructor lamented that her phone would usually hang when she tried to access the Schoology app on her phone. She told me she would clear the phone memory so that her phone would not hang easily. I told her, I can provide her my iPad for her use. She nodded in agreement. (Line 61-64: Field notes: 10th March 2017)

Following this, the researcher loaned an iPad to the instructor to enable her to conduct the teaching and learning activities as prescribed in the module. During this orientation, in one instance, Student1 felt that her smartphone was unable to support the apps. Thus, Student1 brought her laptop and a pen drive to the orientation workshop in case she needed further assistance from the instructor. The following excerpt supports:

> She asked me if it was OK for her to access the module using her laptop at home. I told her, it's OK, as long as she has Internet, she can access the module on different mobile devices which includes a laptop. She also brought along her pen drive and asked me if she could copy all the videos included in the module. (Line 65-69: Field notes: 10th March 2017)

During that process, the researcher also guided Student1 on how to access the web-based module on www.schoology.com and also how to transfer the video files used in the module into her pen drive. The efficiency criterion for technical usability hence created some mixed reactions. More importantly, although there were issues, these were promptly addressed by the researcher and instructor; hence, very little disruption was incurred during the teaching and learning process of the intervention. The summary of the themes identified from the responses of the participating instructor is shown in Figure 6.1.

Pedagogical usability

- User control
- Learner activity: Problem centered instruction
- Motivation: Inquisitive attitude towards learning
- Added value
  - Covers more material than the original curriculum
  - Relevance to professional practice
  - Authenticity of learning materials
  - Provides instructional guidance for instructors
  - Maximise quality class time
  - Reusable
  - Access to experts
- Collaborative learning
- Valuation of previous knowledge
- Flexibility
  - Diverse learning opportunities
  - Students' contribute to the learning resources

Technical usability

- Ease-of-use
- Efficiency: Practicality of the module
- Technical design and navigability
- Accessibility

Figure 6.1 Summary of themes from an interview with participating instructor.

Summary

The purpose of this phase, as explained in this chapter, was to evaluate the PSFC module effectiveness and the usability. The PSFC module effectiveness was established using the pre-test/post-test model by calculating the various measures of learning gain including measures of class-average and single-student normalised gains. The quantitative data revealed significant gains in both the cognitive knowledge (learning gains) and the problem-solving skills of the students after using the PSFC module. The class average normalised gain ‹g› for cognitive knowledge (learning gains) and the class average normalized gain ‹g› for problem-solving skills exceeded the pre-defined target ‹g› of 30% which defined the minimum value of effective educational intervention. This supports the use of First Principles and Cognitive Apprenticeship model which emphasise knowledge building and learning through solving real-world problems.

The PSFC module usability was approached from the pedagogical and technical point of view. The interview data drawn from the participating instructor revealed that the PSFC module was usable from both the technical and pedagogical aspects. This was substantiated by the survey findings on students' learning experience which showed a positive perception towards the PSFC module. Chapter 7 elaborates on the overall findings of the study, the conclusions drawn from the data analysis, the limitations of the study, the implications for theory and practice, as well as recommendations for future research.

CHAPTER 7

DISCUSSION AND CONCLUSION

Introduction

This chapter focuses on the discussion of the study. It begins by looking at the summary of the study from three phases: the needs analysis phase, the design of the module phase and the implementation of the module phase. This chapter will thus be organised under discussion of the results, discussion of the results in relation to the literature, limitations, implication of the results for theory and practice, recommendations for further research, and a final conclusion.

Summary of the Study

This study was developed based on the issue that students studying Culinary Arts at Community Colleges in Malaysia were unable to transfer their knowledge to new environments; they were also unable to solve related problems at the workplace; hence, they lacked in critical thinking and problem-solving skills. A survey was conducted to investigate this phenomenon. Based on the interview, during the needs analysis phase, it was found that instructors teaching Culinary Arts at Community Colleges focused more on developing students' technical skills instead of focusing on applying subject matter knowledge in solving real-world problems which can develop and enhance the problem-solving abilities required in the workplace. From various studies conducted, it was noted that the Flipped Classroom (FC) as a pedagogical model has the potential to help students develop a basic understanding of the subject matter before entering class, that is "before class", and this understanding can then be applied during the face-to-face session, that is "during class time", for problem-solving activities, group discussions, and presentations.

In the traditional settings of Culinary Arts classrooms, instructors are faced with a shortage of instructional materials for classroom use and in particular, materials which include real-world problems; they also lacked a systematic instructional model which can guide them in teaching students the skill of solving problems. As a result of this outcome noted from the needs analysis phase, this study was designed with the main aim of using a FC pedagogical model to enable the Culinary Arts instructors to develop students' problem-solving skills, enhance their cognitive knowledge, that is acquire more knowledge in the subject matter besides facilitating the instructors' teaching and learning process. The design and developmental research (DDR) method were used to develop the PSFC module.

To develop this module, this study was conducted in three phases. The first phase was the needs analysis phase. At this stage, data were collected through the Problem-solving Practices and FC Readiness (PSFCR) Questionnaire which was administered to 1,025 students from 11 Community Colleges offering the Culinary Arts programme in Malaysia. The survey was used to identify the level of problem-solving skills among students and their readiness for the FC pedagogical model. The needs analysis phase also includes semi-structured interviews which were conducted with 10 Culinary Arts instructors from two Community Colleges. The purpose was to uncover their current teaching practices in the Culinary Arts classroom setting.

The second phase was the design and development of the PSFC module. Data regarding the module design were collected by using the FDM which involved 19 experts. During the developmental phase of the PSFC module, three experts reviewed the design documents of the PSFC module; they provided comments and suggestions which were then addressed. Once the module was improvised based on the suggested improvisations, six experts (including the three experts who reviewed the module previously) were approached to re-evaluate the module. A checklist of the elements proposed by the Cognitive Apprenticeship and Merrill's First Principles forming the theoretical foundations of this study was provided.

In the third phase, the PSFC module was implemented on one group of first-semester Culinary Arts students and one participating Culinary Arts instructor. All came from the same Community College. This study used the quasi-experimental approach where the one-group pre-test/post-test study was designed to assess the PSFC module effectiveness. A pre-test and post-test were administered to find out whether the PSFC module was effective for improving the students' cognitive knowledge (learning gains) and for developing their problem-solving skills. Following this, a survey was administered to the students to extract the perception of their learning experience using the PSFC module. A semi-structured interview was also conducted with the same participating Culinary Arts instructor. Both sets of data were also used to support the quantitative findings which focused on the pedagogical and technical usability of the PSFC module. Merrill's First Principles design theory provided a unique theoretical framework to implement the FC approach. Second, this study was conducted in a Community College context; more specifically to the teaching and learning of the first-semester Certificate in Culinary Arts course. Third, the FC module was designed to be used by the instructor and the students. The effectiveness, students' experience, and instructor's view on the FC module usability were studied.

Discussion of the Research Findings

This section is divided into three parts. The first part presents the discussion on the findings of the needs analysis phase. The second part presents the discussion on the findings of the design and development phase, and the third part discusses the findings of the PSFC module effectiveness and usability.

The implications for the need of the module will then be discussed from three angles: the quantitative data which uncover the cognitive skills used for problem-solving by students, followed by the students' FC readiness and the findings of the Culinary Arts instructors' current teaching practices (qualitative data). When all these data were examined together, the findings derived from the quantitative data would be substantiated by the outcome of the qualitative data.

Discussion of the Needs Analysis Phase Findings

Students' lack of problem-solving skills. The quantitative data emerging from this part of the study revealed that the respondents' average scores relative to the different dimensions of their cognitive skills ranged from 3.21 to 3.38 on a five-point Likert-type rating scale. This indicates that on average, these respondents exhibited medium use of their cognitive skills in problem-solving. The qualitative data also revealed that students lacked problem-solving skills, especially in situations where problems arise due to mistakes made and due to changes in situations. The interviews conducted with the instructors also revealed that Community College Culinary Arts students were unable to think beyond their typical thinking requirements; hence, they were often at a loss what to do and were unable to find solutions. When these findings were taken together, the students were assessed as being not ready to join the industry since current employers were seeking employees who were able to think and also solve problems. These findings support the work of other studies for example, the one linking the lack of problem-solving skills to TVET graduates (Bakar & Hanafi, 2007; Department of Community College Education, 2011; Mimi Mohaffyza Mohamad et al., 2014; Rahman, Mokhtar, Hamzah, & Yasin, 2011; Sander, 2012; Zaliza Hanapi et al., 2015). Optimal use of common sense has been described as one of the key employability skills required for hospitality graduates from 2010 to 2030 (Beesley & Davidson, 2013; Sheldon, Fesenmaier, Woeber, Cooper, & Antonioli, 2008), alongside critical thinking and innovativeness and creativity in developing new ideas. Similar findings on common sense and creativity were reported essential to develop problem-solving skills among culinary graduates (Cheng, 2012; Gersh, 2011). Common sense can be developed by solving specific workplace problems or performing specific workplace tasks (Gerber, 2001).

In accordance with the present findings, previous studies have also demonstrated that these are valid concerns because employees with strong communicative skills, ability to perform tasks and who were highly critical and able to solve problems were more sought after and not just those who possessed technical skills (Deutsch et al., 2009; Lin & Cherng, 2006; Müller et al., 2009; Young & Chapman, 2010). The results derived from this study also support the idea recommended by Thompson, Poulston, and Neill (2017) who stated that today's institutions must take the necessary measures to ensure that the simultaneous goals of developing subject matter knowledge and skills are achieved, to ensure the success of hospitality students.

Nonetheless, manifestations of the students' inability to solve problems, their poor articulation skills when doing oral presentations, and their lack of creativity and innovativeness were evident during the interviews held with the Culinary Instructors.

The majority of them expressed concerns that their students were mostly low achievers with poor academic results; their students also lacked interest in the Culinary Arts, and these factors can actually deter them from acquiring the skills to solve problems. Moreover, these students were also unmotivated and lacked interest in learning; most do not prepare before attending classes, and of those who attend, many do not retain the information disseminated. These findings were also consistent with the outcomes noted by Ng et al. (2017) and Chunxiang (2017) who found that most TVET instructors had lamented on classroom management problems and the TVET students' characteristics which encompass being unattentive, unmotivated as well as passive. The findings of the current study also corroborated the findings of Chunxiang (2017) who reported that the TVET students' reasons for enrolment were their unsatisfactory results, their poor confidence to re-sit college entrance examination and most had aimed for the diploma level to satisfy their parents which contributed to students being unmotivated and lacking interest in learning

The quantitative data findings also indicated that the least popular strategy as highlighted by the respondents when solving problems was "analogising" what was encountered with similar problems encountered before. A possible explanation for these results may be the respondents' lack of exposure to real-world problems. In any learning process, particularly when learning new concepts and contents, students need to have a familiar frame of reference which can then be used as a resource to develop an analogy to facilitate their learning process (Kauchak & Eggen, 1998). Unfortunately for the students involved, this was a problem since their exposure was limited. The qualitative data drawn from the instructors substantiate this finding.

