DEVELOPMENT OF COLLABORATIVE TPACK MODULE FOR CONTINUING PROFESSIONAL DEVELOPMENT IN A HIGHER EDUCATION INSTITUTION

VINOTHINI A/P VASODAVAN

FACULTY OF EDUCATION
UNIVERSITI MALAYA
KUALA LUMPUR
2020

DEVELOPMENT OF COLLABORATIVE TPACK MODULE FOR CONTINUING PROFESSIONAL DEVELOPMENT IN A HIGHER EDUCATION INSTITUTION

VINOTHINI A/P VASODAVAN

THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
KUALA LUMPUR

2020

UNIVERSITY OF MALAYA
ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: **VINOTHINI A/P VASODAVAN**

Matric No: **PHB150011**

Name of Degree: **DOCTORAL DEGREE**

Title of Project Paper/Research Report/Dissertation/Thesis ("this Work"):

DEVELOPMENT OF COLLABORATIVE TPACK MODULE FOR CONTINUING PROFESSIONAL DEVELOPMENT IN A HIGHER EDUCATION INSTITUTION

Field of Study: **CURRICULUM AND INSTRUCTIONAL TECHNOLOGY**

I do solemnly and sincerely declare that:

(1) I am the sole author/writer of this Work;
(2) This Work is original;
(3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
(4) I do not have any actual knowledge, nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
(5) I hereby assign all and every right in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
(6) I am fully aware that if in the course of making this Work, I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate's Signature Date:

Subscribed and solemnly declared before,

Witness's Signature Date:

Name:

Designation:

ABSTRACT

Teaching and learning in higher education should be more than just a transmission of knowledge. The focus should be on acquiring skills for interacting, applying, evaluating and creating new knowledge as well as problem solving. This can be achieved through social interactions and cognitive process during collaborative learning (CL) using collaborative learning (CL) tools. Therefore, instructors should be able to integrate CL tools effectively into instruction by having a good understanding of incorporating them into appropriate pedagogy and content. Hence, in this study a Collaborative TPACK module was developed for continuing professional development (CPD) to build instructor's skills and knowledge in TPACK so that they able to teach meaningfully with CL tools. A design and developmental research with three phases; need analysis; design and development; implementation and evaluation were employed. In the first phase, seven instructors, two Head of Training Units and a trainer were interviewed to gain insights on instructors' current technology skills and perspective regarding the use of CL and CL tools. In addition, data was triangulated with previous TPACK training evaluation and learning activities took place in the university learning management system (LMS) to identify the frequently used tools by instructors for teaching. Instructors seems to have a basic knowledge pertaining to the usage of technology in education but lack of knowledge on CL concepts and implementation in the teaching process. Hence, there was a need for module development. In the design phase, the elements appropriate for the Collaborative TPACK module was determined using the Fuzzy Delphi Method (FDM). First, a semi structured interview was conducted with four experts and the data was analysed thematically to design the FDM survey. The survey was administered to sixteen experts for consensus on the elements in the module. Consensus was achieved for the elements of learning outcome, content, instructional strategies, resources/media, assessment and delivery that should be incorporated into the module. After the module development, the Collaborative TPACK module was reviewed by four experts before implementation. The module was implemented among thirty-four instructors in one of the public higher education institutions in Klang Valley using one group experimental design. In addition, seven instructors participated in the follow up session by completing several tasks such as lesson design, lesson observation and designing the e-portfolio. In addition, post lesson observation was conducted to gather rich description about their experiences and opinion teaching with collaborative TPACK. Besides that, a survey was administered to explore the instructors' perception on the module usability. Instructors found that the module is usable form the pedagogical and technical aspect. The Wilcoxon Matched-pairs Signed Ranks Test indicates a significant difference in the pre and post TPACK score and t-test analysis indicates a significant difference in the pre, and post-test score due to the implementation of the Collaborative TPACK module. This study contributed to the element of collaboration in the existing TPACK model which known as Collaborative TPACK by incorporating Merrill's First Principles and taxonomy of learning outcome in a CPD programme. This study also adds to the repertoire of knowledge the important of continues assessment with inclusion of phase five, transfer of knowledge and the retention of expertise. It is recommended that the module should be implemented in other higher education institutions to develop instructors' skills and knowledge in collaborative TPACK

Keyword: TPACK, First Principles of Instruction, Taxonomy of Learning Outcome, Collaborative Learning, Collaborative Learning Tools

PEMBANGUNAN MODUL KOLABORATIF *TPACK* BAGI PROGRAM PEMBANGUNAN PROFESIONALISME BERTERUSAN DI SEBUAH INSTITUT PENGAJIAN TINGGI

ABSTRAK

Proses pengajaran dan pembelajaran di institusi pengajian tinggi harus berfokus lebih daripada sekadar transmisi pengetahuan. Tumpuan harus diberikan pada kemahiran berinteraksi, mengaplikasi, menilai, mencipta pengetahuan baru dan kemahiran menyelesaikan masalah. Kemahiran ini boleh dicapai melalui interaksi sosial dan proses kognitif menerusi pembelajaran kolaboratif menggunakan teknologi. Oleh itu, pensyarah perlu memiliki kefahaman yang baik untuk mengintegrasikan tiga komponen teras *TPACK* iaitu pengetahuan, teknologi, pedagogi dan kandungan supaya dapat menggunakan teknologi untuk pembelajaran kolaboratif secara berkesan. Justeru itu, dalam kajian ini sebuah modul kolaboratif TPACK bagi program pembangunan profesionalisme berterusan di institut pengajian tinggi telah dibangunkan untuk membina kemahiran dan pengetahuan pensyarah dalam *TPACK* supaya mereka mampu membuat percaturan yang bijak untuk mengintegrasikan teknologi untuk tujuan kolaborasi. Pendekatan kajian Reka Bentuk dan Pembangunan yang merangkumi tiga fasa iaitu analisis keperluan, reka bentuk dan pembangunan serta penilaian telah digunakan. Pada fasa pertama, analisis keperluan, temu bual separa berstruktur telah dijalankan dengan tujuh pensyarah, dua Ketua Unit Bahagian Latihan dan seorang pelatih *TPACK* dengan tujuan mengenal pasti pengetahuan and kemahiran pensyarah terhadap penggunaan teknologi serta perspektif mereka terhadap pengajaran berasaskan kolboratif. Di samping itu, bagi tujuan triangulasi data, bahan dokumen yang berkaitan iaitu penilaian latihan *TPACK* terdahulu dan maklumat aktiviti pembelajaran menerusi Sistem Pengurusan Pembelajaran universiti dikumpul untuk mengenal pasti teknologi yang kerap digunakan oleh pensyarah untuk mengajar.

Dapatan kajian menunjukkan pensyarah mempunyai pengetahuan asas berkaitan dengan penggunaan teknologi dalam pendidikan serta masih kurang berpengetahuan mengenai konsep pengajaran kolaboratif untuk diaplikasikan dalam sesi pembelajaran. Oleh itu, wujudnya keperluan untuk membangunkan sebuah modul untuk tujuan membina kemahiran dan pengetahuan pensyarah dalam kolaboratif *TPACK.* Dalam fasa kedua, reka bentuk, elemen- elemen yang sesuai untuk modul telah ditentukan menggunakan kaedah Fuzzy Delphi (FD). Sehubungan dengan itu, temu bual separa berstruktur telah dijalankan dengan empat pakar dan data dianalisis secara tematik untuk mereka bentuk instrument FD. Seterusnya, instrument tersebut diedarkan kepada enam-belas orang pakar untuk mendapatkan tahap persetujaun mereka terhadap elemen- elemen dalam modul. Persetujuan yang dicapai adalah merangkumi hasil pembelajaran, kandungan, strategi pembelajaran, sumber rujukan/media, penilaian dan kaedah penyampaian. Modul yang dibangunkan telah dinilai semula oleh empat pakar dan dimurnikan sebelum perlaksanaan. Dalam fasa ketiga, bagi menilai keberkesanan modul, kaedah eksperimen berasaskan satu kumpulan telah diaplikasikan. Seramai tiga puluh empat pensyarah dari sebuah institut pengajian tinggi awam di sekitar Lembah Klang telah dipilih dan didedahkan dengan modul kolaboratif *TPACK.* Sebagai tindakan susulan, tujuh pensyarah telah menyediakan rancangan pembelajaran dan mereka bentuk portfolio elektronik. Untuk memahami keadaan dan suasana yang berlaku ketika proses pembelajaran dan pengajaran berdasarkan kolaboratif *TPACK*, kaedah pemerhatian telah digunakan. Di samping itu, temu bual separa berstruktur dijalankan selepas sesi pemerhatian untuk memahami secara mendalam pengalaman dan pendapat pensyarah terhadap keberkesanan modul. Selain itu, satu kaji selidik persepsi pensyarah tentang modul telah dilaksanakan untuk menentukan kebolehgunaan modul. Dapatan kajian berdasarkan analisis Ujian

Wilcoxon menunjukkan perbezaan yang signifikan dalam skor pra-*TPACK* dan pasca-*TPACK*. Ujian-*t* juga menunjukkan perbezaan yang signifikan di antara skor pra-ujian dan pasca-ujian selepas intervensi. Kajian ini menyumbang kepada elemen kolaborasi dalam model TPACK yang sedia ada yang dikenali sebagai Collaborative TPACK dengan menggabungkan Prinsip Pembelajaran Merrill dan taksonomi hasil pembelajaran dalam program pembangunan profesionalisme berterusan Kajian ini juga menekankan kepentingan penilaian berterusan dengan memperkenalkan fasa kelima, mengekal dan mengembangkan pengetahuan dan kemahiran. Modul ini dicadangkan digunapakai di institusi pengajian tinggi awan yang lain untuk membina kemahiran dan pengetahuan pensyarah dalam kolaboratif *TPACK*.

Kata Kunci: TPACK, Prinsip Pembelajaran Merrill, Taksonomi Hasil Belajar Berasaskan Gagne, Pembelajaran Kolaboratif

ACKNOWLEDGMENTS

My help comes from the LORD, the maker of heaven and earth
Psalm 121:2

All praises and glory to the Almighty God for his wisdom and strength for making my journey possible and smooth. I would like to use this medium to express my utmost appreciation to all those who provided me with the possibility to complete this report. I am honored to be one of the recipients of the *MyBrain (PhD)* Scholarship by Ministry of Higher Education (MOHE). Thanks to MOHE for their generous financial support and am proud to be the first in my family to receive doctoral degree.

My special thanks go to Assoc Prof. Dr Norlidah Alias and Assoc Prof. Dr Dorothy DeWitt for their guidance and supervision throughout this journey. Without their assistance and dedicated involvement in every step throughout the process, this thesis would have never been accomplished. Thank you so much for their support and understanding over these past three years.

Most importantly, none of this could have happened without my family. I would also like to acknowledge with much appreciation the crucial role of my dearest husband Mr Josiah@Joe who supported and encouraged me to embark on this doctoral programme in the first place. To my parents; Vasodavan Suppiah and Sukuna Muniandy for their continuous financial and emotional support. This thesis stands as a testament to their unconditional love and encouragement. Thanks also go to University Malaya (UM) for their permission to conduct my research and the provision of the necessary assistances to complete the thesis.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

MOHE	Ministry of Education
CPD	Continuing Professional Development
LMS	Learning Management System
CSCL	Computer Supported Collaborative Learning
CK	Content knowledge
PK	Pedagogical knowledge
PCK	Pedagogical Content Knowledge
TK	Technological Knowledge
TCK	Technological Content Knowledge
TPK	Technological Pedagogical Knowledge
TPACK	Technological Pedagogical Content Knowledge
ID	Instructional Design
IM	Instant Messaging
ZPD	Zone of Proximal Development

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

Background of the Study

The technology rapid growth has had a significant influence on people's interaction with each other in the world, and the changes have shaped the way people learn and teach with technology (Almerich, Orellana, Rodríguez, & García, 2016). In this twenty-first century, technology has become prominent in the educational institution where teaching and learning has gone beyond boundaries, via the Internet at any time and anywhere without constraints (Bilici, Guzey, & Yamak, 2016; Tseng, Lien, & Chen, 2016). This means that educational institutions are facing more challenges to have their teachers/instructors and the students well-equipped with the technology knowledge, that forms part of their daily life as well as integrating technology process into teaching and learning (Almerich et al., 2016), since technology is often evolving and subjected to change over time (Bower, 2016).

The advancement of educational technology creates an opportunity for the instructors to teach by using varieties of tools such as iPad, Smartboard, laptop, mobile, web-based tool and much more (Bilici et al., 2016). Therefore, the focus of technology in education is no longer to see, if the instructors should incorporate technology into their current pedagogies, the past studies show that, the instructors were combining technology into the classroom instruction, but how the technology was being used to transform their pedagogies to create new learning experiences for students is still challenging (Angeli & Valanides, 2009).

Instructors are the most powerful agents to propose technology in the educational practice, hence, they need to be adequate with the knowledge of technology in order to in-coperate technological resources in their pedagogies because the quality of teaching practices indirectly influences the students learning and outcome (Almerich et al., 2016; Ward & Parr, 2010). However, merely technology knowledge does not guarantee that, the instructors can implement technologies into their teaching practices, because teaching and learning processes in the twenty-first century require instructor to move from designing lesson with technology for information transmission and drill-and-practice (Koh, Chai, Benjamin, & Hong, 2015) to restructuring learning activities to critical thinking, problem-solving, communication, collaboration and knowledge construction through social learning environment (Learning Partnership for 21st Century, 2016). This indicates that, instructors need to be technologically and pedagogically competent, to incorporate technology into their daily teaching practices (Almerich et al., 2016).