Instructors had revealed that the curriculum currently used in the Culinary Arts discipline in the Community Colleges, was not up-to-date with the advanced skills readily available worldwide; it lacked the use of real-world problems which could be used to provide students with more opportunities to learn. In addition, there was a lack of good instructional guides for instructors to develop problem-solving skills among their students, a skill that is much required by Culinary Arts graduates at present. The finding derived from the current study broadly supports the work of other studies such as Antun and Salazar (2006) and Lin and Cherng (2006); they had linked the employability skills of Culinary Arts graduates with employers' expectations. Therefore, in this study, the latest concepts and principles of interest involving real-world culinary competencies, as perceived by the industry practitioners that need to be learnt, were proposed by the experts. This measure was also suggested by (Kilbrink et al., 2014; Min et al., 2016) to ensure students stay up-to-date. Thus, this measure is to ensure that the module stays up-to-date with industry needs besides reflecting industry realities.

From the interviews conducted with the Culinary Arts instructors, it was revealed that students were expected to replicate the instructor's demonstrations which were conducted during the hands-on practicum component in the kitchen class. One intent of this 'mimicry' was for the students to acquire the instructor's approval but this shows their lack of creativity and innovativeness. Hence, the findings were found to be consistent with the outcomes of previous studies which highlighted that in the formalised culinary curriculum, the pedagogical model used during the hands-on practicum was based on the master-apprentice framework and the kitchen hierarchy structure developed by Auguste Escoffier in the early 20th century (Deutsch, 2014; Woodhouse, 2016). The reason for the manifestation observed by the instructor may be attributed to the 'master'/apprenticeship tradition which was founded on the idea that a more experienced employee is 'right' when the apprentice is 'wrong' (Lucas, 2012).

A number of issues were identified from this traditional culinary pedagogical model. Firstly, concerns were expressed about the ineffectiveness of the traditional lecture in retaining students' attention. This is because students were easily bored with the one-way lecture; they preferred hands-on activities when learning. Similarly, this finding is also consistent with the outcome noted by Lin et al. (2017) who argued that lecture-based teaching bored students and deprived them of acquiring critical thinking skills, problem-solving skills, and communication skills. These results also corresponded with the Everett (2016) and Lin et al. (2017) study which noted that Culinary Arts students need to actively participate in lectures to enhance their content comprehension and knowledge retention. From another standpoint, Lucas (2012) also noted the ineffective vocational pedagogy where TVET instructors presented their subject areas in a certain closed-down nature which allowed students little opportunity for engagement with the contents. Thus, it is essential to stimulate and engage students' interest by providing them with a variety of learning materials that can provoke their interest as well as address their different learning styles. This can be achieved by embedding activities and breaks to sustain their attention.

Another concern regarding the traditional teaching method was the students' lack of language proficiency in English and Malay. This has been highlighted by Muhd Khaizer Omar et al. (2012) who found that in the Malaysian Community Colleges, students possessed the technical skills which were specific to their area of specialisation, but they were unable to solve problems; they lacked innovativeness, and had an inadequate level of English proficiency (which is a particular concern of the private sector) (Awang et al., 2013). Nevertheless, instructors mentioned that culinary terms should be used in the original without being translated. This is to ensure that students will not face problems due to miscommunications at the workplace. Similarly, Choi (2014) noted that course materials and activities should use the language that employees were expected to use at their workplace for communication purposes. Thus, these characteristics were taken into consideration when deciding on the form of delivery for the PSFC module as these factors may affect students' interest levels and their information retention (Jackson, Helms, Jackson, & Gum, 2011).

Moreover, Community College students' entry qualifications is a pass in Malay language, and they are more proficient in Malay. However, when designing the module, Malay language can be used and preferably bilingual as professional terms should be in English to ensure students are prepared for the world of work (Yusoff & Ibrahim, 2013). Additionally, using readily available *YouTube* videos must be done with caution as "students may not be familiar with native speakers' accent and follow their speaking pace"(Yang, 2017). Thus, the videos were translated into Malay language by a certified translator and were attached as a separate PDF file for students to view.

Secondly, the hands-on practicum which consisted of the demonstration-replication method were more likely to inhibit student's ability to think innovatively, a skill that is required when they join the workplace. This is because the traditional Culinary Arts instruction follows the recipe-based pedagogy where the chef-instructor demonstrates the recipe, then the students diligently replicate the demonstration, and the chef-instructor provides feedback based on the outcome (Brown et al., 2013; Deutsch, 2014; Noe, 2005). It was also found that the core cognitive apprenticeship methods of Modeling, scaffolding and coaching are integrated into the teaching and learning but the articulating, reflecting and exploring are under-utilised.

The growing concerns about the quality of culinary education as mentioned before the call for a reform of the traditional didactic-demonstration-replication teaching approach. This would enable culinary students to transit smoothly from “school” to “workplace” to prepare them for their future careers (Deutsch et al., 2009). For instance, Deutsch (2014) claimed that the ‘recipe-based pedagogy’ undervalues students’ capability to think innovatively when they enter the workforce. This is supported by Hegarty (2011) who suggested that culinary instruction be transformed to include cognitive educational programmes which inculcate problem-solving in lessons to enhance students’ competencies. The call is also endorsed by Deutsch (2014) who pointed out that employers are also seeking non-technical proficiencies such as the ability to communicate problems, solve problems and display initiative. For example, the hands-on practicum session should not just involve demonstration and replication, but also some problem-solving activities related to the workplace as a way of preparing students for their future careers. By offering problem-solving topics related to the realities of their future careers, students may develop a sense of ownership towards their own occupational and personal needs (Hedges, 1996).Therefore, in the current study, students were given opportunities to solve hands-on practicum problems relevant to their future careers.

Instructors’ lack of instructional model to teach problem-solving. The next finding noted in the current teaching practices of Culinary Arts was the lack of an instructional model for instructors to teach problem-solving. This inadequacy was linked to the lack of instructional guidance, instructional materials, lessons and resources which could be used by the instructors. This finding suggests a need to design an instructional model consisting of the relevant instructional materials and resources which can guide instructors in teaching problem-solving. This finding is consistent with the outcome noted by DeWitt and Alias (2015) who found a lack of instruction models for problem-solving which can be used by instructors in the Malaysian context. Therefore, in this study, lessons were designed based on an instructional model that allowed instructors to teach problem-solving using well designed instructional materials, lessons, and resources. The findings of this phase of the study indicated a real need to instill opportunities for authentic and real-world problem-solving for the Culinary Arts programme which supports Merrill's First Principles. Nevertheless, some focus needs to be given to developing the students' prior knowledge so that it can be used to activate learning. Therefore, in this study, the instructional materials developed for the PSFC module would consist of examples of real-world situations. These were provided through authentic videos and students were required to solve real-world tasks by following a problem-solving instructional model.

FC readiness using mobile technology. In surveying the student's readiness for the FC, the quantitative data would also be substantiated by the qualitative data. This phase of the study looked at the respondents' use of the smartphone devices. The results derived from the survey also support the idea that smartphones, as a ubiquitous tool, can be used by instructors to interact with students in higher education in traditional classroom settings (Dobbins & Denton, 2017; Woodcock et al., 2012). Based on the results taken from the respondents' mobile device ownership and use, the needs analysis provided the evidence indicating that the majority of the students (97.4%) owned smartphones running on Android platforms (89.1%). The qualitative interview data also revealed that readily available smartphones were also found to be the instructional tool that students and instructors could use to search for online information as well as demonstration videos. This is particularly noted at the low tech settings of a Community College. The high smartphone ownership rate may be attributed to the competitive prices of smartphones in the market (Tan Choon-Keong, Ng Shi Ing, & Kean-Wah, 2013). This phenomenon is consistent with the data obtained in previous studies concerning mobile learning in HLIs in Malaysia (see Mehran Qadri, Yusree Abubaka, and Ibrahim (2015); Yeap, Ramayah, and Soto-Acosta (2016). The low tablet ownership reflected in this study may be attributed to the fact that tablets are more costly than smartphones; there was also no necessity to own both as the smartphones and tablets share the same function although tablets were considered as leisure devices (Sedek, Mahmud, Jalil, & Daud, 2014; Tan Choon-Keong et al., 2013).

From the technology perspective, the Internet can be used as a problem-solving as well as a researching tool, considering that most respondents (91.8%) have mobile Internet subscription services which allow 24/7 connectivity. Interacting with smartphones usually involves using Internet connections. In this study, 91.8% of the respondents claimed that they have Internet connectivity on their smartphones with some 45% having broadband access at home. These results may also account for the 15.4% of the respondents who used the Internet for more than 20 hours on a daily basis. Taking into account that 91.8% of the respondents have mobile Internet subscription services which allow for a continuous Internet access, it is thus deduced that the Internet could be used as a problem-solving research-tool.

The needs analysis conducted also provided evidence that students possess a high level of online skills, thereby displaying their readiness for the FC approach. Overall, 77.9% of students agreed that they were able to find their way around the Internet. In addition, 74.3% of the students also agreed or strongly agreed that they were comfortable in communicating with others using online chatting platforms. The qualitative data revealed that instructors used the mobile instant messaging apps as a platform for communicating with their students. These results also mirror the outcome derived from previous studies that examined the potential of using appropriate technology for pedagogical approaches, for example as a measure to blend face-to-face teaching with mobile messaging apps and social media to enhance engagement and communication between students and instructors (Guthrie, Harris, Simons, & Karmel, 2009; Ng et al., 2017; Rossyahida Abd Rahman & Hashim, 2011). The survey results further support the outcome which mentioned that TVET instructors used videos, online resources, social media and mobile messaging apps in their teaching and learning process. It appears that these technologies enabled the instructors as well as the students to search and use subject related materials, search for related resources and so apply some learning flexibility (Ng et al., 2017). Based on this, it would seem that the smartphones or mobile apps not only support the pedagogical setting but can also be applied as a tool to access resources and materials.

Another important finding derived from the needs analysis is that 52.8% of the students also agreed or strongly agreed that they need the presence of instructors to remain motivated. The qualitative data substantiated this finding, revealing that students have poor academic results; thus, they required more attention from instructors. The attention from their instructors can make them more motivated in performing better. From the perspective of motivation, it was noted that slightly more than half of the group of students in this study also agreed that they would be able to complete their work even with online distractions; and similarly, slightly more than half of them also agreed that they would be able to complete their work even with distractions at home. All these findings support the results of previous research which showed that students were aware of the pitfalls caused by technological distractions (social media, television, and laptop). Nevertheless, it is deduced that these technological distractions may make it difficult for students to study or complete their homework outside of the classroom. Therefore, they would require self-regulation strategies to compensate for their lack of motivation (Flanigan, 2014).

Some 58.5% of the students in this study also agreed or strongly agreed that they would be able to understand course-related information when it is presented in short videos (one to three minutes). The qualitative data substantiated this finding. The instructors interviewed reported that they used *YouTube* videos to deliver information to students. These findings are consistent with recent studies which stressed that the length of the video lecture influences student video watching behaviour (Ozan & Ozarslan, 2016; Tolks et al., 2016; Zainuddin & Attaran, 2015). Thus, short videos of (less than 10 minutes) need to be included to make the videos more appealing to students using the PSFC module.