Several competence models in technology have been proposed in recent years for the instructors that the technology competencies are the key factors for the instructors to make changes in their teaching practices, because, by having a certain set of competence skills instructors feel safe, confident and competent to introduce certain technological resources and also use them in teaching practices (Almerich et al., 2016; Ertmer & Ottenbreit-Leftwich, 2010). National ICT policies such as, United Nations Educational, Scientific and Cultural Organization (UNESCO) and International Society of Technology in Education (ISTE) developed a framework that could be applied to instructors in the various levels of the education system from Primary Education to Higher Education.

The UNESCO's (2011) competence framework emphasizes that, instructors need to have three different approaches to teach which begin with Technology Literacy, Knowledge Deepening, and Knowledge Creation to assist their students to become collaborative, problem- solving, creative learners through using technology.

Based on the International Society of Technology in Education, ISTE (2008) instructors need to set a professional learning goal by practising pedagogical approach with technology integration and reflection on its effectiveness such as, project-based learning, virtual collaboration, increase personalization and differentiation learning, provide instant feedback to students with digital tools, promote student reflection using collaborative learning (CL) tools and many more.

Besides that, another framework known as Technological Pedagogical and Content Knowledge (TPACK) were also developed to assist instructors, in developing and integrating technological, pedagogical, and content knowledge into teaching and learning (Koehler & Mishra, 2005). Good teaching requires a comprehension of the relationship between the three domains, because, many at times; the instructors tend to neglect pedagogy and content knowledge when integrating technology in teaching and learning (Mishra & Koehler, 2006). Hence, even though, technology can promote students' learning, instructors are still needed to be well-equipped with a set of competencies, that will facilitate the in-cooperation of technology in instruction and learning effectively.

In the local context, Malaysia has the seventh highest internet penetration rate across Asia (Department of Statistics Malaysia, 2016). In 2015, 71.1% of individuals aged 15 years and above use the internet (Department of Statistics Malaysia, 2016). The percentage of computer users increased from 56.0 % in 2013 to 68.7 % in 2015, and mobile phone users from 94.2% to 97.5 % in the same period (Department of Statistics Malaysia, 2016). This shows high levels of digital adoption and internet penetration in Malaysia, with tremendous growth. The technology adoption is not only in the key sectors such as finance, eGovernment, eHealth, IT security, cloud computing, mobile telephone applications, multimedia, creative, gaming, and the video industry, but also, in education (Acutance Sdn Bhd, 2013).

Since Internet penetration in Malaysia is currently stands at 67%, this creates an opportunity for higher education to utilize the benefit of online learning (Ministry of Higher Education (MOHE), 2015). Through online learning, higher education could shift from mass production of the delivery model to technology-enabled innovations to create personalized learning, where learning is delivered and tailored according to students' learning ability (MOHE, 2015). To achieve this purpose, MOHE has included Globalized Online Learning as one of the shifts to transform education in the Malaysian Higher Education Blueprint 2013-2025 that, enables the access to good quality content and enhanced the teaching quality and learning, as well as lower the cost of delivery (MOHE, 2015). In addition to the online learning, MOHE highlighted the need for blended learning model, to be the main pedagogical approach in the higher educational institution. Hence, students would benefit from the technologies usage such as Massive Open Online Courses (MOOCs), live streaming and video-conferencing.

Through blended mode, teaching, and learning take place via face to face along with online learning, either in asynchronous or synchronous way (Fleck, 2012; So & Brush, 2008). This allows higher education to be shifted towards the blended instruction mode for the courses offered via a Learning Management System (LMS). As such, MOHE is making online learning an integral part of higher education and lifelong learning, starting with the transformation of undergraduate courses using LMS with up to 70% of programmes to use blended learning models (MOHE, 2015). Blended learning approach ensures the flexibility and time efficacy in learning (Alrushiedat & Olfman, 2013; Baris, 2015);, provides an independent and collaborative learning experience for the learners (Noor, Attaran, & Alias, 2015; Simpson, 2015); enable cost reductions and location convenience (So & Bonk, 2010) and promote social present (Carceller, Dawson, & Lockyer, 2015; Nasirun, Noor, Yusoff, & Othman, 2015). To achieve these outcomes, MOHE together with the higher education institutions are working towards building the capabilities of the academic community, as stated in the National e-learning Policy.

By 2020, 75% of higher education instructors need to have knowledge on TPACK, basic skills in e-learning, as well as to implement blended learning mode in teaching and learning processes (MOHE, 2015). This vision could only be achieved if instructors have the knowledge and skills that will assist them to employ technological resources in their curricular designs, by planning effective teaching and meaningful learning experience for the students.

Problem Statement

Over the recent years, technology has undeniably changed the look of education by breaking the barrier of distance, as well as providing wide access to education. Traditionally, people had to be present in the class for learning to occur, but today, with a lot of technology opportunities, educational content is readily available within one’s reach.

Technology in higher education is to transform the process of teaching and learning (Al-Qirim, 2015; Baran, 2016; Henderson, Selwyn, & Aston, 2017; Hue & Jalil, 2013). Therefore, integrating a suitable technology tools into the process of teaching and learning, can ultimately contribute significantly to the instructions pedagogy skills and the way students learns, as well as given access to the information (Jimoyiannis, 2010). When the technology tools are used effectively, it increases the learning possibilities (Rienties, Brouwer, & Lygo-Baker, 2013) by providing a robust learning experience for learners, beyond classroom context (Hsu, 2016).

Even though, the instructors understand the importance and promise technology hold in shaping their teaching and students learning, many instructors are still facing challenges incorporating technology into their instructions (Wachira & Keengwe, 2011), and being less confident to convince themselves that, technology could improve their classroom instructions (Jimoyiannis, 2010).

The instructors' less interest in technology is due to the inadequacy of technology and pedagogy skills in integrating technology into the lesson (Ansyari, 2015; Hsu, 2016; Jetnikoff, 2015; Mbatha, 2015; Osman, Jamaludin, & Mokhtar, 2014) which constantly lead to the instructors rejecting the technology usage in the classroom (Wachira & Keengwe, 2011). This situation becomes even more challenging, when some instructors had limited their technology usage to basic activities such as, drill and practice, using the Internet to fill in free time by information searching, use the computer as reward activity when students answer correctly, using Microsoft Word processing for designing worksheet and assessment, instead of incorporating higher- level technology instruction (Hsu, 2012, 2013; Jimoyiannis, 2010; Jimoyiannis & Komis, 2007) in the form of CL tools such as wikis, blog, podcast, instant messaging, and discussion forum is to enhance students learning through knowledge building, engaging and motivating learners in the learning activity.

However, it seems that, instructors do not have a sufficient knowledge, skills, abilities, or competencies to employ CL tools in their teaching practices (Bower, 2016; Hobbs & Tuzel, 2017; Valcárcel, Basilotta, & López, 2014) therefore they will continue with traditional didactic pedagogy approaches by using technology for basic task, which does not contribute to the students learning (Hsu, 2016). Hence, instructors need certain knowledge, skills, abilities, or competencies in integrating technology to remove the challenges instructors are facing and feeling less confident in incorporating technology in daily teaching and learning activities.

Teaching and learning in the higher education should go beyond transmission of knowledge (Dewitt, Alias, & Siraj, 2015) and teaching facts and concepts as content to acquiring skill of interacting, applying, evaluating, creating new knowledge and problem solving (Martin, 2006; Ronen & Pasher, 2011). Hence, this could be achieved through social interactions and cognitive process during collaborative learning (DeWitt, Alias, Siraj, & Hutagalung, 2014; DeWitt, Alias, Siraj, & Zakaria, 2014). However, in Malaysia education context, collaborative learning is rarely implemented, due to instructors perception that more time is required for social interaction to take place in the classroom instruction (DeWitt, Siraj, & Alias, 2014). Therefore, there is need to design a collaborative module to develop instructors' skills to teach using CL tools.

Besides that, a great amount of time is also needed for instructors to keep themselves updated with ever-changing technology; this makes instructors feel challenging in integrating technology into their pedagogy (Jetnikoff, 2015). Due to the nature of technology that keeps on evolving, instructors are also struggling in deciding on using the right technology in their instruction (Bower, 2016). Hence, to integrate technology effectively into instruction, a good understanding of how technology could be incorporated together with the pedagogy and content knowledge is required by the instructors (Koehler & Mishra, 2009; Koehler, Mishra, & Yahya, 2007; Niess, 2005; Rienties, Brouwer, & Lygo-Baker, 2013; Yeh et al, 2014).

Integrating technology in to instruction can be done by incorporating technology pedagogical content knowledge (TPACK) as a body of knowledge that consist of content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK) and intersection of technological content knowledge (TCK), technological pedagogical knowledge (TPK) and pedagogical content knowledge (PCK). Hence, there is need to develop instructors TPACK since instructors need to have appropriate pedagogical and content knowledge to teach in an effective way, besides having technological knowledge by keeping up with the rapid growth of technologies.

Teaching in an effective way using TPACK is not just about how well instructors could teach with a technology (Jen et al., 2016) but also, design the instructional strategies that are linked to type of skill or task instructors wish students are to learn (Spector, 2016). Therefore, instructors are able to differentiate in details, the specific learning outcome they are setting to either consist of learning domain such as verbal information, intellectual skills, cognitive strategies, attitude, or motor skills (Gagné, 1972) since there is no one size (learning domains) fit all instructional tasks (Jen et al., 2016). In addition, previous TPACK module based on the specific subject like Mathematics, Science, Geography and English were designed by identifying instructional objectives/goals, followed by determining pedagogical and technology approach, without concern on theories of how people learn. Therefore, there is need to integrate learning domain in TPACK module development, so that, instructors are able to plan instruction by taking into account the kinds of skills students need to be learned (Spector, 2016) that will fit with right TPK with PK to build instructors TPACK.

Furthermore, TPACK model could be integrated into practice through a professional development (Ansyari, 2015; Cabero & Barroso, 2016; Wu, Hu, Gu, & Lim, 2016). However, professional development seems to place a heavy emphasis either on the pedagogical aspect of technologies or technological, aside from content and pedagogy (Cabero & Barroso, 2016; Goh & Kale, 2015; Koehler & Mishra, 2005; Mishra & Koehler, 2006). Despite a comprehensive training provided to elevate instructors TPACK, instructors were still unable to enhance their pedagogical practice as their believes on the best teaching approach, mismatch with what was being exposed in the training thus, a minimal impact was found in the actual teaching practice (Charalambous & Karagiorgi, 2002; Deni, Zainal, & Malakolunthu, 2013; McCarney, 2004). At the university levels, the professional development is focusing on problem-based learning, e-learning, case teaching, curriculum design, pedagogy and the modular approach and method of teaching (MOHE, n.d.). Although, extensive research has been carried out on improving the quality of teaching in the higher education through training however, most of it are the replicate of traditional behaviourist models, that is based on didactic and transmission-oriented approaches whereby, the training module is mainly to spreading teaching skills and knowledge while there is no room for inquiry or reflection on instructors actual teaching approaches. Professional development designed based on this approach is usually produced instructors who may not discover weakness or resistant to change their teaching practices since they assume that, teaching as skills to be mastered. Hence, there is need to design a continuing professional development (CPD) that would be used to develop instructors TPACK, based on transformative model of CPD that instructors have control over their learning processes in the CPD programme.

Therefore, this study seeks to overcome the problems that were discussed above by developing a Collaborative TPACK module for instructors in the higher education settings, by taking into consideration the complex interplay between technology, pedagogy, and content as well as instructors learning needs and concern.

Since this study would develop a module hence design and development methodology would be implemented through three phases of need analysis; design and implementation; and evaluation.

Purpose of the Study

The study purpose was to design and develop Collaborative TPACK module for CPD in a higher education institution by using information based on experts' opinions on TPACK, CPD, and CL tools. This design and developmental research were carried out in three phases, mainly the needs analysis; the design and developmental; and the implementation and evaluation (Richey & Klein, 2005).

Objectives of the Study

The primary purpose of this study was to design and develop Collaborative TPACK module for CPD in higher education institution. This study was conducted based on developmental research, which was also known as a problem-solving oriented approach or a specific context (Richey, Klein, & Nelson, 2004; Richey & Klein, 2007). This form of research was to create knowledge through specific product or program involving the process of design, development, and assessment (Siraj, Alias, DeWitt & Hussin, 2013).

The research would be future guided by three different phases mainly known as, the analysis, the design and development phase and the evaluation phase. The objectives of each phase as the following;

1. Analysis Phase

    i. To discover instructors' technology skill regarding the use of the collaborative learning (CL) tools in the institution's Learning Management System (LMS).

    ii. To discover are instructors' current perspective regarding the use of collaborative learning **(**CL) and CL tools in the institution's Learning Management System (LMS)

    iii. To discover form of tools that instructors' access in the institution's Learning Management System (LMS).