In terms of "Internet Discussion" the students in this study reported that they would participate in online discussion using online tools. They also prefer to have more time to prepare responses to a question. These results are also in agreement with those obtained by Black et al. (2017) who noted that students need to take their time in processing the material and in saying meaningful things about it when lectures and assessments happen outside of class. In the FC setting, students can be encouraged to actively participate in online discussions on the LMS (Moffett, 2015; Rémy Magnier-Watanabe, 2013). Thus, in this study, the LMS was used as a platform to deliver the PSFC module.

As for "Importance to your success", the majority of the students in this study perceived that being in regular contact with the instructor and having the ability to immediately apply the course materials are crucial for their success. These results are in agreement with previous studies which showed that one of the drawbacks of FCs is not being able to get help when needed (Kim, Kim, et al., 2014; Yong et al., 2015), or when there were not enough problems for learners to apply the newly acquired knowledge (Yong et al., 2015). As a result, the module designed needs to provide problem-solving opportunities using real-world problems so that students can immediately apply the concepts that they have learned. Problem-solving activities in groups can be conducted during face-to-face sessions with the presence of the instructor. The majority of the students in the context of this study also perceived that frequent participation is required for FC to be successful. This outcome supports the findings of past studies (Abeysekera & Dawson, 2014; Wilson, 2013), which suggested that active participation occurs when students work together in small groups.

Next, when examining the students' readiness for the FC, 67.4% of them had mentioned that they were unaware of the FC approach. This finding was expected; hence, the results implied that institutions should introduce this new approach of teaching and learning for the benefit of their students (Mohammed Amin Embi et al., 2014). The qualitative data gathered substantiated this finding. It highlights the need for instructors to design a model that can be used practically and conveniently as there is a need to shift the teaching practice from traditional lectures to student-centred approaches.

The result notes that 84.2% of the students agreed or strongly agreed that face-to-face instruction should make up between 50% and 90% of the course delivery. This result also supports the idea that the NetGen learners yearn for more face-to-face interactions which supersede online interaction or mediated communication, as mentioned by Oblinger and Oblinger (2005) and Dede (2005). The qualitative data substantiated this finding; it revealed that current teaching practice employs the traditional culinary pedagogical model in which the face-to-face class meeting, at

Community Colleges, was used primarily for introducing students to materials for the first time and for disseminating related materials (often through the form of lecture). Due to this imbalance, instructors need to use class time to include more hands-on learning experiences so that students can actively participate in the learning process. Taking this into consideration, the face-to-face sessions in the PSFC module needs to be well planned to ensure that good quality face-to-face instructions are implemented.

As for the preferred content format of the online materials, the highest preference noted was for materials to be delivered using *PowerPoint* with video explanations (35.4%), followed by the use of videos (27.9%). The qualitative data substantiated this finding; it revealed that instructors were currently using both *PowerPoint* slides and videos to deliver information as students preferred visual media. *PowerPoint* slides with video explanations are also known as screencasts and are widely used in other FC studies for delivering lecture materials before class (Blair et al., 2015; Porcaro et al., 2016; Snyder, Paska, & Besozzi, 2014; Tolks et al., 2016). Similarly, videos have been used extensively to deliver lessons in Culinary Arts classrooms to facilitate learning. However, videos are not there to replace the live demonstrations provided in the class (Brown et al., 2013; Everett, 2016; Hsu & Chien, 2015; Mohammad Azli Razali et al., 2012). Growing up in an intensive environment of television, movies, and video games, it appears that students have developed preferences where comprehension is more likely to occur through visual images (Jackson et al., 2011). Thus, *PowerPoint* with video explanations and videos were considered as resources to deliver lessons in the module.

In conclusion, the findings derived from the needs analysis phase are significant in two major aspects. Firstly, the findings noted have enhanced the understanding of the profile of the Culinary Arts students, especially their levels of problem-solving skills and their FC readiness. Secondly, the findings noted have also enhanced the understanding of the Culinary Arts instructors profile about their current teaching practices, their concerns, and challenges faced in the Community College settings. As asserted by Salavuo (2008), these findings are especially useful when designing socially and culturally relevant technology-mediated instruction. The findings from the needs analysis phase also provide evidence indicating that the majority of the TVET students prefer visual images, videos, demonstrations, group discussions and interactive activities in their lessons (Guthrie et al., 2009; Ng et al., 2017; Warner, Christie, & Choy, 1998).

These findings also indicate that there is a pressing need to improve students' level of problem-solving skills and to provide instructors with adequate guidance in implementing problem-solving instruction as a measure to facilitate the FC approach in a Culinary Arts classroom. The role of the instructor changes from being the transmitter of knowledge to being a facilitator who provides scaffolding to students when they are in the midst of task completion. With the FC approach recommended, the instructor concerned will also have more time to delve into the subject matter, particularly when the face-to-face time is spent on solving real-world problems with students. Since students would came prepared and informed (by completing "before class" tasks), they were able to ask questions in order to clarify their doubts. This resulted in informed inquiry which enabled scaffolding to take place as found by (Black et al., 2017). The findings of this study are significant because one of the Program Learning Outcomes of the Culinary Arts program in Community Colleges is for students to be able to solve problems creatively and innovatively. Hence, these results support the idea that there is a need to develop a pedagogical module for problem-solving using real-world problems. This can be achieved through the FC approach that emphasizes developing professional knowledge and problem-solving skills during instruction. Therefore, in this study, the learning process combines theory and practice and not just practical skills. The process also uses structured tasks to develop students' ability to solve problems, improve their articulation skills when doing oral presentations, and so enhance their creativity and innovativeness.

Discussion of the Design and Development Phase

The following is the discussion of the findings extracted from the second phase of the study. It looks at how the elements were incorporated into the PSFC module. On the whole, the findings in this study showed the experts' consensus in listing the elements required for the PSFC module in terms of objective, content to develop real-world problems, instructional strategies, resources/media, platform and assessment strategies. In some elements, almost all of the items seemed acceptable to the panel (objective element, content area to develop real-world problems element and the instructional strategies during practical class element), whereas in some elements (instructional strategies before class and platform), there was a high level of rejection of most items. The panel accepted most of the objectives since the objectives list could be easily carried out for the content areas and instructional strategies suggested. On the other hand, the panel did not seem to achieve consensus on most of the platforms, and most of the items had to be rejected. This might be because there are so many potential platforms, each with its own advantage and disadvantage, and each expert may have different preference for the different platforms.

Designing the objectives. When developing a module, the learning objectives and learning activities must be chosen and organised based on the students' needs and abilities. This will ensure that students can achieve the module goals effectively. From the perspective of the objectives, the one with the highest consensus was to apply knowledge to solve real-world problems. This finding is consistent with that of Molnar (2017) who highlighted that this objective is much more difficult to accomplish in the traditional classroom when compared to the FC, due to time constraints. Following the call by Fulkerth (2009) and Talbert (2015) and recent studies that focused on FC designs (Gilboy et al. (2015); Hsieh (2017); Khalil and Elkhider (2016); Lo and Hew (2017); Sergis et al. (2017), the learning objectives proposed for the FC were redesigned. They were rearranged according to cognitive complexity. Given the phases of instruction in the flipped model, the objective for the "before class" session focused on remembering and understanding concepts (lower levels of Bloom's taxonomy). The "before class" objectives enabled students to complete tasks at their own pace; it also encouraged students to come prepared with the prerequisite knowledge before participating in the "during class" activities. The objectives for the "during face-to-face" sessions required prerequisite knowledge which can be the concepts acquired to solve problems or practical tasks through application, synthesis, and creation (higher levels of Bloom's taxonomy).

Designing real-world problems. In searching for content areas that could be used to design real-world problems, the findings from the FDM showed that the experts agreed that the content areas to be covered in the module should be designed based on the knowledge, skills, attitudes, and behaviour of students (Conway & Little, 2000) and their level of innovativeness and creativity (Hu, 2010), all of which are expected of a Community College Culinary Arts graduate.

In this study, the content area which received the highest consensus among the experts was the Standards of Professionalism: Chef Identity and Work Ethics content area. It is important to note that this content area was not available in the existing curriculum. This specific content area focused on the overview of the industry and organisation, and personal qualities to be developed in preparation for industry employment. Surprisingly, this specific content area also reflected the top five most important course subjects ranked as important by industry practitioners in the hospitality industry over the past 10 years: internship/industry experience, preparation for industry employment, leadership, hospitality management and organization, and ethics, as found in a longitudinal study conducted by Min et al. (2016). The Standards of Professionalism: Chef Identity and Work Ethics content area serve as a fundamental topic that must be covered in the hospitality field at the fundamental level to groom students to be professionals at their workplace. Similar findings were shown in a study by Mack (2012), who suggested that Culinary Arts education needs to teach and inculcate professionalism clearly in order to address the mismatch between students and industry expectations. In Mack (2012), it was discovered that the traits of professionalism for the line cooks and the chefs in the restaurant industry that required the most improvement were interpersonal skills, respect for others and work ethics. These were also the same traits which acquired the highest consensus among the experts in this study for developing the standards of professionalism in the content area proposed for the PSFC module.

The other three content areas (Kitchen Safety, Food Safety, and Kitchen Fundamentals) that achieved experts' consensus matched the Introduction to Western Cooking in the Basic Western course module – which is currently being offered to the first-semester students taking the Certificate in Culinary Arts programme at Community Colleges. These aforementioned content areas served as the fundamental content areas deemed essential for developing competent Culinary Arts graduates as the topics are the most fundamental topics students need to grasp well (see Birdir and

Pearson (2000); Horng and Lee (2009); Lin and Cherng (2006); (Reezlin Abdul Rahman et al., 2011). In this module, the real-world tasks and problems were designed based on these content areas that reflected the emerging trend as suggested by experts; this would serve as a bridge between academic and industry requirements. This outcome makes a significant contribution to this study.

Designing instructional strategies. When designing the instructional strategies, the experts' consensus was also achieved. This includes strategies incorporated for the "before class" sessions, where students access supportive materials to complete tasks related to the concept that needs to be applied to solve problems during the face-to-face session. This strategy was to ensure that students developed the necessary prior knowledge to facilitate their learning. When students attend the face-to-face sessions, which are facilitated by their instructors, they can participate in the review activities of the concepts covered, making learning more meaningful. These intentions portrayed in the PSFC module mirror the findings of Karanicolas et al. (2016) who found that students must complete "before class" activities based on the concepts covered by the learning materials which have been accessed by students in order for them to fully benefit from the FC approach. This is because the concepts covered for the before class have been strategically designed for them to be relevant to all the phases of learning. If students do not come prepared before class, they may be unable to see the link between the content covered in the before class activity and the problem-solving activities in the "during class" session.

During the hands-on practicum session, experts' consensus was also achieved in the area where students perform technical tasks after watching the instructor's demonstrations. Unlike traditional apprenticeship where the instructor only demonstrates how to perform the task and students are expected to replicate the demonstration, the FC approach focuses on cognitive apprenticeship. Here, the instructor provides coaching and scaffolding by explaining the mental processes guiding the activity. Translating the model of traditional apprenticeship to cognitive apprenticeship involves making the instructor's thinking visible to students and the students' thinking visible to the instructor (Weibell, 2011). These support the work of a few other studies which link cognitive apprenticeship teaching methodologies with teaching problem-solving in FCs (Giuseppe et al., 2016; Jamieson et al., 2017). The findings on instructional strategies that reached expert consensus in this study suggest that the cognitive apprenticeship model describes how learning and social interaction can be designed into a more formal learning context in a TVET setting using the PSFC module.