2. Design and Development Phase

    i. To design and develop the Collaborative TPACK module for CPD in higher education, based on the opinions of the panel experts from the aspect of learning objective, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery.

3. Evaluation Phase

    i. To assess the effectiveness of Collaborative TPACK module for CPD in developing instructors TPACK.

    ii. To assess the effectiveness of Collaborative TPACK module for CPD in developing instructors TPACK for different taxonomy of learning.

    iii. To explore the instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD.

Research Questions

The following research questions were identified in line with the objectives of this study, according to the phases of the study:

1. Analysis Phase
   i. what are instructors' technology skill regarding the use of the collaborative learning (CL) tools in the institution's Learning Management System (LMS)?
   ii. what are instructors' current perspective regarding the use of collaborative learning (CL) and CL tools in the institution's Learning Management System (LMS)?
   iii. what form of tools that instructors' access in the institution's Learning Management System (LMS)?
2. Design and Development Phase
   i. what are the experts' opinions on the learning objective, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery that should be incorporated into Collaborative TPACK module for CPD?
3. Evaluation Phase
   i. is the Collaborative TPACK module for CPD effective in developing instructors TPACK?
   ii. is the Collaborative TPACK module for CPD effective in developing instructors TPACK for different taxonomy of learning?
   iii. what are the instructors' perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD?

Significance of the Study

Research on integrating collaborative TPACK in an online environment with different domains of knowledge is relatively new in Malaysia. In essence, this study contributes to the general body of knowledge, on the innovative use of CL tools for different domains of knowledge. The findings of this study could benefit MOHE, higher education institution, instructors, and students by providing guidelines and the principle of implementing collaborative TPACK in instruction and learning.

This study could provide the MOHE with the guidelines to determine effectiveness of CL tools that have been integrated into classroom context. The findings enable them to evaluate the quality of innovative pedagogy in teaching and learning. The feedback from MOHE is very important in designing and planning the curriculum in higher education level.

At the same time, higher educational institutions are required to implement online learning as an integral component, due to that, instructors are needed to be innovative in teaching and learning in blended learning mode. This study identifies possible pitfalls and barrier towards implementing collaborative TPACK, that higher educational institutions would take into consideration in planning, executing, and evaluating any technology in-cooperation program.

The study findings could assist instructors to integrate technology into their pedagogical practices This study is also very useful for instructors, to promote the cultures of innovation in the use of technology. They could benefit from this study as the module development consist of activities are being planned based on skills, knowledge, and information on collaborative TPACK are provided. As an added value, this design could be implemented and applied across disciplinary regardless subject and level of education. The findings enable instructors to plan course/module to be in integrated with CL tools which would encourage students in knowledge building and meaning making instead of absorbing known information.

At the same time, students would benefit by becoming learners who are responsible for their learning, while using technology. Learning did not take place in isolation but happened anytime and anywhere with the support of computer-based tools. Individual learning is not the focus but learning in a group with discussion, debate, argumentation, and deep understanding.

Rationale of the Study

Collaborative TPACK module is needed among the higher education instructors for several reasons. First, teaching and learning in the 21st century is going beyond boundaries via the Internet at anytime and anywhere, without constraints and often evolving and subject to change over time. Hence, instructors need to be well-equipped with the knowledge of technology to be able to in-cooperate technological resources in their pedagogy because the quality of teaching practices indirectly influences the students learning and outcome. Therefore, it is important to design and develop a module to train instructors to be technologically and pedagogically competent to incorporate technology into their daily teaching practices.

Secondly, MOHE has included Globalized Online Learning as one of the shifts to transform education in the Malaysian Higher Education Blueprint 2013-2025, that enables the access to good quality content and enhanced the teaching quality and learning. Therefore, it is important to design and develop a module to prepare instructors to conduct their teaching and learning in blended learning models, since MOHE highlighted the need for blended learning model to be the main pedagogical approach in the higher educational institutions.

In addition to that, MOHE policy towards building the capabilities of the academic community, as stated in the National e-learning Policy also indicates the need for an online Collaborative TPACK module. By 2020, 75% of higher education instructors need to have knowledge on TPACK, basic skills in e-learning, as well as to implement blended learning mode in teaching and learning processes. Therefore, it is important to design and develop a module, that would equip the instructors with knowledge and skills of TPACK to be integrated for effective teaching with technology.

Moreover, online collaborative learning is very important for students in developing their high-level intellectual skills, such as critical thinking, analytical thinking, synthesis, and evaluation, which are key requirements for learners in the 21st century. Since instructors are the most powerful agents to propose technology in the educational practice,, hence they need to be well-equipped with the knowledge of technology before they would be able to teach with CL tools. Therefore, there is need to design Collaborative module to develop instructors' skills to teach using CL tools.

Limitation of the Study

The study was conducted based on design and developmental research (DDR) which focuses on development stage with need analysis phase, followed by design and development and finally implementation and evaluation stage. Due to that, this study was only focusing on a product that was the development of collaborative TPACK model. Based on Richey and Klein (2005) developmental research was context-specific hence limitations developed from the unique conditions that exist in a study.

Participant of this study was one of the limitations. The findings of this study are only limited to the participants in the context of the higher education institution and the finding may not represent in another situation. However, the findings may be useful and applicable to the situations and related contexts with similar characteristic, rather than being generalizable to a wider range of instructional contexts (Richey & Klein, 2005).

Definitions of Terms

Instructor. Instructor according to Cambridge Dictionary, a person whose job is to teach people a practical skill or it can be a teacher of a college or university who usually teaches a limited number of classes. In this study, instructor referred to university lecturer who teaches within his/her field of expertise.

Computer Supported Collaborative Learning (CSCL). Computer Supported Collaborative Learning (CSCL) is referring to learning that occurs socially through the use of computer, where learners can learn together (Roschelle & Teasley, 1995). In this study, CSCL is a technology, that support collaborative learning through interaction among group members.

Collaborative learning (CL) tools. CL tools are known as Web 2.0 applications that refers to internet technologies that enables and promotes Web content development through social and collaboratively that allow rich and varied information resources to be accessed promptly and globally (Biasutti, 2017; Fırat & Koksal, 2017; Oliver, 2010). In this study, CL tools refer to different type of online application such as wiki, discussion forums, blog, podcast, and text messaging/chat that useful for teaching and learning.

Collaborative TPACK. Collaborative TPACK is referring to acquisition of new knowledge and skills incorporating technology, pedagogy and content, based on different types of learning domains through CL tools such as wiki, discussion forums, and text messaging.

Taxonomy of learning. Identifying the taxonomy of learning would help instructors to determine and analyse the learning goals or outcome (Smith & Ragan, 2005). In this study, taxonomy of learning or domains of learning used interchangeably referring to learning capabilities such as, intellectual skills, cognitive strategies, verbal information, attitudes, and motor skills (Gagné, 1985)**.**

Content knowledge (CK). CK is referring to knowledge of the actual subject matter, that is to be taught (Koehler & Mishra, 2008). In this study, CK referred to the subject knowledge or the field of expertise that instructors possess.

Pedagogical knowledge (PK). PK is referring to instructional strategies to interact with students, evaluate their learning, and managing the classroom (Koehler & Mishra, 2008). In this study, PK was referred to as practice of teaching and learning in form of collaborative and technology integration.

Pedagogical Content Knowledge (PCK). PCK is referring to various instructional strategies to make students understand the subject matter (Koehler & Mishra, 2008). In this study, PCK is referring to teaching approach via collaborative learning in specific taxonomy of learning.

Technological Knowledge (TK). TK is referring to mastery of computer hardware and software utilized for information processing (Koehler & Mishra, 2008). In this study, TK was referred to as knowledge about how to use discussion forum, wikis, blog, podcast and instant messaging.

Technological Content Knowledge (TCK). TCK is referring to the understanding of technological affordances and constraints to support teaching and learning of the subject (Koehler & Mishra, 2008). In this study, TCK was referred to as the using CL tools for teaching specific taxonomy of learning.

Technological Pedagogical Knowledge (TPK). TPK is referring to the use of technologies to developing better teaching practices (Koehler & Mishra, 2008). In this study, TCK was referred to as the use of discussion forum, wikis, blog, podcast, and instant messaging for collaborative learning.

Technological Pedagogical Content Knowledge (TPACK). TPACK is referring to understanding that emerges from an interaction of technology, pedagogy and content knowledge (Koehler & Mishra, 2008). In this study, TPACK was referred to as the knowledge about using CL tools such as discussion forum, wikis, blog, podcast, and instant messaging to promote collaborative learning in teaching intellectual skills, cognitive strategies, verbal information, attitudes, and motor skills.

Conclusion

It is important for instructors to be well equipped, with knowledge and skills of teaching in higher education from transmission of knowledge to acquiring skill of interacting, applying, evaluating, creating new knowledge and problem solving which could be done by applying and fostering the interplay between content, pedagogy and technology in the teaching process. The Collaborative TPACK module in this study intended to engage instructors in a CPD to develop and enhance their abilities in TPACK. This study analysed, designs, develops, implements and evaluates the Collaborative TPACK module for CPD. Having provided the background, the problem statement, purpose, the objectives, research questions, significance, rational, limitations and operational definitions of the study in this chapter, the following chapter discussion was on the literature review, with the aim of gathering insight to establish a guiding framework for this study

CHAPTER 2

REVIEW OF LITERATURE

This chapter discussed the relevant literatures with the aim of gathering insight to establish a guiding framework for this study. The review of literature consisted of nature of collaborative learning; Computer Supported Collaborative Learning (CSCL); benefits, limitations, and delivery of CL tool and Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006). Continuing Professional Development (CPD) with Transformative Model (Jang & Chen, 2010) was referred to develop the module. An eclectic theory of ID, The First Principles of Instruction (Merrill, 2013), was utilized with underpinnings of the Social Constructivist Theory (Vygotsky, 1978) to design the module content. The Collaborative TPACK module also designed by considering the Taxonomy of Learning Outcome by Gagné (1985).

Nature of Collaborative Learning

Collaborative learning is often seen as very important from educational perspectives since students need to have collaborative skill before they step into working environment. Hence, instructors play prominent role to create future collaborators among the students, who work together as a team (Vangrieken, Dochy, Raes, & Kyndt, 2015). Collaborative learning seems to be very popular during 1970s, when it was used widely to teach different level of education from pre-nursery to university in all the subject either in the classroom setting or outdoor (Johnson, Johnson, & Smith, 2007).

Collaborative learning occurs via face to face or computer-supported setting (Dillenbourg, 1999; Laal & Laal, 2012). In both traditional and online learning modes, collaborative learning has proven to be an effective instructional method (Bernard, Rubalcava, & St-Pierre, 2000). Collaborative learning is a form of pedagogical approach, where students acquire knowledge as group and help each other to towards specific project or common goals. This is usually achieved through problem solving, task accomplishment or knowledge creation (Dillenbourg, 1999; Kuo, Belland, & Kuo, 2017; Laal & Laal, 2012; Stoddart, Chan, & Liu, 2016). This mean that, collaborative learning occurs when there is a join interaction among the group members and the whole activities are performed through a shared task (Vangrieken et al., 2015). Collaborative learning also an acquisition of knowledge, skills, and attitudes resulted from group interactions which is very important for the development of social experiences among the learners (Fu & Hwang, 2018; Johnson & Johnson, 2004).

Besides that, collaborative learning took place when learners in a group contribute and discuss the learning material without instructors' immediate intervention (Cohen, 1994). Collaboration is also a mutual engagement of learners, to solve problem together in an organized way through face to face interaction where learning activities took place at the same time synchronously (Roschelle & Teasley, 1995).

However, collaborative learning among group can happen not only through synchronous mode, but also through asynchronous by integrating appropriate technology and instructors or peers play an important role as moderator, to coordinate the learning process. On the other hand, there has been a split regarding to the differences between collaborative and cooperative learning. Researchers identify the differences and commonalities between collaborative and cooperative learning based on different ideas of the role, purpose, and individual participants in the activity (Lethinen et al, 1999).

Regarding collaborative, learning is a natural process where students and instructor's interaction and responses are usually unplanned (Hiltz, 1994; Johnson &

Johnson, 2004; Jonassen, Lee, Yang, & Laffey, 2005; Vygotsky, 1962, 1988). Since the interaction between learners is the heart of collaborative learning, (So & Brush, 2008) hence, learning involves a group of learners working as a team to achieve common goals (Kuo et al., 2017). As a result, new knowledge, skills, and attitudes are obtained (Jonassen et al., 2005). Collaborative learning activities are less structured, and more students are directed by depending on learners' culture, community and learning procedures (Johnson & Johnson, 2014).

Meanwhile, cooperative learning is a process, where learners in a group divide the task and take responsibilities for a portion of the problem solving and assemble each individual portion into the final output. In cooperative learning, learners are very highly interdependent among each other's especially when they perceive that the individual learning goals can only be achieved when the other group members reached their own goals (Johnson & Johnson, 2014). Cooperative learning activities are most structured and instructor directed in providing the learning task (Johnson & Johnson, 2014; Millis & Cottell, 1998; Slavin, 1996).

Hence, it can be concluded that, collaborative learning occurs as group interaction when learners engaged with a shared task in achieving mutual goals whereas in cooperative, learning occur individually when learner take responsibility and coordinate their respective task and assemble individual task into the final output.

Previous research had indicated that, collaborative learning had a positive impact on learning and great emphasis from instructors and researchers more than half a century. Collaborative learning promotes knowledge construction, whereby, students create meaning for themselves rather than just receiving it from the others (Hannafin, Hannafin, & Gabbitas, 2009; Heo, Lim, & Kim, 2010; Jowallah, 2014; Kim & Song, 2005; Suthers, 2006).

Collaborative learning also serves as a meaning-making when students integrate each other perspective, synthesize and make sense of the ideas (Koschmann, 2002; Nastasi & Clements, 1992; Roschelle & Teasley, 1995). Knowledge construction and competencies can be developed when collaborative learning is applied to ill-structured, complex tasks embedded in an authentic context (Jonassen, 1991, 1994; Keen, 1992). Therefore, through the creation of shared goal, shared exploration and shared the process of meaning making, learners can achieve a deeper level of knowledge generation (Palloff & Pratt, 2001). Besides that, collaborative learning promotes and improving student's memory, produce fewer errors, and motivate learners and assists students to retain information, rather than working individually (Bligh, 2000; Johnson & Johnson, 1986). In the same vein, DeWitt, Alias, Siraj, & Spector (2017) agree that, working together with peers or instructors can have a positive influence on learning. Hence, collaborative learning promotes knowledge construction among learners, in order to create more meaningful learning environment.

Past studies had found out several factors that can most likely impact the effectiveness of collaborative learning. One of the most important factors is the social interaction. The essential condition and key for successful collaborative learning begin with social interaction (Bromme, Hesse, & Spada, 2005; Johnson, Johnson, & Stanne, 1986; Kobbe et al., 2007; Kreijns, Kirschner, & Jochems, 2003) when each student showcases their prior knowledge and understanding, to establish a shared knowledge in the learning environment (Jonassen et al., 2005; Kaye, 1992; Palloff & Pratt, 1999). To reach a mutual understanding or social negotiation of views and meanings among a community of learners, students communicate about the content of instruction and resolve any differences of opinions (Hiltz, 1994; Jonassen et al., 2005; Palloff & Pratt, 1999).

Therefore, learning is the result of social interactions in a learning community and not the learning materials (Kaye, 1992) but Kim & Song (2006), argued that, the interaction happened not only from students to students; students with the instructors, but also, students with the learning materials. Each student will be developing critical thinking skills due to the process of collaboration and resolving differences (Hew & Cheung, 2013; Karpov & Haywood, 1998; Kim & Song, 2006). Also, learners will develop a positive attitude toward group members by building group cohesion and relationship, as well as, better communication skills (Johnson & Johnson, 1989, 1999).

Second factor is the interdependence among each other in a group. A positive interdependence develops a community of learners who work together on a shared task towards achieving a common goal (Collazos, Guerrero, Pino, & Ochoa, 2003; Wang, Chen, & Khan, 2014) however, when individuals have a little interaction and do not focus on the goals of the group, negative interdependence may occur (DeWitt et al., 2017). Group members need to be aware that, they are connected with each other in a way to ensure success been achieved together (Johnson, Johnson, Stanne, & Garibaldi, 1990).

Other factor that influence collaborative learning is the interpersonal interaction. Even though, learning is an individual process, collaboration can be influenced by the group and interpersonal interactions (Kaye, 1992). Rationale for group interactions to be influenced are based on individual learner's age, activeness, and values; internal factors such as leadership and communications (Tubbs, 1995). Besides that, group size, group composition, the nature of the task, learning styles potentially influence the effectiveness of collaborative learning, however, all these variables are connected one way or another to one essential element known as social interaction (Kreijns et al., 2003).

Finally, factor such as instructor's readiness, plays significant roles for effective collaborative learning (Koo, 2008; Orooji & Taghiyareh, 2015). Learner's readiness towards collaborative learning is influenced by participants background, experiences, and opinions (Orooji & Taghiyareh, 2015). When the learner had enough experience with collaborative activities and positive attitudes they were highly expected to follow the instructions (Orooji & Taghiyareh, 2015) however when the learners are not ready for collaborative learning, they likely to be 'free-riders' threat to collaborative learning results (Shumar & Renninger, 2002).

In conclusion, collaborative learning happens naturally among the community of learners, through social interaction and the establishment of group understanding whereby the group perform task together as opposed to cooperation in which group split the task and combine each of their part into the final output. Collaborative learning can be useful for promoting joint construction of knowledge among learners, when factors that influence successfulness of collaborative learning is being addressed. More so specifically, identifies how collaborative learning activities could be carried out effectively through support of computer. since it is a very complex teaching activity.

Computer-Supported Collaborative Learning (CSCL)

This section discusses collaborative learning using CSCL. In 1989, NATO sponsored a workshop which was held in Maratea, Italy. This workshop was the birth of the field of CSCL, and it was the very first time the term “computer-supported collaborative learning” was being used in the public and international gathering. Later in 1995, Indiana University organized the first full-fledged CSCL conference (Stahl, Koschmann, & Suthers, 2006).

CSCL is defined as “a field of study centrally concerned with meaning and the practices of meaning-making in the context of joint activity and the ways in which, these practices are mediated through designed artifacts.” (Koschmann, 2002, p.20). CSCL also known as technology that supports collaborative learning by enhancing interaction among group members (Lipponen, Rahikainen, Lallimo, & Hakkarainen, 2003) through contribution and creation of knowledge (Resta & Laferriere, 2007).

This means, CSCL in these recent years is still focusing on environment, where two or more students work together on learning tasks by establishing group understanding, discussing, and applying knowledge to promote meaningful learning. However, the rapid growth of social media and CL tools such as wikis, blog and podcast require different technical applications that, instructors need to learn in order to integrate CL tools in their instruction.

There is a body of empirical evidence indicating the benefits of CSCL in teaching and learning environment. CSCL create a learning environment, where the learners can interact with their peers to promote meaning-making (Koschmann, 2002; Koschmann, Stahl, & Zemel, 2007; Stahl et al., 2006). Meaning- making in learning could only take place, if learners are making sense of the joint activities in a group (Suthers, 2006). Meaning-making happens through the process of social negotiation that promotes leaners, to formulate different perspective, ideas and stance to be contributed in a group (Dillenbourg, Baker, Blaye, & O’Malley, 1996; Timothy Koschmann, 2002).

Therefore, from the learners’ perspective, learning means constructing new knowledge through social negotiation (Jonassen, 2004) that, tends to foster higher phases of collaborative knowledge construction and knowledge building (De Wever, Keer, Schellens, & Valcke, 2010; Schrire, 2006; Stahl, 2000; Tang & Tan, 2017).

Knowledge construction happens when learners create meaning for personal learning, rather than receiving it directly from peers. Meanwhile knowledge building is developed intentionally, as a group of learning collaboratively involve in meaning making by solving discussing and comparing ideas or problems (Scardamalia & Bereiter, 2003, 2006; Suthers, 2006). Previous research also suggests that, there is a potential for CSCL to foster deep-level engagement (Resta & Laferriere, 2007; Sinha, Rogat, Adams-Wiggins, & Hmelo-Silver, 2015; Tang & Tan, 2017) Simulations and modelling tools that have interactive features, create opportunities for deep engagement with learners (Stahl et al, 2006).

In CSCL, high quality engagement in joint activity depends on the collaboration among learners that leads to conceptual understanding (Sinha et al. 2015) because, engagement mediates the relationship between motivation and learning (Tal, Krajcik, & Blumenfeld, 2006). Therefore, collaborative group engagement provides opportunities for students to work on inquiry-based practices to solve authentic problems (Sinha et al. 2015).

Hence, CSCL with component of collaborative learning and computer- support is beyond transmitting or sharing information among group of learners, but collaboratively, it means making in joint activities through technology, such as, CL tools as mediation.

Collaborative Learning (CL) Tools in Higher Education

In this 21st century, CL tools, and mobile learning, and the interactive surfaces have created new opportunities and affordances for learning (Bishop & Elen, 2014). In the context of higher education, CL tools are transforming the learning process to be less linear, where learners are forced to follow standard structures of learning moving to collaborative learning experience, beyond the traditional classroom setting (Garcia, Elbeltagi, Brown, & Dungay, 2015; Marhan, 2006) that allows students to acquire social knowledge construction through sharing, discussing and producing various concept in learning in a dynamic and instantaneous manner (De Wever, Van Keer, Schellens, & Valcke, 2009; Lee & Markey, 2014; Scardamalia, 2002)

CL tools are described as an “architecture of participation,” it promotes the user-friendly platform, immediate learner response and structural levels, and values each participant’s opinion (McAfee, 2006). Besides that, CL tools are also known as Web 2.0 applications (Biasutti, 2017). The term Web 2.0 refers to internet technologies, that enable and promote Web content development through social and collaborative means (Oliver, 2010) that allow rich and varied information resources to be accessed promptly and globally (Fırat & Koksal, 2017).

Many CL tools are not to be installed in any devices or require a high specification hardware (Dewitt et al., 2015). Examples of the CL tools include content creation (blogs, wikis, podcast); social networking sites (Facebook, Twitter, YouTube); bookmarking (tagging and RSS feeds) and communication tool (instant messaging (IM) and discussion forum). Through CL tools, most of the activities related to the education, such as reading a text and discussing it online, writing online content, creating audio and video can be carried out. Hence, integrating appropriate CL tools in instruction is very important to promote students learning.

A number of studies have found that, CL tools have potential to facilitate learning in online learning environments. CL tools have shown to be useful for learning (Dewitt et al., 2015), it is known for its task-specific collaborations with goals and work-oriented activities (Cheung & Vogel, 2013). Integrating CL tools for learning increases interactions among learners (DeWitt, Siraj, & Alias, 2014) allow the communities of common interest not only to be a passive user of the available tools, but also to create, share, contribute and comment on the content through a various file formats that can be shared or edited online (Cheung & Vogel, 2013; Churchill, 2011) and develop student-centred personalized learning environments (Sigala, 2007).

Therefore, instructors in higher education need to be aware of the educational potential of CL tools and be ready to be trained to benefit from the advantages of CL tools in their teaching and learning. This study developed a module, based on several types of CL tools which would be discussed in next sections.

Discussion Forum

Discussion forum is also a widely used tool in many educational learning platforms (Chan & Chan, 2011; Yang, Sinha, & Adamson, 2013). Discussion forum is text-based (Özçinar, 2015; Sloan, 2015) and asynchronous CSCL tools (Hou, Wang, Lin, & Chang, 2015) that allows the learners to engage in dialogue with peers or instructors at their conveniences without temporal or geographic restrictions (Hew & Cheung, 2013; Özçinar, 2015; Zion, Adler, & Mevarech, 2015).

Discussion forums are organized in a hierarchical structure and usually designed with a topic-centred interface, whereby, learners could easily browse the topics and locate the information that they need (Darabi, Liang, Suryavanshi, & Yurekli, 2013; Hou et al., 2015). Studies show evidence that, learning can occur in an online environment (Caswell & Bielaczyc, 2001; Chan & Chan, 2011) and discussion forum proves to benefit the learners in improving their learning experiences (Means et al., 2010)

Discussion forum facilitates social interaction, where the students feel isolated or lonely to get connected with each other (An, Shin, & Lim, 2009; Andresen, 2009; Cho & Tobias, 2016; Hew & Cheung, 2013; Loncar, Barrett, & Liu, 2014; Ng, Cheung, & Hew, 2009; So & Brush, 2008). This view is supported by (Kozan & Richardson, 2014; Sloan, 2015) that social context of learning environment motivate the learners to become more active to participate in the learning community.

Discussion forum facilitates collaborative knowledge construction because, they promote reflective and critical thinking (Hew & Cheung, 2013); share ideas, learn from peers, build knowledge collectively (Kent, Laslo, & Rafaeli, 2016); promote higher-order thinking skills such as critical thinking (Gašević, Adesope, Joksimović, & Kovanović, 2015; Özçinar, 2015). Online discussion also as an effective tools in promoting reflective comments and practices especially from the passive learners to compose their thoughts (Burhan-Horasanlı & Ortaçtepe, 2016; Hewitt, 2001; Poole, 2000) since, discussion forum create more equitable participation (Harasim, 2000; Yim & Warschauer, 2017; Zhu, 2006).

Moreover, through the online discussion forum, learners can identify, explore, integrate, and resolve issues relating to the subject learned (Cui & Wise, 2015; Guiller, Durndell, & Ross, 2008; Hara, Bonk, & Angeli, 2000; Farshid Marbouti & Wise, 2016); facilitate the negotiation and co-construction of new knowledge (Garrison, 1992; Hull & Saxon, 2009; Newman, Webb, & Cochrane, 1995); lead to a group problem solving (Weinberger & Fischer, 2006). Some researchers found that, learners performed better in their academic when they participate in discussion forums (Carceller et al., 2015; Kent et al., 2016; McDougall, 2015).

A study by Carceller et al., (2015) among students from the Faculty of Arts showed that, when students were actively participated in a discussion forum, they experience academic advantage. This mean, discussion forum interaction leads the students to better academic outcomes, through the social interaction that allows students to access information and emotional support from peers.