Experts' consensus was also achieved for student participation in problem-solving activities related to the workplace environment. This will enable students to link the required concepts and principles to the conditions and procedures of the real workplace when solving real-world problems. Instructors facilitate the problem-solving tasks by providing coaching and scaffolding which are expected to fade over time. These also support the idea of creating authentic work tasks anchored in real-world situations (Chi et al., 1982; Savery & Duffy, 1995) in TVET settings. Students were encouraged to verbalise their learning and thinking process during presentations and when recording their reflective thoughts on their learning experience. The findings noted from this design-phase also supports the idea of integrating reflective practices into student learning in TVET so that they become more aware in recognising what is going on in the current workplace and be able to use that information to modify their actions accordingly, thereby, developing their problem-solving skills (Lucas, 2012).

In reviewing literature for the design phase, it was noted that many of the previous studies did not explicate any specific conceptual framework to enable instructors to design their FCs (Bishop & Verleger, 2013b; Giannakos et al., 2016; Lo & Hew, 2017). Few previous studies had utilised their results to develop design principles for using the FC (O'Flaherty & Phillips, 2015). Perhaps the most important outcome noted from the current study is the design of an instructional model which was developed based on the instructional strategies that could be applied to all the phases of the FC. Moreover, this outcome had been endorsed by the consensus of experts (i.e., before class, during class, and after class), making this study a significant contribution.

Designing media and resources. In terms of the media and resources needed to be developed for use in the PSFC module, experts' consensus was also achieved with regard to lesson plans and stimulus materials for the tasks. This outcome is consistent with that of Sergis et al. (2017) and Lee et al. (2017), who noted that lesson plans and instructional materials should be developed as guidance for instructors to reflect on the design and context of the PSFC module. This was also considered since the FC would be a novelty for the Culinary Arts classroom in the respective Community College. In addition, it was noted in the needs analysis phase, that there was a lack of uniformity in teaching practices, with possible variations occurring among instructors when conducting lessons. Thus, the idea to design a lesson plan template that could serve as a model and guide for all the lessons implemented was developed. This template was also introduced to the instructors and students as a guide for the PSFC module implementation making this study a significant contribution. (See Appendix L).

Designing platform and technology. In designing the platform and technology for use in PSFC module delivery, the experts' consensus on using mobile messaging app to deliver the module was also achieved. In this study, the mobile messaging app, *Telegram*, was used by the instructor to deliver "bite-sized" materials including *YouTube* links, interactive quiz links, images and links to online polls, when facilitating the "before class" sessions. This method of presenting brief and precise information appears to be less overwhelming for learners, thereby making it more conducive to their learning (So, 2016).

The instructors involved were also expected to use *Telegram* to post questions to students and to respond to their queries besides posting announcements outside school hours. Like previous outcomes, this outcome also mirrors those noted in previous studies which examined the potential of using appropriate technology for pedagogical approaches such as blending face-to-face teaching with mobile messaging apps and social media as a means of enhancing student-instructor engagement and communication (Guthrie et al., 2009; Ng et al., 2017; Rossyahida Abd Rahman & Hashim, 2011) and learning flexibility (Ng et al., 2017).

Nevertheless, when using a mobile instant messaging app to deliver the module, the information is stored chronologically; it is deduced that this may not be suitable as an administrative tool. Thus, to ensure a more organised implementation of delivering videos and resources related to the tasks, the instructions, and materials provided in the module were also delivered through the LMS. In previous studies, such as those conducted by Aftab Ahmed Khan et al. (2017) and Rawash, Hassan, Noraini, and Abdullah (2014) it was observed that using both the mobile messaging tool and the LMS ensured a swifter communication.

Consistent with the literature, experts' consensus was also achieved for the assessment of the students' problem-solving skills in the PSFC module which was done through the students' performance of the practical tasks and their reflection of the problem-solving process. This outcome also supports the idea that the FC pedagogy can encourage students to develop their reflective abilities; they need to reflect on the link between the tasks completed before class with the tasks completed during the face-to-face settings. This was also mentioned in previous studies (Miller, 2012; Roehl et al., 2013; Yang, 2017). To ensure that students come prepared for the class, they should be given participation marks as incentives for completing the before class tasks. This finding also reflects those of Mok (2014) who suggested a penalty for students' class non-participation and self-check quizzes to ensure that students come prepared for class.

To conclude, the summary of the FDM findings provided a guideline about the most suitable objective, content to develop real-world problems, instructional strategies, resources/media, platform and assessment strategies for inclusion in the PSFC module development making this study a significant contribution.

Discussion of the Implementation and Evaluation Findings

The following are the discussions of the findings acquired from the implementation and evaluation phase.

Effectiveness of the module. The findings from the one group pre-test/post-test, quasi-experiment showed that the null hypothesis was rejected. Thus, there was a significant difference between the pre-test and post-test mean score in terms of cognitive knowledge (learning gains) with $t(29) = 12.458$, and $p = 0.000$, following the PSFC module implementation. From the pre-test/post-test scores, the class average normalised gain ‹g› was 65.4% for cognitive knowledge (learning gains), and the class average normalised gain ‹g› for problem-solving skills was 34.1%. These results showed that class average normalised gain in this study exceeded the pre-defined target ‹g› of 30% which was taken to be defining the minimum value at which the educational intervention could be regarded as effective. The results of the high learning gains reflected those of McLean et al. (2016) who found that formative assessments of tasks completed before class (such as the interactive quiz on *EdPuzzle* and the online quiz on *Schoology* provided in this study) allowed students to interact meaningfully with the contents presented. Moreover, the problem-solving activities conducted during class reinforced the concepts learnt in a way that enabled students to connect and apply the concepts. This ultimately resulted in an improved post-test score. The results noted were also in agreement with those obtained by McLaughlin and Rhoney (2015), Kong (2014) and Lo and Hew (2017). Thus, this study has provided support for the use of Merrill's First Principles and Cognitive Apprenticeship model to supplement instruction in an otherwise lecture-demonstration course to increase student understanding to apply the fundamental concepts of Culinary Arts in solving related problems.

PSFC module usability. The implications for the usability of the PSFC module following its implementation arose from the findings of the participating instructor's view on the technical and pedagogical usability of the PSFC module (qualitative data) and the students' perception of their learning experience in using the PSFC module (quantitative data). When the data were examined together, the qualitative data offers findings that substantiated the quantitative data. The qualitative data extracted from the interview revealed that the participating instructor found the module to be easy to use; it was organised systematically, and users only had to follow its sequence to navigate the module in order to complete each lesson.

In looking at the students' learning experiences, findings were consistent with the literature. A total of 93.4% of the students who used the PSFC module reported that they had benefited from it. This was confirmed by the participating instructor who revealed that students were more knowledgeable upon implementation of the PSFC module; they also understood the contents better when compared to students from the previous semester. In addition, the respondents' average scores relative to the different dimensions of areas that helped them improve their learning ranged from 3.93 to 4.70, on a five-point Likert-type rating scale. This indicates that, on average, these respondents exhibited high levels of positive perception of their learning experience when using the PSFC module. A possible explanation for this might be that the lessons and use of technology during the PSFC module implementation were well planned. When the FC implementation process is well planned, and the process is combined with the appropriate use of technology, students are able to maximize their learning opportunities (Lee et al., 2014).

During the "before class" session, the instructor facilitated the implementation by providing feedback to clarify students' responses or to orientate them to the contents. This was accomplished by posting online polls when starting the "before class" session and the "during class" session with feedback provisions during the problem-solving activities and presentations. However, the interview with the participating instructor revealed that she preferred students to work independently during the "before class" session with lesser guidance given on the mobile messaging app. She also mentioned that it might not be practical for the instructor to be guiding students, especially for their "before class" session as scheduled. This may be affected by her other duties and family commitments. Studies have shown that it is a challenge for students to focus and concentrate when doing individual study in the absence of an instructor. Thus, in this study, the instructor's presence supported the students' efforts in focusing their attention on the class and to be able to concentrate during their individual study in a structured manner. From this outcome, the design of the PSFC module would require the presence of the instructor to act as the "sage on the side" to facilitate student learning (James et al., 2014; Jenkins, 2017).

The quantitative survey data also indicated that students had a high preference for using enhanced communication such as the mobile instant messaging app such as *Telegram* and LMS such as *Schoology* as much as 80%. These two technological networks enabled students to collaborate and share ideas with their instructors outside regular class time, a finding that is consistent with that of Rambe (2015). Consequently, students asked more questions as they spent more time preparing for class. Using the PSFC module, the relationship between the instructor as a facilitator and the students were also enhanced. The quantitative data extracted from the survey indicated that 86.7% of the students agreed or strongly agreed that they communicated more with their peers and their instructors through this FC module. This may have occurred because of the better quality interactions which were permissible in a FC (Murray et al., 2015).

The instructor also implied that students were more confident in asking questions especially after watching the demonstration videos before coming to class. This finding also concurs with Brown et al. (2013) who highlighted that online video availability enabled students to watch demonstrations of the proper techniques of classic knife skills as often as they wanted, compared to live class demonstration which could only be observed once. The instructor's feedback also concurred with the findings of those studies by Brown et al. (2013), Khalid et al. (2014) and Mohammad Azli Razali et al. (2012) that have employed blended learning approach by introducing videos as part of the blended learning approach to polish students' culinary skills.

Nevertheless, an implementation schedule was designed to ensure that students studied the online content to be prepared before coming to class. This was also mentioned in previous studies (Lee et al., 2017; Mason et al., 2013; Talbert, 2012). Data drawn from the interview with the participating instructor showed that the students seemed to be more committed to their lessons; the instructor also noted that they need not be reminded about their "before class" sessions, following the second week of the PSFC module implementation.

One important result that can be drawn from the findings of the PSFC module implementation is that 83.4% of the students agreed or strongly agreed that they had to work harder when following the PSFC module. A possible explanation for this outcome may be attributed to the fact that the "before class" tasks were linked to the "during class" tasks. Thus, students need to know how to apply the concepts learnt when solving the related problems during the problem-solving activities. Hence, students had to spend more time preparing for class. This outcome corroborates with the findings of past studies (Johnson & Renner, 2012; Sohrabi & Iraj, 2016) which observed that students need to complete quizzes and review the materials at the beginning of the session (Khalil & Elkhider, 2016).

Overall, it appears that students require a clearly defined and well-structured guidance that is complemented by adequate scaffolding for their FC activities. In the beginning, students may be resistant to a new method that required them to be more engaged in the "before class" tasks to prepare for the "during class" problem-solving activities. The FC was designed based on the foundation that students come prepared for a class and then be ready to learn. Hence, if this is not addressed, the biggest barrier to the FC would be the lack of preparedness of students which is consistent studies by (Ebbeler, 2013; Kim, Kim, et al., 2014). In the current study, the participating instructor mentioned that students needed some time to adjust to the PSFC module format and it was noted that in the implementation, the space for students to adjust to the PSFC module format was fairly short. It was added that by the fourth week of the implementation, students seemed to have realised that they would learn more during class time if they came prepared (Mason et al., 2013). This resonates with La Lopa (2010) who found that Culinary Arts students should also be given guidance to plan their out-of-class time to study to increase their performance.