Despite the promises hold by discussion forums, the online discussion still has its own disadvantages. First, discussion forum lacks many characteristics of face to face social interaction, such as non-verbal cues, auditory and interpersonal signals (Adrianson, 2001) hence hinder the collaborative learning process(de Jong et al., 2012). Secondly, social interactions may distract the learners from completing activities (Janssen, Erkens, Kirschner & Kanselaar, 2012). Such distraction is negative for collaboration and group performance. Besides that, learners seldom respond to the peers' questions or continue the discussion due to high workload in a discussion forum that leads the learners to skim or ignore messages (Peters & Hewitt, 2010).

Some researchers reported that, the learners only tend to read posts when it was still new (Chan, Hew, & Cheung, 2009; Hewitt, 2003;. Marbouti, 2012). Even though, the discussion forum promotes reflection among learners, but in practical application, it fails to support different view- points (Koschmann, 2003) because learners usually either agree or ignore their peer's ideas and opinions (Özçinar, 2015). At the same time, since discussion forum involves interaction through writing, it demands a great amount of time commitment, which lead learners to frustration, thus influence learners' participant level and engagement (Dennen, 2008; Jonassen & Kwon, 2001; Meyer, 2003; Palmer, Holt, & Bray, 2008).

In conclusion, instructors in higher education may integrate discussion forum for more interactivity in the learning environment. However, the potential benefits of discussion forum need to be supported, by a good pedagogical approach, appropriate instructional design and scaffolding as well as discussions structure and facilitation process.

Wikis

Wikis also mean 'quickly' in Hawaiian word (Biasutti, 2017). Wikis are actually web pages, which allows learners to create a hypertext and review it by editing, recording and changing any part of their posts in the web page (Cress & Kimmerle, 2008; Leuf & Cunningham, 2001). In the beginning, Wikis was widely used outside academic context, however, some instructors proposed that, Wikis features might benefits to be used to promote collaborative learning in higher education (Zheng, Niiya, & Warschauer, 2015).

Wikis have unique and powerful features for information-sharing and considered as good tool for as a collaboration through Internet (Biasutti, 2011; Pifarré & Li, 2012). Wikis enable the learners to collaborate in creating, editing, modifying, expanding the web pages to produce collective text (Biasutti, 2017; Cole, 2009; Pifarré & Li, 2012) as well as, develop curricular materials collaboratively (Biasutti & EL-Deghaidy, 2015). This means, more than one person typically contributes to the authoring and publishing of specific content (Judd, Kennedy, & Cropper, 2010). In addition, featured with user's ability to edit each version of Wiki produced by main author is transparent to the co-writers, hence there is continues encouragement to improve the quality of shared Wiki due to the transparency (Li & Zhu, 2017). This is what sets wikis apart from other 'social' writing and publishing tools for example blogs (Judd et al., 2010).

Data obtained from several researchers identified that, wikis are mostly used as tools to support group-based collaborative learning tasks (Abdekhodaee, Ross, &

Chase, 2015; Davis & Miyake, 2004; Judd et al., 2010; Roussinos & Jimoyiannis, 2013). Through wikis, learners create an online working environment that enable them to develop collaborative learning skills (Chu, Capio, Aalst, & Cheng, 2017; Leight, 2008). Wikis enable students to communicate, develop and generate ideas to complete final project (Biasutti & El-Deghaidy, 2012; Mak & Coniam, 2008). Using wikis for group assignments add transparency to joint activities as well as, for individual and group progress (Abdekhodaee et al., 2015), this is because, instructors are able to track students' progress and monitor contribution by individual in joint activity (Hazari, North, & Moreland, 2009; Mak & Coniam, 2008).

Some of the authors had reported that, wikis support learner higher order process such as thinking skills through revisions of shared documents with peers (Donnelly & Boniface, 2013; Salaber, 2014; Sanden & Darragh, 2011) by applying, analysing, synthesising and evaluating the shared knowledge (Nichols, 2010). Therefore, wiki based activity with suitable context such as problem-solving or analysing information significantly is able to promote learner achieving higher levels of learning (Altanopoulou, Tselios, Katsanos, Georgoutsou, & Panagiotaki, 2015; Stafford, Elgueta, & Cameron, 2014)

A number of authors found in higher education, wikis support collaborative knowledge creation as the learners actively participate in the learning, by constantly sharing ideas (Biasutti, 2017; Pifarré & Li, 2012; Raman, Ryan, & Olfman, 2005; Yim & Warschauer, 2017) since wikis are designed for constructing knowledge by an unlimited number of learners (Heimbuch & Bodemer, 2017). Considering wikis are usually used to create written text, learners jointly create a hypertext, that enable them to revise the content conveniently by adding and deleting at any point in time (Raitman, Augar, & Zhou, 2005) Hence, collaborative knowledge building generated through this joint activity and group writing tasks (Hadjerrouit, 2014; Köhler & Fuchs-Kittowski, 2005).

A study by Hazari, North and Moreland (2009) also found that, through a web platform and a group discussion among peers, wikis allow the learners to express their own opinions while working collaboratively. This promotes learners motivation and continues engagement in the process of learning in the community of the learners (Davidson, 2012; J. Lu, Lai, & Law, 2010).

Another study by Biasutti and El-Deghaidy (2012) conducted among students from the Faculty of Education enrolled in the Teaching Strategies module used online Wiki activities for group projects. After they involved in various activities, such as reading and collaborative group work, students found that, they were able to develop knowledge management processes as they were engaged in the knowledge acquisition, internalization, creation, sharing, and application which are the process of knowledge management.

In contrast to the past studies discussed above, He and Yang (2016) conducted a study among undergraduates that were involved in a team project for Business Case Analysis. Students were using wikis as a collaborative platform, to complete the task and researcher did not find any evidence of advantages using Wikis in term of quality of Wiki enabling collaborative content. That mean, learners behaviour using wiki did not directly contribute to the actual performance in the team because learners show negative perceptions towards wiki.

Therefore, instructional support is critically needed, to generate a high-level collaborative activity and to develop the student collaborative skills (Cole, 2009; Wever, Hämäläinen, Voet, & Gielen, 2015) since wiki itself does not guarantee effective collaboration (He & Yang, 2016). Hence, there is necessity to integrate wikis with other collaborate tools since using only wikis for communication seems to have a negative effect on the collaborative outcome (He & Yang, 2016). At the same time, even though wikis may provide opportunity for collaboration, however, it is depending on the instructor's pedagogical strategy for effective learning design, to foster collaborative writing using wikis (Hadjerrouit, 2014; Zheng et al., 2015).

In conclusion, there seems to be inconsistent result from the past studies of using wikis as CL tool to support effective teaching and learning. Therefore, instructors need to focus on well-designed instruction with Wikis, that promotes higher- level collaborative activities for learner to develop collaborative skills.

Blog

A blog is described as a web- based publication with a series of entries in the reverse-chronological order with frequent updates by an individual (Ifinedo, 2017; Shana & Abulibdehb, 2015; Top, 2012). According to Blogging Statistics -Worldometers (2017), total worldwide blog users have written approximately 2.10 million posts, and the number is still increasing as it has become a popular tool for young people. It has been recorded that, users of blog from age of 21 to 35 account for the usage of 53.3 % of the total blogging population, and 20.2 % usage of the total blogging population represent individual aged 20 and below (Lenhart, Purcell, Mith, & Zickuhr, 2010; Sysomos.com, 2016).

Blog contain multimedia elements such as text, graphics, animations, audio, and video as well as links to other sites (Churchill, 2011; Ifinedo, 2017; Kim, 2009; Kim & Jang, 2015). Learners can access the blog to add and edit comments to the published article. There are no advanced programming skills required for learners to create blogs by using multimedia elements (Papastergiou, Gerodimos, & Antoniou, 2011). Therefore, blog could be an interactive tool for teaching and that requires minimum effort to create and maintain to promote collaborative learning.

There is a large volume of published studies in higher education, that describes benefit of integrating blog in teaching and learning. Blog has been used in higher education to facilitate student learning (Ifinedo, 2017; Shana & Abulibdehb, 2015; Top, 2012) for lesson revision (Evans, 2008); knowledge exchange (Ifinedo, 2017; Kim & Jang, 2015); language learning through reading and writing blog (Ducate & Lomicka, 2008); enhance peer feedback (Dippold, 2009; Kim & Jang, 2015; Novakovich, 2016) and reflection on subject learned (Ifinedo, 2017; Pham & Usaha, 2016; Thomas, 2017; Yang & Chang, 2012). Blogs seem to improve the learning process hence instructors can use blogs for various purpose like promoting effective learning.

Some authors also describe blogging, as a pedagogical tool for enhancing learner's engagement by increasing their participants and interactions in blended learning (Cuhadar & Kuzu, 2010; Thomas, 2017; Yang, 2009). Instructors are able to monitor learners engagement level by monitoring their progress on course blog (Novakovich, 2016). Meanwhile, learners also will be motivated to perform when their works are published online (Novakovich, 2016). Learner will continue to engage with peers or instructors by taking control over their own learning (Arslan & Sahin-Kizil, 2010).

Ifinedo (2017) conducted a study on students who enrol in a Management Information System course. Student were actively involved in creating a blog by writing their reflections on the chosen topic from the course textbook. Ifinedo found out that, students understood the benefit of using a blog in the learning when they believe that, blogs can promote interaction, collaboration, and cooperation with peers.

Findings also revealed that, students who believe in using blogs for learning content benefitted blogs as their grades improved.

Despite the positive impact of blogs on the learning environment, several studies argued that, instructors were still having difficulty in implementing blogging into the learning process. This was due to attitude, skills, and experience in handling these CL tools (Kim, 2009; Lambert, Gong, & Cuper., 2008). Learners are more comfortable in agreeing with peers' opinions, than disagreeing, which lead to the failure to interpret information or involvement in argumentation that is vital to the process of peer support (Chang & Chang, 2014). On the other hand, research that investigated on blog and its effectiveness in promoting reflection among learners to foster deep learning seemed to demonstrate inconsistent results (Carr et al., 2013; Chang & Chang, 2014; Petko, Egger, & Graber, 2014; Rostami & Hoveidi, 2014). Hence, the success of blog in promoting effective teaching and learning does not only depends on element of social interaction, but also, other factors such as learners' motivation, engagement with content and peers as well as immediate feedback that needs to be addressed.

Even though, blogging usually involved text-based websites, there is also an audio blog or also known as voice blogging, that contain sound like music or human voices (Huang, 2015). Besides audio blog, there is also blog that combines text, graphics, images, and integrative media such as podcasts and vodcast (video) (Kim & Jang, 2015). Both podcasts and vodcast are getting popular, since they can easily be posted on a website thiswill be discussed in next section.

The studies presented thus far provide evidence that, blog as platform for learners collaborate idea and knowledge; peer interaction; promote reflection and thinking skills as well as create a sense of community. Therefore, with proper instructional strategies, instructors and learners will benefit from the use of blog in teaching and learning.

Podcast

In higher education, the integration of podcasts in the online learning environment has become more common (Caladine, 2008; Copley, 2007) and it may be delivered via LMS or uploaded to the iTunes University, that serves as the podcasting-hosting site (Bolliger, Supanakorn, & Boggs, 2010). Then the learners can easily download this online audio content and install the iTunes software program on their portable devices such as a laptop, MP3 players or iPods, and access downloaded podcast through a Real Simple Syndication (RSS) feed allows listeners to subscribe to their favourite podcasts (Fose & Mehl, 2007; Lee & Markey, 2014; Mack & Ratcliffe, 2007; McGarr, 2009).

There are three types of podcasting that are available and widely used, these are audio-podcasts which include only audio and require very small storage, followed by a combination of audio and digital still images known as enhanced podcasts and finally, the video podcasts or vodcasts which include audio and video with larger storages (Bolliger et al., 2010; Liu & McCombs, 2008).

In education, podcast could be categories into two types which are substitutional podcasting/course casting and supplementary podcasting (McGarr, 2009). He emphasizes that podcasting or also known as course casting consists of lectures/tutorials audio recordings, whereby, learners have the privilege to review the material often. Whereas, supplementary podcasting serves as an additional material to assist learner's understandings of a particular content. Hence, instructors are able to employ podcasting, to facilitate learning process among learner with different learning ability, since podcast content can be developed in form of audio, audio and image or video (vodcasts).

Several authors reported the benefits of integrating podcasting into teaching and learning activities in higher education. The voice of the podcast creator makes the information being delivered to be more personal to the learner, than the written words alone. This approach is translated into a more humanized online learning environment (Donnelly & Berge, 2006; Mark Lee, Miller, & Newnham, 2009); learners take control over their learning by the option of reading an academic material, listening to the podcasts or combination of both (Donnelly & Berge, 2006; Naseri & Motallebzadeh, 2016).

At the same time, learners are engaged with the content through knowledge construction and co-production of learning material (Bolliger et al., 2010; Middleton, 2016). Podcast also allow learners to learn at their own pace and time, since they are able to download the lesson and learning materials into portable device, such as smartphones, iPads, laptops and listen to them anytime anywhere to help students who do not have the ability to attend regular classes (Bolliger et al., 2010; Donnelly & Berge, 2006; Merhi, 2015). Learner also build self-confidence, when creating their own podcasts based on lesson learned in the class because, they feel less anxious as producing podcasts involves performing behind the scenes (Hamzaoğlu & Koçoğlu, 2016).

Besides that, adopting well-structured podcasts able to promote self-efficacy among individual students or groups of students, in terms of assessment guidance and feedback, when they are collaborating together in activities that foster self-efficacy through social interaction (McSwiggan & Campbell, 2017). Therefore, podcast is a powerful tool that could be integrated with traditional resources such as books, lecture handouts, worksheets to support learning.

Ng'ambi and Lombe (2012) conducted a study among postgraduate students that enrol in the Educational Technology course. The author found out that, the group of learners who created their own podcasts using the knowledge gain in class as basic for next learning, were able to co- construct knowledge and engage in high-level cognitive processes. This was due to active involvement in learning by developing the podcast content from several research and formulation of idea as well as podcast serve as, a scaffolding role or modelling when learners are performing reflective task.

Besides the above mentions benefits of podcast in teaching and learning, several studies have revealed that, there are some issues that need to be addressed when podcast is being integrated. Listening to a supplementary podcast does not necessarily improve students learning outcomes (Pegrum, Bartle, & Longnecker, 2015). Podcast needs to be integrated into the curriculum, since listening to a podcast itself does not necessarily translate into learning (Ng'ambi, 2008) Hence, podcast needs to be integrated in lesson with appropriate learning strategies, such as, reflection and collaboration so that, learner would be able to construct knowledge and meaning-making from listening to podcast content.

When providing learners with podcasting as supplementary resources, when they are already using textbooks, power-point slides and books would lead them to cognitive overload (Walls et al., 2010). This negative outcome happens, when learners are unable to realize the benefits of self-pacing multimedia features of podcasting. Some researchers also found out that, absenteeism in face to face classroom among learners was high due to easy availability and accessible of lecture recordings in podcast form (Maag, 2006; Weatherly, Grabe, & Arthur, 2002).

A study by Moore and Smith (2012) study found out that, there was lack of interaction between learners of Doctor of Physical Therapy and instructors, because, the learners were unable to post questions during skills practice in developing podcasts. The learners felt live demonstration would be better option, since they were able to ask questions at any point of the lesson. However, video podcasting skills appear to be well suited for teaching basic psychomotor skills efficiently, since it saves time when instructors conduct live demonstrations and learner would have more time for practise.

In conclusion, as podcasting becomes more important in teaching and learning, now instructors need to think and use podcast as pedagogy tools through well-designed podcasts that is engaging, focused and interesting.

Instant Messaging (IM)

Instant Messaging (IM) sometimes known as chat is widely spread in the higher educational setting (Baron, 2004). Students in the higher education spent about 20 minutes to an hour each day actively chatting with an average of 18 hours per week on online activities (Junco & Mastrodicasa, 2007; Salaway, Caruso, & Nelson, 2007). This is an indicator that, students actively use IM for communication purpose.

Basically, IM is a synchronous type of communication where messages are encoded and decoded by users during interaction in a real time (Huang, 2011; Zwaard & Bannink, 2014) usually based on a written text, when messages need to be composed, modified and reviewed if needs be before sending (Zwaard & Bannink, 2014). Therefore, individuals could interact with each other through instant information sharing and feedback.

There is an increasing amount of literature on using IM for effective teaching and learning activities. IM tools have been used widely in the online discussion (Branon & Essex, 2001; Hou & Wu, 2011). Based on a study by Hou and Wu (2011) on students enrolled in a Web Design course, who participated in collaborative synchronous discussions using IM to develop their information sharing and problem-solving skills. The result indicated that, there was some knowledge construction by sharing and comparing information among students even though, more than half of the discussion messages were out of the topic.

Integration of IM in the learning environments promotes student's engagement (Heiberger & Harper, 2008; Nelson Laird & Kuh, 2005; Salas & Alexander, 2008) since learners who communicate through text chat showed more motivation and produced a richer vocabulary due to the non-threatening and anonymous nature of chat communication (Beauvois, 1992). Thus, it gives instructors the privileges to understand the learners learning attitude and style instantly (Hwang & Yang, 2008). Because the learners experience less communication pressure, IM yielded higher learner participation (Abrams, 2003; Freiermuth & Jarrell, 2006; Freiermuth & Huang, 2012; Kern, Ware, & Warschauer, 2008). Hence, learner participate more in learning activities, since they are feeling more comfortable expressing their views and opinion on topic of discussion in IM compared to face to face interaction.

High utilization of IM tools seems to reduce one-way discussion among learners, since IM promotes towards phases of social knowledge construction which allow the learners to learn from each other (Gunawardena, Lowe, & Anderson, 1997). Along the process, learners could develop questioning skills (Wang, 2005); enhances learners' group decision-making and brainstorming skills (Branon & Essex, 2001) and facilitates team coordination in synchronous discussions (Isaacs, Walendowski, & Ranganathan, 2002; Nardi, Whittaker, & Bradner, 2000).

When a student needs to convert their thought into words, it encourages reflection that leads to a better understanding of the material being learned with (Harasim, 1990) and learners pay even more attention to the content when communication is limited to text medium (Werry, 1996). Hence, when learners pay more attention to the content rather than the instructors, incorporating IM in lesson will promote effective learning, since learners can engage in authentic and meaningful interaction.

A study conducted by Sun, Lin, Wu, Zhou, and Luo (2018) among the 78 pre-service teachers, who participated in the collaborative learning activities using Moodle and WeChat found out that, both tools facilitated collaborative learning with different affordances. The discussion forum in Moodle shows that communication was aimed at knowledge construction, however, using the mobile instant-messaging app, WeChat resulted in more social interactions.

The studies presented thus far provide evidence that, IM used widely to enhance learner participation however data from several researchers have identified some drawback of IM in teaching and learning. IM is frequently used during multitasking since it is common for higher education learner to chat with a large number of friends simultaneously (Junco, 2005). Junco and Mastrodicasa (2007) reported in their study that, 75% of IM users are chatting on IM, while engaging in the academic task. Therefore, leaner unable to complete their academic tasks when multitasking even though, IM beneficial for enhancing social interaction (Junco & Cotten, 2011). However, Junco and Mastrodicasa (2007) study did not address the type of chat activities that learners engaged which lead to a failure in completing their academic task since involving in academically related chat somehow will promote learning among learners.

Since IM needed to be typed, modified and review before sending it out (Zwaard & Bannink, 2014), this will make the whole process slower and deliberate for information exchange, than video call which learner could see and hear each other voice. On the other hand, since text messaging is presented only in a dialog form, there is a tendency to miss a nonverbal cues like tone and eyes contact (Stodel, Thompson, & MacDonald, 2006; Williams, 1999) and this could lead to a misunderstanding and misinterpretation among learners (Zhang & Carr-Chellman, 2001). The instantaneous nature of IM often leads the learners not to have an ample time for reflection on the topic being discussed and ultimately, affect the deep learning process (Branon & Essex, 2001).

In conclusion, even though, IM is mainly used for socializing, the feature of IM being a synchronous communication tools tend to instant knowledge sharing and feedback. Hence, IM could be beneficial if instructors integrate IM as one of the pedagogy tools, through well-designed lesson that connect better with content to create more interesting and exciting learning environment.

Learning Management System (LMS)

Most often, instructors in higher education institutions perform specific instructional tasks related to learner learning activities, by using the Learning Management System (LMS) as a platform (Schoonenboom, 2014). Therefore, almost all LMS have embedded and offer essential CL tools, such as blogs, wikis, podcast, text messaging/chat and discussion forum to organize and control learners' joint activities.

LMSs is a software application or Web-based technology, that is also referred to as Course Management Systems (CMS), Virtual Learning Environments (VLE; Embi, Hamat, & Sulaiman, 2012). This platform helps to facilitate online learning environment and provide ubiquitous learning (Ain, Kaur, & Waheed, 2016). For this reason, LMSs have become an integral part of higher education on a worldwide level (Browne, Hewitt, Jenkins, & Walker, 2008; Ellis, Ginns, & Piggott, 2009; Limayem & Cheung, 2008; Mahdizadeh, Biemans, & Mulder, 2008). LMSs are very frequently used to support traditional face-to-face teaching at universities (Elissavet & Economides, 2003; Paulsen, 2003; Torrisi-Steele & Drew, 2013).

There is a large volume of published studies, that described the activities that take place in the LMSs platform. The instructors benefited from the LMSs by integrating platform for content, delivery, managing and creating course content (Almarashdeh, Sahari, Zin, & Alsmadi, 2010; Heirdsfield, Walker, Tambyah, & Beutel, 2011; Squillante, Wise, & Hartey, 2014), providing feedback to students (Bradford, Porciello, Balkon, & Backus, 2007; Zainuddin, Idrus, & Jamal, 2016), group formation and publishing exam grades (Chawdhry, Paullet, & Benjamin, 2011; Wilson, 2007), evaluating students' performance (Heirdsfield et al., 2011) and sharing teaching resources (Becker & Jokivirta, 2007; Malikowski, Thompson, & Theis, 2007).

Besides the basic function, LMSs was developed to offer instructor more features that contribute towards shared knowledge, resources, communication and networking between instructors and students as well students with peers (Al-Busaidi & Al-Shihi, 2010; Lonn, Teasley, & Krumm, 2011; Zainuddin et al., 2016; Zanjani, Edwards, Nykvist, & Geva, 2017) This atmosphere only could be achieved through the integration of collaboration tools into student learning activities.

What we know about LMSs affordance is largely based on empirical studies, that have been investigated globally. However, in the context of higher education in Malaysia, different scenarios were reported. Studies in the area of LMSs are mostly limited to only one group's perspectives, which is students (Ain et al., 2016; Ariffin, Rahman, Alias, & Sardi, 2015; Zainuddin et al., 2016). As a result, only a limited study on instructor's perspective is available. A study conducted among the academic staff from private and public higher education institution shows that, lack of training and time commitment are the reasons for the instructors reluctant to use the LMS (Embi et al., 2012).

Instructors also prefer conventional teaching methods with normal face to face class with attendance and the alternative applications. Instructors mostly used to substitute LMS for content sharing applications such as Slideshare, self-developed websites and social networking sites such as Facebook (Embi et al., 2012). LMS is being used mainly as a repository of materials and information (Ariffin et al., 2015; Zainuddin et al., 2016) however, Ain et al., (2016) study yields different findings that, LMS usage is beyond course-related activities and downloading/uploading files are to be integrated in discussion forum. Hence, LMS would be useful in creating fun and engaging education activities for learners. If instructors employ LMS beyond updating or uploading any learning materials to more collaborative activities, such as discussion forum, IM and creating online content with Wiki and blog.

Even though, a large and growing body of literature had investigated LMS from a global and local perspective, but there are several issues that need to be addressed. LMSs existence does not always guarantee the success of the platform. More often, the LMSs are underutilized (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007), this is because of traditional didactic approaches, that are transferred to the online environment (Picciano, 2015; Zanjani et al., 2017). Even, with the incorporation of varieties of CL tools in LMSs with the aim of diverting instructor away from the traditional didactic approaches, there are still some obstacles impeding the use of LMSs.

Instructors play a vital role in utilizing LMSs, students get to experience CL tools activities, only when instructor make it available for learning (Bolliger & Wasilik, 2009) but however, the instructors are facing challenges in the aspect of insufficiency in instructional design support; ineffective and insubstantial training technology competency; pedagogy and mind-set; motivation and technical constraint (Merfert, 2016; Morón-García, 2006; Panda & Mishra, 2007; Tuapawa, 2016; Webster & Hackley, 1997).

Most time, instructors fail to understand the success of online teaching and learning depend on personal innovativeness to experiment and adopt new technologies independently (Al-Busaidi & Al-Shihi, 2010), involvement and belief in the effectiveness of this learning tool (Emelyanova & Voronina, 2014).

Therefore, instructors who are enthusiastic and engaging toward online teaching and learning could incorporate collaborative features, by using tools such as, discussion forum, Wiki, blog and IM that promote learning through social interaction and inspire learners to actively engage in the learning process anywhere and anytime.

The Nature of Technological Pedagogical Content Knowledge (TPACK)

Incorporating instructional technology tools in the learning environment is important for teaching in this twenty- first century (Clark, 2010; Morrell, 2012; Nixon & Hateley, 2013; Nixon & Kerin, 2012) because, the digital technologies play a vital role in the learner's life and the educational experiences (Rowsell, Saudelli, McQuirter Scott, &

Bishop, 2013; Voogt & Knezek, 2013). Since digital technologies is important in teaching and learning, educational institutions are moving towards incorporating digital technologies with academic context (Saudelli & Ciampa, 2016).

However, learning to teach the subject matter is a different approach to learning the subject matter with technology (Niess, 2005; Saudelli & Ciampa, 2016) . Given this, not many instructors have the experience pedagogical strategies for teaching subject matter, within the technology framework (Niess, 2005).

Studies have attempted to explain how the instructors incorporate technology into teaching. To effectively integrate technology into instruction, the instructors need to have a good understanding of how technology can be incorporated together with pedagogy and content knowledge (Hughes, 2005; Margerum-Leys & Marx, 2002; Niess, 2005; Zhao, 2003). Mishra and Koehler (2006) proposed a technology pedagogical content knowledge (TPACK) as a body of knowledge that, the instructor required to integrate technology into teaching and to learn in a meaningful way.

This means that, the TPACK framework emphasizes on keeping up with the rapid growth of digital technologies, instructors need the technological knowledge as well as having a pedagogical and content knowledge (Jen et al., 2016; Koehler & Mishra, 2008; Mishra & Koehler, 2006).