The quantitative data also substantiated the findings: 83.3% of the students agreed that in using the PSFC module, they learned by exploring their own strategies for learning. This finding is consistent with that of Iwaniec, Simmonds, and Swan (2017) who found that students may find it challenging initially but they get used to the FC method. This tends to apply to first-year students who were developing their abilities to work independently and to be engaged with the materials. This behaviour indicates self-regulated learning strategies, which is required in a problem-based FC as noted by Çakıroğlu (2017).

The qualitative data revealed that both instructors and students followed the flow of lesson according to the different phases of instruction using the media and resources provided in the PSFC module. This finding resonates with past studies that highlighted the explicit learning flow of Merrill's First Principles makes it easier to conceptualise and implement FC for practitioners, and better engagement and learning was reported among students (Hoffman, 2014; Wang, 2017).

Students learn best when they are actively engaged in the learning process (Bradford, 2005). Using a module may require a high level of motivation and self-discipline (Sidek Mohd. Noah & Jamaludin Ahmad, 2005; World Health Organization, 1985). Thus, it seems like a primary challenge because students might not be prepared before entering class in the beginning; hence, proper motivation needs to be provided to help them become accustomed to making preparations before entering the face-to-face sessions (Long et al., 2016).

Perhaps the most significant finding detected from the PSFC module implementation phase is the fact that all (100%) the students agreed that the learning activities they worked on were related to real-life applications and information. When students used their acquired knowledge to solve related problems, it gives greater value to the knowledge. Another important finding is that the majority of the students agreed that they were able to apply out-of-class experiences and learn from the practical applications. The high response rates may indicate that the use of local real-world contents and problems are suitable and applicable besides being unique to the PSFC module and not available elsewhere. This is endorsed by the participating instructor who revealed that the real-world problems and examples used in the PSFC module reflected trends in the industry which is beneficial to prepare students to be industry-ready. Despite the content of the PSFC module being slightly advanced when compared to the existing curriculum, the participating instructor implied that the slight difficulty in terms of the advancement added value to the module since the content areas in the module were suggested by experts; they were also more up-to-date than the existing curriculum. This may fill in the gap of past studies concerning the mismatch between employer demands and ability of culinary graduates.

The real-world problems provided in the PSFC module consisted of problems which may arise due to mistakes made as well as problems caused by changes to some situations. These were designed to develop students' problem-solving skills which would be required in the workplace. Proponents of real-world problem-solving skills emphasised that the real-world problem-solving activities designed must be consistent with the demands of the working environment for which students are being prepared (Chi et al., 1982; Savery & Duffy, 1995) without simplifying the context (Jonassen, 2011). This proposition was also reiterated by Soden (2013) who stated that in teaching problem-solving related to TVET, it is necessary to teach thinking skills which are linked to competencies required for the occupations targeted by students. In this context, the problems must be related to culinary arts (Buttles, 2002; Ro & Choi, 2011). In short, it means that effective learning occurs when students can learn from knowledge presented in a real-world setting (Alexander, Onodipe, Ayadi, and Lin (2017); (Bates & Galloway, 2012); Johnson et al. (2014); Karanicolas et al. (2016); (Strayer, 2012). In Chapter 2 (Literature review), the use of Merrill's First Principles, Cognitive Apprenticeship and the FC model was discussed. In this regard, the emphasis on real-world problems provided in the PSFC module was successfully delivered.

In looking at the pedagogical usability of the PSFC module, the participating instructor's intention to reuse the PSFC module for the following semester, as noted from the qualitative data, suggests that the module is applicable; hence it adds value to the module. This outcome is substantiated by the quantitative data which showed that 90% of the students surveyed agreed or strongly agreed that they would choose to take another flipped course. Similarly, 90% agreed or strongly agreed that they would continue with this module if it were to be delivered through the same approach. These findings are considered as very promising; they add value to the module. This finding, as noted from the students' survey, was also in accordance with the findings of earlier studies which indicate users' high perception of the Flipped Classroom (Sohrabi & Iraj, 2016; Zainuddin & Attaran, 2015). The outcome of this phase of the study further indicates that developing blended learning courses in the hospitality industry allows the reusable creation of ICT based learning materials in the long run (Wong et al., 2013), thus making FC cost-effective in the long term (McLaughlin et al., 2014; Mok, 2014).

In terms of the pedagogical usability which highlight the flexibility of the PSFC module, the qualitative data revealed that the module encouraged flexibility; it provided diverse learning opportunities via different media and resources as well as access to experts via guest lectures, all of which further motivated students. Consistent with the literature, the subject matter can be made more exciting and interesting with direct inputs from the industry professionals during guest lectures (Majumdar, 2011). The quantitative findings also substantiated this finding when it was revealed that 86.7% students agreed that the most preferred activity in the PSFC module was the online testing and evaluation (e.g., interactive quiz on *EdPuzzle* and online quiz on *Schoology*). Consistent with the literature, this study also found that participants using the PSFC module also indicated the highest preference for interactive online test and evaluation. A possible explanation for this is the impact of the interactive quizzes on student engagement and learning process. It appears that students also valued the opportunity to assess their knowledge in a safe environment (McLean et al., 2016).

The qualitative data further revealed that there was an increased collaboration among students when they participated in group problem-solving activities where they had to discuss and share knowledge collaboratively in teams. The quantitative data substantiates this finding as it was reported that 70% of the students preferred to work in group discussions and collaborative activities provided in the module. This finding is consistent with previous studies (McIntosh et al., 2000) which stated that real-world problem-solving not only motivates students to be more enthusiastic about the topic but also helps them to break away from the usual routine, thereby reinforcing the concepts acquired. When students participated more and engaged in the learning process, their critical thinking and problem-solving skills are enhanced (Iwaniec et al., 2017). By learning with such experiences, students are able to generate their own thinking skills, and this makes them realise that there are a few alternative ways to solve a problem (Kwok & Tan, 2004).

Perhaps the most unexpected finding noted from the PSFC module implementation was the knowledge that students had the lowest preference for working on assignments and class work individually (36.7%). This is in contrast to their preference for collaborative learning activities although both the learning activities before class and during class were mostly formed through instructor guidance. This outcome thus corroborates with studies looking at the NetGen which state that these learners are most effective when they find, filter and make sense of information learnt or when solving problems in groups rather than working individually (Dede, 2005; Oblinger & Oblinger, 2005). Nevertheless, communication and collaboration abilities are essential skills needed in the 21st century. As most of the PSFC module activities involved group work, they were thus conducive for developing communication and collaboration abilities. In addition, teamwork skill is crucial, and most food service operations would require it in individuals (Brown et al., 2013) especially in an increasingly challenging workplace environment (Bourdain, 2013; Ko & Chung, 2015).

Another interesting finding noted in the PSFC module implementation phase was that only 56.7% of the students surveyed found the module easy to use through their smartphones, a finding consistent with Janson (2017) who noted that learning through mobile means is overwhelming for the learner since it is often used in a rich physical environment and it also demands a high self-regulated learning ability. From Janson's (2017) finding, it was also observed that most students in the current study needed technical assistance to help them improve their learning experience when using the PSFC module. The qualitative interview data validated this finding. The participating instructor was of the opinion that during the first week of the PSFC module implementation, the students struggled a little. However, during week two and three, they were already comfortable with using the module assisted by the continuous technical support. In terms of the technical usability (accessibility) of the PSFC module, the quantitative and qualitative data converged. Both findings noted the lack of facilities such as a seamless *Wi-Fi* access around campus. Such usability issues encompassing battery life, Internet speed, and interactions have been frequently cited in mobile learning research (Elias, 2011; Looi et al., 2009; Nedungadi & Raman, 2012). Internet connectivity posed the highest challenge to instructors when teaching through ICT especially in Malaysia (Malini Ganapathy, Manjet Kaur Mehar Singh, Sarjit Kaur, & Liew Wai Kit, 2017). Thus, despite the significant advancement of smartphones and Internet connectivity at present, these issues remain valid (So, 2016). Nonetheless, the students' positive perceptions of the module, as noted in the apparent benefits, outweigh the perceived drawbacks.

As a conclusion, the interview findings with the participating instructor showed that the PSFC module is both pedagogically and technically usable. Students had also indicated a high positive perception of their learning experience when using the PSFC module. Taken together, the PSFC module was thus found to be efficient and practical for use in the Culinary Arts classroom setting. With the PSFC module, Culinary Arts lessons would no longer be passive lectures and demonstrations and replications only. Instead, lessons would be transformed to become an avenue for classroom engagement, collaborative learning, and knowledge application in real-world settings. The pedagogical contents in the PSFC module allowed students to gain confidence as evidenced by their motivational changes, improved study skills and critical thinking and their overall performance in knowledge acquisition. Day (2017) noted that this is especially beneficial for low achievers and students who struggled with traditional lectures. Additionally, past research also indicated that employers preferred college graduates with the ability to work as a team, to communicate effectively and to apply knowledge in real-world settings. Therefore, it is deemed that the PSFC module would be useful as it can enhance these skills.

Research Implications

This section discusses the implications and suggestions drawn from the discussion of the findings of the study. There are three types of implications in the study, theoretical implication, pedagogical implication, and implications for practice. Theoretical implication refers to the findings of the study in relation to the theories used in the study. The implication to practice refers to the impact of the study on the stakeholders, for example, the Ministry of Higher Education, Community College Culinary Arts instructors, Community College Culinary Arts students and other contributors.

Theoretical implications. In linking the contribution of current research to the theoretical aspect it can be said that this study had developed a module based on the combination of the following: First Principles of Instruction (Merrill, 2007), Cognitive Apprenticeship (Collins et al., 1990) and the FC Model using Merrill's First Principles (Lo & Hew, 2017). The study responds to the call made by Deutsch (2016) and Soden and Pithers (2001) who highlighted that the traditional culinary teaching practices inhibit student's ability to think innovatively which is required when they join the workplace environment. It is interesting to note that the findings of the *t*-tests on the pre-test/post-test results indicate that students displayed improved learning gains and problem-solving skills at the end of the study. This information is important given that past studies provided little empirical evidence that problem-solving skills improved following FC intervention.

Some studies merely reported that more time is dedicated for application of knowledge but could not provide empirical evidence on students' acquisition of problem-solving skills (O'Flaherty & Phillips, 2015). One explanation for this finding is that authentic activities sequenced from simple to more complex real-world tasks, examples of how knowledge is applied, access to experts, and a social context in which students collaborate and construct knowledge for problem-solving in the PSFC module may influence learning. The findings also showed that the explicit learning flow of Merrill's First Principles makes it easier to conceptualise and implement for practitioners, and better engagement and learning was reported (Hoffman, 2014; Wang, 2017). Therefore, it would be hoped that a significant amount of instruction at Community Colleges are provided with real-world problems at a level suitable for students to acquire knowledge and problem-solving skills to produce industry-ready graduates.

Figure 7.1 shows how the researcher combines the theory and model in the PSFC module design and development.

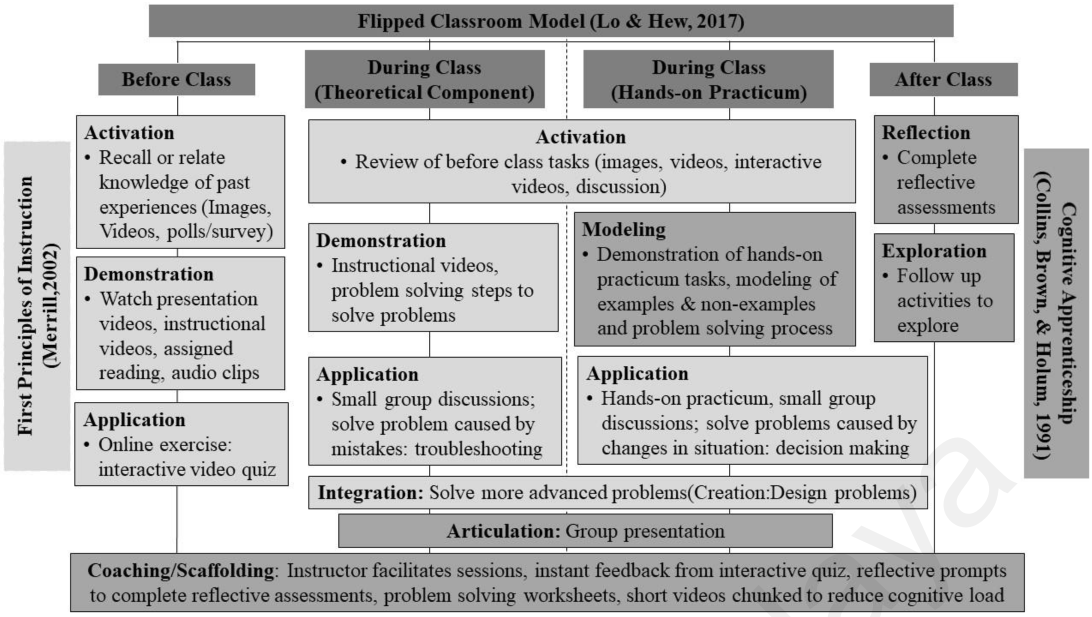


Figure 7.1 The PSFC module for Community Colleges using First Principles of Instruction (Merrill, 2007), Cognitive Apprenticeship (Collins, Brown, & Holum, 1991) and Flipped Classroom using Merrill's First Principles (Lo & Hew, 2017)

Figure 7.1 shows the PSFC module that was developed by combining the abovementioned models. Based on the findings of the FDM, the instructional strategies that had achieved the experts' consensus were also mapped into the different phases of the instruction of the Merrill's First Principles and Cognitive Apprenticeship. The FC model has three phases, "before class" session, "during class" session and "after class" session. Since the Culinary Arts class setting in the Community College has two "during class" face-to-face sessions, this enables problem-solving activities to be conducted during the theoretical component and during the hands-on practicum component. The lessons were housed in *Schoology* and before class sessions were facilitated by the instructor on the *Telegram* app. During the before class session, students received sufficient foundation for the new knowledge during the Activation and Demonstration phase.

Next, this study also provided evidence that learning is promoted when the demonstration includes examples and non-examples of concepts (*YouTube* videos), demonstration of procedures (screencasts, *YouTube* videos, instructor's demonstration), visualisation of processes (images, *YouTube* videos). In order to implement Modeling, the participating instructor took the time in class to show students how to perform a procedure/technique as well as the thought processes involved in making those decisions. The participating instructor also reviewed additional examples or techniques to give students opportunities to observe the behaviours and thought processes involved in conducting the techniques. Modeling was also exhibited using relevant media.

Next, the study also provided clear evidence that the Application phase during the “before class” activities can include information-oriented activities that students can complete without frustration since instructors provided opportunity and experience for students to demonstrate what they already know, thus resulting in more efficient instruction. In the study, students were given opportunities to apply knowledge and practice problem-solving skills according to the objectives stated by practicing consistently during face to face instruction. For example, “during class”, the information-about practice for recall or recognise information were accomplished using interactive quizzes and online polls. This study also provided evidence that learning is promoted when learners are engaged in solving real-world problems. The problem-solving activities revolved around scenarios and artefacts gathered from real workplace settings. During the theoretical session, students solved the what-happens practice which predicts a consequence of problem caused by mistakes. During hands-on practicum session, students solved the “how-to” practice which encourages students to do the procedures individually and in teams. The “information-about” practice, “how-to” practice, and “what-happens” practice were parallel to the Application phase mentioned by Merrill (2002).

Besides the four phases of the First Principles, the PSFC module combined the four dimensions of Cognitive Apprenticeship (CA) to design the learning environment, i.e., content, method, sequence, and sociology. In terms of content, the FDM findings showed the domain knowledge areas that students need to know in order to solve problems and accomplish tasks. The heuristic strategies used were the problem-solving steps outlined by Jonassen (1997). In terms of method, the PSFC module outlined the six teaching methods that were parallel to the core of cognitive apprenticeship. The instructor to become a facilitator who models (Demonstration phase), scaffolds (supports), fades (gradually decreases guidance) and coaches (offers suggestions, feedback, and hints to the student)(Kerka, 1997). When implementing coaching, the instructor moves around the classroom and helps coach students through the work process, while also giving suggestions on how they could improve their approach to techniques. With the advent of technology, resources and media such as videos, interactive quiz videos with interactive feedback and supplemental materials also facilitated the teaching process by Modeling, scaffolding, fading and coaching students.

Next, in the Integration phase, the articulation and reflection methods which helped students to be aware of their own problem-solving strategies were included. In Cognitive Apprenticeship, students were engaged in acts of observing, practicing and reflecting. Follow-up activities were also designed for students to extend the knowledge learned. The exploration method enabled them to work independently, and the natural culmination of the fading of supports was included in the Integration phase.

Next, in terms of sequencing, the global before local skills principle is applied. For example, in lesson two, the global principle was to enable students to identify the different types of spices via a sensorial test activity before proceeding to learn other skills. Moreover, since tasks were arranged with increasing complexity, the global skill was necessary to help students prepare for the following task (prepare spice mixture according to a given recipe). The sequencing principle also required some form of scaffolding before students were required to solve a more complex and interesting problem (create a variation of spice mixture).

The PSFC module also fulfilled the sociology dimension by having students carry out tasks and solve problems that reflects how their knowledge will be used in the future by designing meaningful and relevant tasks. Students were also learning actively using the knowledge rather than passively receiving it. The learning environment involved participants actively communicating and engaging in solving problems and completing tasks related to Culinary Arts.

This would seem to confirm that using cognitive apprenticeship methods is an approach that holds relevance for both Modeling the effective use of problem-solving for Culinary Arts Instructors and as a method for the design of the FC environment which is particularly unique to this study. As cognitive apprenticeship methods foster the emergence of practical skills within an authentic setting, it provided effective means to enculturate Culinary Arts Instructors into the practice of problem-solving instruction in their teaching practices. The model in Figure 7.1 was further developed based on the findings of the FDM method in Phase 2 of the study. (See Figure 7.2).

Problem-solving Flipped Classroom (PSFC) Module

CONTENT
The Standards of Professionalism: Chef Identity and Work Ethics, Kitchen Safety, Food Safety and Kitchen Fundamentals

"Before class" session

LEARNING OBJECTIVE
Knowledge and/or comprehension-based objectives

INSTRUCTIONAL STRATEGIES
Activation: Images, Videos, Online polls/surveys
Demonstration & Modeling: Videos, Assigned reading, supplementary materials
Application: Interactive quiz
ASSESSMENT: Participation mark as incentive

SCAFFOLDING/PLATFORM/RESOURCES/MEDIA
Instructor facilitates lessons and provides feedback based on students' responses on *Telegram*
Videos chunked into (less than 10 minutes) segments to reduce cognitive load
Key point highlighted in supplementary materials

"During class" session - Theoretical component

LEARNING OBJECTIVE
Application, synthesis and creation-based objective

INSTRUCTIONAL STRATEGIES
Activation: Images, Videos, Interactive quiz
Demonstration &Modeling: Videos, Assigned reading
Application: Solve problems caused by mistakes- Troubleshooting problems (Jonassen, 1997)
Integration: Solve problems caused by changes in situation - Design problems (Jonassen, 1997)
Articulation: Group presentation
Exploration: Solve problems to explore

SCAFFOLDING/PLATFORM/RESOURCES/MEDIA
Activation: Instructor facilitates lessons and provides feedback based on students' responses on face-to-face
Demonstration & Modeling: Videos chunked into (less than 10 minutes) segments to reduce cognitive load
Demonstration: Key point highlighted in supplementary materials
Application: Instant feedback from interactive quiz
Modeling: Live demonstration of hands-on practicum task
Application:
Activities apply, develop knowledge acquired during "before class" tasks
Work in small groups to allow interaction, peer support, feedback
Articulation: Instructor support through metacognitive prompts
Exploration: Follow up activities to further extend learning

"During class" session – Hands-on practicum

LEARNING OBJECTIVE
Application, synthesis and creation-based objective

INSTRUCTIONAL STRATEGIES
Activation: Images, Videos, Online polls/surveys
Demonstration & Modeling: Videos, assigned reading, perform hands-on technical tasks
Application: Solve problems caused by changes in situation – Decision-making problems (Jonassen, 1997)
Integration: Solve problems caused by changes in situation - design problems (Jonassen, 1997)
Articulation: Group presentation
Exploration: Solve problems to explore

SCAFFOLDING/PLATFORM/RESOURCES/MEDIA
Activation: Instructor facilitates lessons and provides feedback based on students' responses on face-to-face
Demonstration & Modeling: Videos chunked into (Less than 10 minutes) segments to reduce cognitive load
Demonstration: Key point highlighted in supplementary materials
Application: Instant feedback from interactive quiz
Modeling: Live demonstration of hands-on practicum task
Application:
Activities apply, develop knowledge acquired during "before class" tasks
Work in small groups to allow interaction, peer support, feedback
Articulation: Instructor support through metacognitive prompts
Exploration: Follow up activities to further extend learning

ASSESSMENT: Hands-on practicum task

"After class"

LEARNING OBJECTIVE
Application, synthesis and creation-based objective

INSTRUCTIONAL STRATEGIES
Exploration: Solve problems to explore
Reflection: Self-reflection of lesson activities and problem-solving process

ASSESSMENT: Self-reflection tasks

SCAFFOLDING/PLATFORM/RESOURCES/MEDIA
Follow up activities to further extend learning
Metacognitive prompts to assist reflection

Figure 7.2 Design of the flow of instruction in the PSFC Module based on the elements that achieved expert consensus

Figure 7.2 shows the elements of teaching and learning which were included in the PSFC module design.

Secondly, this study offers implication to the process of developing a systematic module which followed the Design and Developmental Research methodology (Richey & Klein, 2014) based on the aforementioned theories and model. The development of the model took into account the profile of the Culinary Arts students and the challenges faced by Culinary Arts instructors in their current teaching practices in the Community Colleges. The development also took into account the consensus of experts who were from various fields encompassing academicians and industry practitioners. They provided input from the FC perspectives, Instructional Technology, Pedagogy, Culinary Arts, Problem-solving, and TVET. Consequently, the PSFC module was designed.