Mishra and Koehler (2006) developed a framework (TPACK) that builds on Shulman's (1986) pedagogical content knowledge (PCK) model, which articulates content knowledge (CK) and pedagogical knowledge (PK) as primary focus of teacher's knowledge. Mishra and Koehler (2006) extended PCK model to include technological knowledge (TK) as a third major area of knowledge. Finally, the framework illustrates three additional interactions among these knowledge domains;

technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPCK) as shown in Figure 2.1

With this integration, TPACK serves as a set of knowledge in applying emerging technologies into supporting specific pedagogical strategies, with the aim of enhancing students learning in particular subject matter (Koehler & Mishra, 2008; Mishra & Koehler, 2006; Saudelli & Ciampa, 2016). The description of each component of the TPACK model is discussed below.

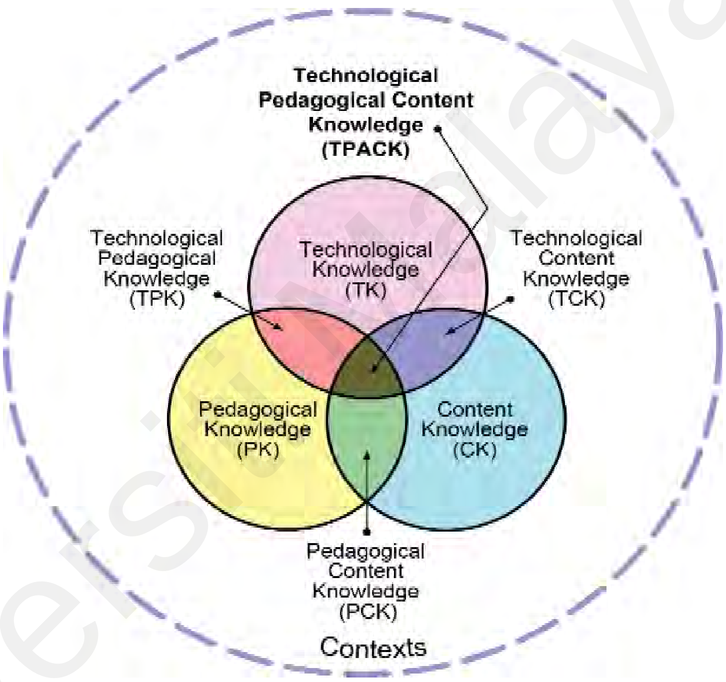

Figure 2.1 Technological Pedagogical Content Knowledge (TPCK) Framework. Reprinted from TPACK ORG, by Mishra & Koehler, 2006, from http://www.tpack.org/. Copyright 2012 by Mishra & Koehler. Reprinted with permission.

Content Knowledge

Content Knowledge (CK) is knowledge about the subject matter without a consideration of teaching the subject (Chai, Koh, & Tsai, 2013). In higher education settings, different content is covered within the faculties. As a result, instructors must know and understand the subject, that they are teaching as knowledge of the content is essential for instructors (Koehler & Mishra, 2009). Shulman (1986) stated that, this knowledge includes facts, concepts, theories and practices, and approaches within the field. Instructors need to give careful attention and understand to the nature of knowledge and inquiry is different from one field to another (Chang, Jang, & Chen, 2015; Koehler & Mishra, 2008; Mishra & Koehler, 2006; Tseng, Lien, & Chen, 2016). For example, in learning Science, instructors would need to integrate knowledge of scientific facts, theories, method, and evidence-based reasoning. In Art appreciation knowledge such as, art history, well-known painting, and sculptures (Koehler & Mishra, 2008) and in learning English, the instructor would focus on phonemic, letter-sound relationships and spelling patterns (Goldschmidt & Phelps, 2010).

Pedagogical Knowledge

Pedagogical Knowledge (PK) is a deep understanding of practices and the process of teaching and learning as classroom management, assessment, and student teaching (Chang et al., 2015; Janssen & Lazonder, 2015). PCK is known for deep understanding, because, instructors need to pay more attention to cognitive, social and theories of learning and its application to the learners in the classroom (Koehler & Mishra, 2009; Mishra & Koehler, 2006). Therefore, with deep PK, the instructor could have a better understanding of how students construct knowledge and learn a specific skill, as well as, showing positive character and mind toward learning. Example of pedagogical knowledge is lecture/presentation, discussion, collaborative and cooperative, technology integration, role play and simulation.

Pedagogical Content Knowledge

Pedagogical Content Knowledge (PCK) is similar to Shulman's (1986) idea about the way teaching method matches the subject matter to be taught by the instructors, so that, the learners can have a better understanding pertaining to the specific content (Chai et al., 2013; Janssen & Lazonder, 2015).

When an instructor has PCK, they will know the best teaching approaches to the content and look for a way forward to producing better teaching. PCK suggests multiple ways to represent subject matter, adapted to diverse interests and abilities of learners, and tailors instructional material to foster a meaningful understanding. This shall address learners' difficulties and misconceptions and prior knowledge (Chang et al., 2015; Koehler & Mishra, 2009; Mishra & Koehler, 2006; Pamuk, 2012). For example, in Science, instructors can teach through inquiry based learning (Park, Jang, Chen, & Jung, 2010) and teach concept on electricity using analogies.

Technological Knowledge

Technological Knowledge (TK) is a traditional knowledge and skills, current and emerging technologies from chalk and blackboard to educational games and interactive online learning environments (Chang et al., 2015; Janssen & Lazonder, 2015). Instructors need to acquire knowledge in adapting new technologies, regardless of the technology types. Due to the rapid growth of emerging technology, the nature of TK needs to be shifted along with the time (Koehler & Mishra, 2009; Mishra & Koehler, 2006). Example of TK is knowledge about, how to use computer hardware, software programmes, associated peripherals, the Internet (Chai et al., 2013; Schmidt et al., 2009).

Technological Content Knowledge

Technological Content Knowledge (TCK) is the knowledge about blended technologies for creating contents in different ways to develop better teaching practices (Chai et al., 2013; Chang et al., 2015). Besides being content experts, the instructors need to know the manner in which the subject matter could be changed, when integrating a different kind of technology application.

Instructors also need to have a better understanding of the choice of technologies to afford its content idea and overcome the technological constraints. Moreover, the technological tools can provide greater flexibility in navigating across the content (Koehler & Mishra, 2009; Mishra & Koehler, 2006). For example, in fields of medicine, X-ray machine used to teach medical imaging and in archaeology Carbon-14 dating, been used to teach concept on radiocarbon (Koehler & Mishra, 2008), using computer software like Microsoft Access to create a database management system (DBMS), using SPSS to teach statistic.

Technological Pedagogical Knowledge

Technological Pedagogical Knowledge (TPK) is an understanding of how teaching might change, as a result of using particular technologies. In another word, instructors need to know the pedagogical affordances and constraints of technological tools, used within their fields to develop effective pedagogical designs and strategies to leverage learning outcomes. In addition to this, most of the software programs and web-based technologies such as blogs or podcasts are designed and developed for entertainment, communication, social networking and not for educational purposes.

As a result of this, instructors are required to develop skills in customizing these tools for the pedagogical purpose, rather than the common functions. In order to create best learning experience for learners, TPK requires an instructor with creativity and open mindedness in exploring and experimenting these technological tool (Chai et al., 2013; Chang et al., 2015; Janssen & Lazonder, 2015; Koehler & Mishra, 2009; Mishra & Koehler, 2006). For example, instructors could consider using wikis, blog and forum for collaborative learning, social media such as Facebook, Twitter for discussion, integrating Smartboard technology or presentation software like, Prezi and Microsoft Power Point for lecturing, using ICT as cognitive tools and computer-supported collaborative learning.

Technological Pedagogical Content Knowledge (TPCK)

The term TPCK is an extension of Shulman (1986) knowledge of the pedagogical content (PCK) whereby, the technological component has been added (Mishra & Koehler, 2006). Therefore, this expanded model implied that, to facilitate learning with technology, all the three cores components knowledge of content, pedagogy, and technology need to be integrated (Joo, Lim, & Kim, 2016). This is supported by Koehler, Mishra and Yahya, (2007) that "at the heart of TPACK, is the dynamic transactional relationship between content, pedagogy, and technology. Good teaching with technology requires understanding the mutually-reinforcing relationships between all three elements that are taken together to develop appropriate, context-specific strategies and representations' (p. 741).

Due to that, effective teaching with technology, requires instructors to understand the pedagogical approach that is suitable for technologies, so that, content can be delivered in constructive ways. Having knowledge of technology that facilitates in learning difficult concepts and knowledge of how student prior knowledge could be used to develop new understanding as well as, strengthening the old knowledge with technology integrations (Koehler & Mishra, 2008; Mishra & Koehler, 2006). For example, knowledge about using Wiki as a communication tool to enhance collaborative learning in Science and using Kahoot as an assessment tool to promote game-based learning in History.

Therefore, the true meaning proposed by the TPACK model is the three knowledge; CK, PK, and TK and they are not independent, but should interact with each other (Cabero & Barroso, 2016). At the same time, technology is not separated from content and pedagogy (Janssen & Lazonder, 2015; Mouasher & Lodge, 2016).

One of the most common criticisms by many researchers is the generalist nature of this model, that tends to treat technology in general matter and unable to set a guideline for teaching with a specific type of emerging technologies like games (Cabero & Barroso, 2016; Hsu, Tsai, Chang, & Liang, 2017; Lee & Tsai, 2010).

This view is also supported by Yeh, Hsu, Wu and Chien, (2017) that, TPACK can be very complex structure when personal differences are considered. Considering this issues, when integrating TPACK elements into practise, the support should be tailor made according to the instructors' prior knowledge and experience, for instant in service teachers in school need a different support, than instructors in the higher education setting as well as, pre-service teachers (Janssen & Lazonder, 2015; Yeh et al., 2017).

Review of Technological Pedagogical Content Knowledge (TPACK) Research

There are numbers of published studies on TPACK that were focused on the teacher's education and professional development from pre-service and in-service teachers to university instructors, as evidenced by over 600 journal articles using the TPACK framework (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). The TPACK studies could be categories into four-main areas namely; development of TPACK concept, measurement of TPACK, effects of professional development on TPACK and development of the TPACK model.

Over the past years, most researchers have emphasized on the development of TPACK as a concept. The concept T(PCK) has received a great attention from researcher thus, significant number of articles have been published. Research that surrounds the conceptualization of TPCK was build based on Shulman's (1986, 1987) work on PCK that emphasizes the critical essential for instructors to amalgamate their contents knowledge with pedagogical knowledge. Then, the T(PCK) research was enhanced and extended Shulman's PCK towards the knowledge is required for teaching in the digital era.

Finally, on 2005, Koehler and Mishra introduced the T(PCK) framework, which is known as the interplay between three domains of knowledge namely, content (C), pedagogy (P), and technology (T) and their intersections PCK, TCK, and TPK in a specific context (Koehler & Mishra, 2008; Koehler & Mishra, 2005; Mishra & Koehler, 2006). As a result, this is when the component of TK which concerns knowledge of how to work with and apply technological tools/software. After the TPCK introduction, Thompson, and Mishra (2008) proposed a change in the acronym "to form a whole integration, a Total PACKage" for easier pronunciation among the three fundamental knowledge domains; therefore, TPCK became TPACK.

After that, Koehler and Mishra (2008) developed the concept of TPACK into a situated form of knowledge by recognizing that, meaningful of technology integration, it is essential for instructors to comprehend the complex interplay between content, pedagogy, technology, and knowledge of the surrounding educational context, including students, school and resources, such as, facilities, and the environment.

Numerous studies have attempted to develop indicators in the measurement of TPACK. A wide range of instruments have been developed to assess instructors use and understanding of TPACK from pre-service to in service teachers, such as self-report measures, open-ended questionnaires, performance assessments, interviews, and observations.

Self-report measures basically asking participants to numerically rate their agreed statements with 5- or 7-point Likert scale regarding, all seven or a subset of the TPACK knowledge domains. Self-report measures are popular among the TPACK researchers to collect large amounts of instructors' self- ratings regarding their TPACK understanding and use via surveys (Jen et al., 2016; Willermark, 2018).

For example the most commonly used survey is Survey of Preservice Teachers' Knowledge of Teaching and Technology, consists of 47 self-report items that assess pre-service teachers' knowledge of 7 subscales of TPACK (Schmidt et al., 2009). In the literature, the efforts to construct self-report measure for TPACK started from (Koehler & Mishra, 2005) who measure changes in teachers' perception of their understanding of content, pedagogy, and technology through learning by design approach, using 35 items. However, Koehler's TPACK measurements in form of survey are specific to certain course experiences, thus it is not applicable to a different setting, content area, or approaches such as professional development (Schmidt et al., 2009).

Subsequently, Archambault and Crippen (2009) developed 24 items measuring K-12 online distance teachers to rate their knowledge in a different type of instructional using domains of content, pedagogy, and technology and other overlapping domains; TK, PK, and CK. However, Archambault work only can be generalized in context of K-12 online teacher and the survey conducted was mainly self-reporting by the teachers instead of the measurement of observable behaviour, that tends to lead to a certain level of biases (Schmidt et al., 2009).