This study has shown that the objective element that experts achieved consensus seem to support the findings from a recent study by Molnar (2017) who highlighted that this objective is much more difficult to accomplish in a traditional classroom setting due to time constraints. Next, this study has also shown that the content areas used to develop the module also supported past studies on the fundamental topics offered in Culinary Arts courses which were deemed crucial for Culinary Arts students to grasp well (Mack, 2012; Min et al., 2016).

Next, the findings on instructional strategies that reached expert consensus in Phase 2 of the study were coherent with the key concepts of the cognitive apprenticeship model and the four phases of the Merrill's First Principles. In that regard, the PSFC module designed met the needs of the Culinary Arts students and instructors in Community Colleges by showing how learning and social interaction can be designed into a more formal learning context. In conclusion, the PSFC module this study has extended the role of Merrill's First Principles and Cognitive Apprenticeship principle in the FC in the field of Culinary Arts using it to analyse the specific context on the Malaysian Community Colleges students and instructors which is a contribution to the existing theory.

Implication for practice. The results derived from this study are important to all the stakeholders involved in teaching and learning such as the instructors and students, the Ministry of Higher Education, the DCCE, the Culinary Arts schools' instructors and the students.

Implication and suggestion to the Ministry of Higher Education. In the Malaysia Education Blueprint (Higher Education) 2015-2025 which was launched to transform the Malaysian education system, there was an emphasis on developing thinking skills among students. In particular, the aspiration contained in the Higher Education Blueprint is for students to possess those thinking skills that can enable them to appreciate the different views of others, the ability to think critically and the desire to be innovative, thereby taking the first move to deal with the problem-solving initiative; they were also expected to develop an entrepreneurial mindset to fulfil the job market requirements (Ministry of Education Malaysia, 2015). The instructional model in this study implies a conception for TVET education as a vehicle for developing a thinking workforce, rather than as training in the application of specific procedures.

This is followed by the need to improve the quality of TVET graduates; it was outlined that one of the roles of the Culinary Arts industry is to lead in curriculum design and delivery. Based on the outcome of this study, it can be seen that there is a possibility of engaging industry experts to provide input for curriculum design as has been noted from the design and development of the PSFC module. In this context, not only were experts input and comments extracted for the design of the module, experts such as chef practitioners were also invited to give guest lectures to the students. In addition, artefacts that could be used as a stimulus material for the problem-solving tasks, as suggested by the experts, gathered from real workplace settings, were also embedded into the module. This outcome which was noted from the experts' input can also be traced to the works of previous studies (Lin & Cherng, 2006; Maier & Thomas, 2013; Spowart, 2011; Zhong et al., 2013). By working closely with the industry, thus experts, up-to-date materials, and authentic tasks can be used to design the PSFC module. In that regard, this module also bridges the gap between student and industry expectations.

Implication and suggestions for the administrators. Education administrators should assume responsibility for allocating appropriate resources including manpower, facilities and time, to enable the Culinary Art educators to pursue a student-centered approach in their teaching practice. Following the effectiveness of the PSFC module, the DCCE should take the initiative to encourage more instructors to employ the PSFC approach in their respective classroom settings. This is because the approach is able to increase students' knowledge gain and problem-solving skills, thereby, increasing students' employability skills.

Administrators need to create and provide the opportunity, environment, culture and the infrastructure to implement the PSFC within their respective institutions. Facilities such as high-speed internet connection, mobile devices, or computer labs equipped with mobile devices, should be in provided to facilitate a more successful implementation of the FC. This effort can encourage instructors to reform their teaching and learning practices. The PSFC Module prototype in this study had employed *Schoology*, which is a free platform for the LMS thus, no additional cost is incurred. However, it would be more beneficial if the DCCE is able to develop its own teaching and learning platform which can be used to support course delivery and communication among students.

Implications for Culinary Instructors. Instructors have minimal decision or control over the quality of students entering their classrooms, yet they play a huge role in terms of influencing the quality of the output, by teaching them new knowledge and skills and pushing them to new heights (Connolly & Lee, 2006). Considering the novelty of introducing problem-solving skills through the FC model within Community Colleges, it appears that much can be benefitted. For instance, instructors could benefit from the access to a teaching model template which supports the design and delivery of the PSFC lesson. The selected instructional design theories were based on Merrill's First Principles and Cognitive Apprenticeship model thus the module was created based on theories which fill the gap of an instructional model for teaching problem-solving systematically in the TVET settings. Studies done by other researchers (Frick et al., 2010; Lo & Hew, 2017) have also suggested that the use of Merrill's First Principles can improve students' motivation and learning when compared with other forms of instruction. In addition, as the Cognitive Apprenticeship method fosters the emergence of practical skills within authentic settings, the module also serves as an effective means to instil the Culinary Arts instructors with the practice of applying problem-solving instructions as an approach in future teaching practices. More specifically, the template will facilitate teaching by providing instructors with a structured plan of the teaching and learning activities, as is required in the FC environment (Sergis et al., 2017). With the PSFC module, the Culinary Arts instructors, especially those with less professional experience, will benefit as they become exposed to the most up-to-date and relevant contents, using real-world problems which were designed by experts and practitioners (Lin & Cherng, 2006). The template can also be used to plan for the teaching and learning activities for other subjects which can better assist students to stay relevant to their industry needs.

The PSFC module requires commitment from the instructors because they need to be present online when providing immediate feedback to students. This can ensure that students feel the presence of the instructor. No matter which technological activity is pursued, it is fundamental to provide supportive and timely teacher feedback. This is because learners can use the feedback to make improvements (Kinsella, Mahon, & Lillis, 2017). In this study, supportive and timely teacher feedback was supported by the use of the metacognitive prompts for instructors to coach students into their group discussions and to interact with students during their problem-solving processes. This is because the response can develop students' thinking skills and confidence.

Implications for Culinary Arts students. The impact of this study is related to the creation of a pedagogical tool to improve employability among Culinary Arts graduates. Currently, most Culinary students are being taught through the traditional culinary pedagogical model (lecture and demonstration-replication) in a formal Culinary Arts teaching setting. The traditional model inhibits student's ability to think, especially about issues concerning problems caused by mistakes and problems caused by changes in situations, all of which are problems that students need to solve once they join the workplace environment. The module tests their abilities at a relatively risk-free environment especially when attempting problems presented by experts in the field. Once they welcome the challenges, find the tasks meaningful and interesting, they push themselves to overcome their weakness and lack of knowledge.

As students have been known to have poor content comprehension and retention, the PSFC module ensures that students come prepared to class and this is enhanced by providing students with opportunities to engage with content using interactive videos. Incorporating interactive quizzes such as multiple-choice quizzes as part of the video resource was another way to ensure that the activity is not merely a passive one for students, but that it also provides students with the opportunity to apply materials quickly but not being too daunting for students. The PSFC module can also be used by all students to strengthen their fundamental professional knowledge regardless of their semester as the module covers the fundamental topics in the Culinary Arts programme. Strong grasp of fundamentals makes these students more employable.

Moreover, students in the first year were generally those who had just finished Form Five or *SPM*. As fresh school leavers, they were relatively new to the courses in the Culinary Arts and during this process, they were also in the midst of forming their fundamental conceptions of what chefs do and how chefs think. Using the PSFC module, students, especially those in their first semester, would be able to gain more exposure to the common mistakes chefs make and the changes that occur in particular situations at work in the Culinary Arts industry. Thus, even before stepping into the industry, the authentic materials presented in the PSFC module would have opened up their minds and so equipped them with the necessary knowledge. With more problem-solving practices, the students will learn to internalize the process as early as possible (Brown, 2006) thus making them more employable.

Next, the social impact of this study is related to technology playing an important role in supporting education reform and transformation. Investment in ICT has been used to support major curriculum revisions, shifts in pedagogy and assessment changes (Kozma & Vota, 2014). The kinds of education reforms include the emphasis on high levels of understanding of key concept areas and the ability to apply these concepts to solve complex, real-world problems (Bransford, Brown, & Cocking, 2000). Furthermore, the PSFC module was specifically designed and developed to include a myriad of media and resources which students can use for independent learning. Students can also access the *Schoology* platform by using their smartphones for free thus, as a borderless world, they can learn anytime and anywhere. In this study, the use of the Mobile Instant Messaging platform for instructors to facilitate the "before class" session is fundamental as it provides students with timely and supportive instructor feedback. Students can then come prepared for their actual classes as they had already been exposed to short videos and had also attempted some interactive quizzes. The instant feedback gained from the quizzes as well as from the instructor can be used by the students to make further improvements in their tasks, particularly during the actual class setting. Thus, the module gives knowledge, attitudes and behaviour impacts to the students.

The other curriculum reforms emphasise the 21st century skills that prepare graduates to compete in the knowledge economy, such as communication, collaboration, and creativity. Based on the empirical evidence, the social impact of the study can be viewed in ways new technologies has had a positive effect on the lives of the students in our society. This study has shown that educational technologies can contribute to positive educational outcomes especially in developing a new understanding of obtaining key employability skills such as problem-solving, communication and teamwork in a competitive knowledge society. The activities in the module seem to help students realise their potential and hopefully will enable them to contribute meaningfully to their communities. When students are fully prepared for the future, the community will be best positioned to compete successfully in the global economy.

However, technology alone cannot bring a radical transformation of education. Rather a combination of technology, proper training of instructors and the involvement of industry practitioners will help to realize the greatest social and economic returns to investments in educational technologies. Access to modern information technologies liberate and empower communities by giving them access to knowledge. Innovative application of technology provides opportunities for students and instructors to further their knowledge and effect positive community change. The study has shown that the PSFC module enables instructors to experience technology-supported and higher order learning activities so that they can be prepared to implement similar instructional approaches in their own future classroom. The usability level is very high, and this is beneficial especially for inexperienced instructors and students.

Contribution to the Body of Knowledge

Firstly, the current study contributes to the literature by expanding the application of the FC approach to non-STEM disciplines. Past studies on FC approach in TVET had focused on courses such as Maritime Education (James et al., 2014), beauty and health (Brown, 2008; Naamani & Taylor, 2012), hospitality (UNESCO, 2013a) and XML programming (Guan et al., 2015). In order to develop problem-solving abilities that are required in the workplace of Culinary Arts practitioners, the PSFC module can be applied for the purpose of Culinary Arts instruction in Community Colleges. This knowledge gained from the application of the PSFC module in the Culinary Arts discipline, thus adds to the literature on the use of FCs in the teaching and learning at TVET settings.

Secondly, the PSFC module is an innovation to move away from current teaching practices at the Community College setting. By using the PSFC module, Culinary Arts instructors need to rethink and move away from the conventional way of teaching by planning and preparing for lessons in advance through the use of the FC pedagogical approach. This can reduce the time for transmission of passive lectures and also increase collaborative learning activities during the face-to-face time. Students should participate in more hands-on learning experiences instead of this has been noted as a way of stimulating interest. Despite the emphasis on developing students' technical skills during the hands-on practicum, it appears that this hands-on practicum consists of the demonstration-replication approach which tends to inhibit students' ability to think innovatively, an asset that is required when they join the workplace environment. In this study, the hands-on practicum session was not limited to demonstration and replication only; it included problem-solving activities that are transferable to authentic professional problems which students may face when entering the workforce.

Thirdly, this study should be of particular value to the Culinary Arts instructors as the PSFC module has provided pedagogical support in terms of instructional materials such as examples of real-world problems which were derived from the suggestions of experts. This is pertinent as the existing curriculum in the Culinary Arts offered by Community Colleges does not provide real-world problems that can be used in the classroom instruction. During the development phase, the researcher was also able to gather up-to-date to real-world examples and materials used in the real workplace settings which not only reflected the current trend in the industry but were also examples from the local context. This aspect noted in the module is valuable because as a localised context, students were better able to comprehend, unlike current examples and resources available, which were commonly based on the American and British settings. The local contexts provided is also beneficial to instructors especially those who lacked industrial experiences. Students need to be exposed to the realities of the industry and not just be taught based on the instructor's limited experience working as an intern before becoming a culinary instructor. It has been estimated that only four to five percent of graduates enter the food service industry because majority lacked the confidence or the interest (Lin & Cherng, 2006). The resources and materials for the module consists of videos of workplace settings in the local context, real forms used in the industry, and relevant print materials and online materials. Using technology, the resources made it easier for instructors to provide problem-solving opportunities in the Culinary Arts classroom settings using authentic resources and tasks. Thus, the PSFC module is necessary as it seems to be able to increase students' interest in the field which may henceforth, retain graduates in the industry.

Next, this study also adds to literature by focusing on the least researched problem types among the 11 problem types addressed by Jonassen (2000) which are decision-making problems, troubleshooting and design problems (Jonassen, 2010). In the current study, the problems designed were problems caused by mistakes in the Culinary Arts which were related to troubleshooting, and problems caused by changes in situations which are related to decision-making problems and design problems. The problems provided in the PSFC module were also designed to be closely related to the students' needs for future professional development or immediate everyday life (Hung, 2006).

Besides, the findings reported in this study also sheds new light on the feasibility of using Merrill's First Principles design theory and Cognitive Apprenticeship as the models of instruction to design and develop the PSFC module. It was mentioned that many previous studies did not explicate any specific conceptual framework which could be used when designing FC approaches for implementations (Bishop & Verleger, 2013b;

Giannakos et al., 2016; O'Flaherty & Phillips, 2015). Thus, the current study addresses the gap noted in the lack of models of instruction for problem-solving. This study has also addressed the gap noted in the lack of a design framework which can be used to design FCs using expert consensus. It is a valuable input, and it certainly adds to the literature especially in terms of the design and development of the pedagogical module. The lesson plan template that was developed for the PSFC module can further be used as a guide to implement the FC in a classroom setting in a systematic manner. Further, this PSFC module can also be reused for the subsequent semesters, thereby, giving instructors more time to work with students personally. Therefore, this module is considered a contribution because it is not just reusable, but also sustainable.

In addition, this study has also provided evidence which allows for a better understanding of the profile of Culinary Arts students at Community Colleges in terms of their levels of problem-solving skills, ownership of technology and mobile devices and FC readiness. The sampling is nationally representative of a cohort of students. This profile can be used to design other interventions to address the needs of the Culinary Arts students at Community Colleges. The insights gained from this study may be of assistance to both the Culinary Arts instructors and policymakers who can attempt to engage students with creative problem-solving opportunities using FC. While current research looking at the effects of FC from the perspective of knowledge gains and problem-solving skills is limited, this module offers additional input to research as the valuable findings noted in the development of the FC module was based on an authentic need, the needs of Community College students and instructors. Even though the FC environment is a relatively new instructional approach in the Community Colleges of Malaysia, it has the potential to further enhance students' knowledge gain and problem-solving skills in learning the fundamentals of Culinary Arts. Student perceptions of their learning has been typically considered to be reliable and valid (Gravestock & Gregor-Greenleaf, 2008) and this has been verified by the quantitative and qualitative data acquired from this study.

Recommendations of the Findings

Based on the outcome of this study, a few recommendations are made. Firstly, in terms of incorporating problem-solving in formal culinary instruction, the FC instructional module should reform current teaching practices in the Culinary Arts. The shift from the traditional apprenticeship model where the apprentice learns from the master in the context of the workplace has resulted in a "gap" of skills, knowledge, and attitude which are required in the workplace (Brough, 2008). The implication is that students who are now learning those skills are expected to be chefs based on their culinary instructors who do not provide the authenticity of the workplace. This leads to the first recommendation of the study, to help improve students' learning gains and problem-solving skills, culinary educators might consider structuring their courses around opportunities that would allow for applying the teaching methods of a Cognitive Apprenticeship model instruction and Merrill's First Principles using real-world problems to transform conventional teaching practices in the Culinary Arts.

Next, although the PSFC module provides a guideline for implementing FC specifically to the Culinary Arts students in Community Colleges, the methodology can also be adapted to develop models for other areas of the learning disciplines such as Tourism, IT, Games Art, or Air Conditioning, courses which are provided by Community Colleges. The possibilities are endless.

Limitations and Suggestions for Future Research

Several limitations are associated with the current study. Firstly, the quasi-experimental study employed was based on one group only without any form of comparison between the control group and the experimental group. Moreover, only a small number of participants were involved in the quasi-experiment (30 students and one participating instructor). The study also involved just one iteration of the Flipped Classroom approach.

The other limitations of this study include a very short period (around six weeks) spent on the FC pedagogy implementation. It should be noted that researchers often reflect on the possible 'novelty effect' of using a mobile device for learning, which could wear off after a while (Sharples, 2013). For the current study, novelty effects may be diminished, given that the lessons were conducted over nine "before class" sessions and nine "during class" sessions. The findings also showed that most students and the participating instructor indicated their intention to continue using the module.

Although this study provides one of the first FC interventions in Culinary Arts classroom at a Malaysian Community College known to the researcher, it was limited to a single institution. This might affect the transferability of the findings to other TVET settings. The findings are only for this context; however, the findings may be relevant to this Culinary Arts course offered in other Community Colleges. Nevertheless, it is believed that the context of the study is sufficiently similar to other TVET contexts to make the findings relevant and applicable in other settings. These limitations have to be addressed in future studies.

In future studies, more classes of students should be involved. A larger sample size would have given more power to the statistical analyses conducted. Using a more robust design (e.g., randomised experimental design with separate control and intervention groups) could show the effect of the FC on student knowledge gains and problem-solving more clearly. With this in mind, future research may consider using experimental or quasi-experimental designs to examine the effects of the FC. Thus, in future research, conducting a longitudinal study can help to determine or confirm the positive results and the findings noted in this study and to verify if the students' perceptions of the FC would change over time. A longer period (at least one semester or one year) needs to be implemented to establish longer-term impacts on motivation. Given that it takes a long time for learners to show their problem-solving competence, a longitudinal study that aims to investigate the benefit of the FC to students' problem-solving learning can be an alternative in future research. Besides that, expanding the intervention to other modules or other courses, where appropriate, may provide additional evidence.

The scope of the study does not include the development of self-regulation in the FC setting. However, an opportunity identified from the emerged findings was the notion that future studies should investigate how important self-regulated learning (SRL) skills are for students to come adequately prepared for face-to-face sessions. Since before class activities using videos and interactive quizzes were used extensively in the study, students may require practicing SRL skills in order to become more self-directed and effectively learn from them (Sletten, 2017). Future research should also identify whether a relationship exists between online activities and student success since the use of a LMS, mobile instant messaging app and interactive quiz on *EdPuzzle* documents the length of time students spend completing the online activities.

Conclusion

In this study, the DDR approach was employed to design and develop the PSFC module in three phases. The first phase of the research was the needs analysis phase where semi-structured interviews were conducted with 10 Culinary Arts instructors from two Community Colleges and a survey was administered on 831 Culinary Arts students from all 11 Community Colleges offering the Certificate in Culinary Arts program. The needs analysis phase was to ascertain the needs of the module by identifying the instructors' current teaching practices, the students' level of problem-solving skills and their readiness for the FC.

The second phase of the study was the design and development phase. Data were collected using the FDM which involved 19 experts. The consensus achieved on the elements that were suitable for the PSFC module was used to design the module. Three experts reviewed the design documents. After the PSFC module was developed, six experts validated the PSFC module.

The third phase of the study was the evaluation and implementation phase. The PSFC module was implemented with 30 students and one participating Culinary Arts instructor at a Community College in the Klang Valley. A pre-test and post-test was used to evaluate the PSFC module effectiveness in terms of cognitive knowledge (learning gains) and problem-solving skills. A survey was also administered to identify the students' perceptions of their learning experience using the PSFC module. A semi-structured interview was conducted and data were drawn from the participating instructor who was asked about the pedagogical and technical usability of the PSFC module.

The findings in the needs analysis phase indicated that the problem-solving skills of the students were still at the medium level, but they had a high-level readiness toward using the FC. The findings in the design phase outlined the key elements required in the module in terms of objective, content areas to design real-world problems, instructional strategies, media, platform and technology to deliver the module and the suitable assessment strategies. The PSFC module lessons were developed based on the theoretical framework which used real-world examples and problems. Experts reviewed the module prior to implementation and suggestions were provided to improve it. Validity was increased through the evaluation of the six experts. The module was found to be relevant in meeting the aim of the study. The PSFC module was found to be effective as a significant increase in students' learning gains and problem-solving skills was detected. The participating instructor also noted that the PSFC module was pedagogically and technically usable. Students also had a high positive perception of the PSFC module.

Among the PSFC module benefits was the use of appropriate technology such as mobile messaging apps and a LMS to enhance engagement and communication between students and instructors. The activities included allowed students to link their before class preparation to their face-to-face sessions. This promoted learners' motivation and enabled the instructor to engage with students. During the face-to-face setting, students worked on real-world applications of the concepts they had covered before class. The real-world problems were arranged from simple to more complex levels and they were relevant to the workplace settings in the local context. Students also worked in groups and received coaching from instructors throughout the lessons. After lessons were delivered, students were encouraged to reflect on the problem-solving process, linking what was covered before and during class. Among the drawbacks noted were the occasional issues with the devices, connectivity, and applications not operating as expected. Nonetheless, the apparent benefits outweighed the perceived drawbacks.

The two main implications that can be drawn from the findings of the study are the theoretical implications and the practical implications. The theoretical implications are divided into two: First, this research enabled the development of an instructional module to teach problem-solving based on the emergent trend of the FC. Secondly, the model can serve as a framework for other researchers to design and develop other modules relevant to their respective courses.

The practical implication to be drawn from this study concerns the Ministry of Higher Education, the Department of Community College Education (DCCE), the Culinary Arts instructors, students and other contributors. The experts' consensus on the elements deemed suitable for inclusion in the PSFC module reflect the most recent trends in the Culinary Arts Education and the FC approach. Based on the outcome of the study, it is recommended that the PSFC module be implemented within colleges so that students taking the Fundamentals in Culinary Arts courses are better exposed and this can raise their quality in comparison to other Culinary Arts graduates from private universities as well as those from abroad.

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