Due to that, Schmidt et al. (2009) extended Koehler and Mishra (2005) as well as, Archambault and Crippen (2009) works by developing 75 items that extends to general context, multiple content area such as, maths, science, social studies and literacy and for pre-service professional development in TPACK as well as offered triangulation on survey based on different data analysis (factor analysis).

In recent years, Jen et al., (2016) explored TPACK by developing total of 17 items survey referred to as ''Technological Pedagogical and Content Knowledge-Practical'' (TPACK-P) with 4-point scale of 'Lack of use,' 'Simple adopting,' 'Infusive application,' and 'Reflective application' to examine pre-service and in-service teacher responses in implementing technology in different instructional scenarios.

Koh, Ching and Chin (2013) draws our attention that, the seven domains in TPACK been widely adopted as a theoretical base in understanding instructor's technology skills since the inter-relationship between the seven domains and how these related to instructors TPACK been negated. Hence, Koh develops 30 items to measure primary, secondary, and junior colleges teacher's perceptions related to the seven TPACK constructs.

Open-ended questionnaires were typically used to ask instructors to reflect through writing their overall experiences using technology in teaching or professional development program to develop instructors TPACK. A study by So and Kim (2009) shows that, five open ended items on pedagogy and technology was developed to identify pre-service teacher' understandings, misconceptions, and difficulties on the integration of TPACK.

Next, is the performance assessments to evaluate instructors' TPACK by investigating their performances on authentic teaching tasks in a form of lesson plans (Bilici et al., 2016; Pringle, Dawson, & Ritzhaupt, 2015), portfolios, (Chen, Jang, & Chen, 2015; Saudelli & Ciampa, 2016) or reflective journals/report (Baran & Uygun, 2016; Chen et al., 2015; Tseng et al., 2016), design task (Baran & Uygun, 2016; Graham, Borup, & Smith, 2012; Tai, 2015)

Another type of TPACK measurement is interview whereby a set of pre-determined interview protocol are designed then recorded during the interview. The verbatim later transcribed, analysed and coded for reporting (Chang et al., 2015; Janssen & Lazonder, 2015; Saudelli & Ciampa, 2016; Tai, 2015; Tseng et al., 2016). Koh, Chai and Tay (2014) explored in-service teachers group meetings throughout a semester to discuss lesson ideas, curriculum matters by recording thirteen audios and categorizing teachers' comments as either 'content,' 'technology,' or 'pedagogical'.

Lastly, the observation which were deliberately used to observe and track the instructors TPACK development over time which can take place in the classrooms or during a professional development session. Like interview, field note will be transcribed, analysed and coded for reporting (Bilici et al., 2016; Chang et al., 2015; Saudelli & Ciampa, 2016; Tai, 2015). Kafyulilo, Fisser, Pieters and Voogt (2015) explored pre-service teachers process of integrating technology in microteaching sessions and an observation checklist was adopted from Harris, Grandgenett and Hofer (2010). This shows that, there are many methods can be implemented to identify instructors TPACK however, is a combination of instruments that are able to triangulate findings.

Several studies carried out investigate on how professional development programs influenced instructors ’development of TPACK. A study by Cabero and Barroso (2016) show that, the model for teacher training gives more emphasis on pedagogical and content aspects rather than technological aspects. Cabero study also involved self-reporting by instructors on their TPACK perceptions whereby, self-reporting tends to lead to a certain level of biases (Schmidt et al., 2009). Therefore, more data collection in the form of observation is needed. Based on Doering, Veletsianos, Scharber and Miller (2009) study found out TPACK was separated as three different domains in their professional development programmes. Therefore, professional development programme should integrate domain of technology, pedagogy, and content as one knowledge, rather than viewing professional development as a platform to train instructors only on specific base to effectively develop instructors’ teaching abilities and instructional designs (Angeli & Valanides, 2005, 2009).

This research also involves self-reporting by instructors on their TPACK perceptions whereby, self-reporting tends to lead to a certain level of biases (Schmidt et al., 2009). In addition to that, Jaipal-Jamani and Figg (2015) developed a TPACK-based Professional Learning Design Model (TPLDM) for technology workshops for teachers to plan and integrate technology-enhanced instructions by combining four learning activities mainly, modelling, pedagogical dialogue, demonstration and application to promote teachers TPACK development. Other authors (Guzey & Roehrig, 2009; Jang, 2010; Jimoyiannis, 2010; Richardson, 2009; Wilson & Wright, 2010) also found out professional development programs to have a positive impact on instructors’ TPACK development.

Recent attention has also focused on the development of the TPACK model, that has been an intervention research that examine the effectiveness of course by employing TPACK framework (Angeli & Valanides, 2009, 2013; Baran & Uygun, 2016; Chai & Koh, 2017; Hsu et al., 2017; Lee & Tsai, 2010; Marino, Sameshima, & Beecher, 2009; Mishra & Koehler, 2006; Pringle, Dawson, & Ritzhaupt, 2015).

Besides examining the effectiveness, of course, some studies also tend to focus on the development of TPACK as a concept. Angeli and Valanides (2009) developed ICT-TPCK and technology mapping (Angeli & Valanides, 2013) after questioning the TPACK framework proposed by (Mishra & Koehler, 2006). There were two different epistemological stances about T(PCK) elements namely, the integrative and the transformative view.

The transformative view was suggested by Angeli and Valanides' (2005) ICT-TPCK framework is seen as transformative view, with each domain of knowledge (pedagogy, content, and technology) and its intersection (TK, PK, and CK) is distinct from each other that could be developed on its own. That means that, Angeli and Valanides' view TPCK as a body of knowledge that goes beyond integration of each knowledge towards the transformation of something new and unique, whereby, (pedagogy, content, technology, learner and context) are considered as significant individual contributors to the development of TPCK. However, the integrative TPACK framework proposed by Koehler and Mishra (2008) conceptualizes TPACK as an integrative body of knowledge, that is created consequently by the mere intersection between pedagogy, content, and technology.

In addition to that, some studies were categorized as design-based research or learning by design approach. Koehler and Mishra (2005) was first reported to use the learning by design approach to collaborate faculty members and graduate students to develop online courses, however, Koehler study did not indicate any specific model for lesson design. Later Angeli and Valanides (2009) came up with a specific model named 'Technology Mapping' by offering five criteria, namely teachers' knowledge: pedagogical, subject area, students, environmental context for preservice teachers to create TPACK and lesson ideas.

Kramarski and Michalsky (2010) later based on Angeli's work develop pre-service teacher self-regulated learning (SRL) in the context TPCK with metacognitive instruction. Chai and Koh (2017) developed Scaffolded TPACK Lesson Design Model (STLDM) to change pre-service teachers' TPACK by adding elements of beliefs which seems to be lacking in the previous studies.

Another design -based research by Baran and Uygun (2016) found out that, TPACK model that emphasize on design task increases teachers TPACK however, Baran realized that, there was need to further develop TPACK by investigating design based principles that could be applied to enhance teachers TPACK. Therefore, TPACK-in-action based on TPACK-DBL principles, and authentic design activities were created for the teacher's education programs.

Some studies contributed to the understanding of TPACK for the specific subject domain. Hsu et al. (2017) proposed a framework for Technological Pedagogical Content Knowledge-Games (TPACK-G) after claiming current TPACK research tends to treat technology in a general manner, therefore, the framework unable to guide teachers, when teaching with specific technology such as a game. On the other hand, study by Marino et al. (2009) was focusing on developing TPACK model by adding assistive technology to promote special education practice for pre-service teachers. This model would be used among students with learning disabilities and marginalized group in intention to improve their learning experiences. In addition to that, a study by Tai (2015) was focusing on understanding how English teachers develop Computer Assisted Language Learning (CALL) competency and practice it in the classroom. Therefore, Tai developed TPACK-in-Action CALL to be used in a workshop for in -service teachers.

Besides that, Pringle et al. (2015) study used TPACK framework to examine how Science teachers integrated technology in their science lesson plans. Similarly, Jimoyiannis (2010) developed a professional development model known as Technological Pedagogical Science Knowledge (TPASK) for preparing teachers to teach Science with technology. Guerrero (2010) also proposed TPACK for mathematics education by illustrating the specific uses of technology. He proposed elements of Mathematics TPACK consists of teacher's belief, technology-based for mathematics instruction and classroom management as well as the depth of mathematics content. In the same vein, Niess et al. (2009) proposed TPACK standards and indicators for Mathematics education by focusing on designing technology-rich learning environments, strategies for suitable technologies to facilitate students learning, technology for assessment and technology for promoting teacher's productivity and practice.

The studies presented thus far provides the evidence on TPACK integration in a different area of focus. In Malaysian context, there have been some studies done locally. A study had been carried out in a secondary school setting to validate TPACK instrument in using ICT for teaching and learning (Nordin, Faekah, & Ariffin, 2016) and another study by Tee and Lee (2011) in higher education setting among postgraduate students in School of Education to understanding how TPACK was built through improvised problem-based learning (iPBL) approach in the context of the SECI framework (socialisation, externalisation, combination, internalisation)

Nordin et al. (2016) study was initiated in Malaysia, after a researcher found out several TPACK survey were tested in United State (Archambault & Crippen, 2009; Schmidt et al., 2009) and reported to have high internal reliability. They also claimed that, past studies show inconsistent about the construct validity of the instrument when Schmidt et al. (2009) identified seven and six-factor model respectively; Chai, Koh and Tsai (2010) found a four-factor model and Koh, Chai and Tsai (2010) found a five-factor model of TPACK that had been interpreted as a combined domain. Therefore, the researcher found there was a need to examine the validity and reliability of TPACK by conducting a study in a different context using samples from Malaysia to understand the relationship of TPACK domains.

This design-based research by Tee and Lee (2011) found that, Problem- Based Learning class with conducive social environment promote socialization, externalization, combination, and internalization to assist teachers to develop TPACK by re-thinking their pedagogical practices and content that, they were teaching before selecting appropriate technology.

Given all, that has been mentioned so far, it appears that, only a few studies had been done on TPACK in Malaysia context and there is still much space for research to be done on TPACK that would promote better teaching and learning. So far, there are fewer studies on TPACK focusing on faculty members and if there many, the studies were designed to examine the effectiveness of course by employing TPACK framework.

Besides that, previous TPACK module was designed based on the specific domain of subject or train the teachers to use specific technology, by neglecting the pedagogical approaches. In addition to that, there is no TPACK model development that promotes digital pedagogy, using CL tools. For instructors to be able to integrate technology into online instruction, they need to be well-equipped with knowledge of digital pedagogy (DeWitt et al., 2017).

Therefore, this study attempts to develop a Collaborative TPACK module for instructors in higher education. Hence, this study would employ design and developmental research by helping instructors to identify their needs and later design, implement and evaluate the module implementation to cultivate their TPACK knowledge and skills.

Continuing Professional Development (CPD) in Higher Education

In general, context, Continuing Professional Development (CPD) known as lifelong learning, where individuals take control of their learning and development as well as, maintaining the knowledge and skills, that are related to their careers (Collin, Heijden, & Lewis, 2012). CDP is an ongoing process that involves reflection and action that stimulate individual in moving forward to achieving their ambitions (Megginson & Whitaker, 2003, 2007).

CDP could be offered by the professional bodies that involves membership and a practicing certificate issued as a prerequisite for practicing the profession such as, doctors and lawyers (Collin et al., 2012). Megginson and Whitaker (2007) highlighted that, individual need to focus on CPD as a major intervention for own career development, since individual security is built based on skills, knowledge, and experience once acquired for themselves and not on the job or organization they belong. This statement was supported by Collin et al. (2012) that, employees' development is the major concern of CPD practices.

Usually, all the CPD are linked with human resource development (HRD) practices in the form of formal training courses, coaching, and mentoring (Collin et al., 2012). CPD is different from other types of training and development, because, training usually places the participants in a passive role when the trainer takes charge of the training delivery and agenda of the session (Kennedy, 2005) but in CPD, the participants are engaging in an ongoing process of reflection and action (Megginson & Whitaker, 2007).

Training is often "associated with focused learning or adults pursuing professional recognition or certification." (Spector, 2016, p.41) that focusing on developing skills and competence in performing recurrent tasks (Spector, 2016) however, CPD concern on the practices in developing participant goals and objectives beyond their initial training. (Collin et al., 2012). Finally, training is usually conducted in a formal and a linear setting, which often overshadows participants needs in recognizing and meeting their own development needs (Kennedy, 2005). Meanwhile, Collin et al. (2012) stated that, CPD could be conducted in a formal and informal setting by developing the participant professional experience and expertise, rather than to just focus on learning as an express objective.

Meanwhile, coaching is the process whereby one individual helps another "to unlock their natural abilities; to perform, learn and achieve; to increase awareness of the factors which determine performance; to increase their sense of responsibility and ownership of their performance; so self-coach; to identify and remove internal barriers to achievement." (MacLennan, 2017, p.4).

On the other hand, mentoring happens when a mentor assigned "teacher" who is more experienced and willing to share their knowledge with an individual who is less experienced based on mutual trust (Clutterbuck, 1991; MacLennan, 2017). So as a result of this, these three types of CPD; training, coaching and mentoring are difference and sometimes could be overlapping depending on the context. For example, Clutterbuck (1991) and Landsberg, (1996) pointed out that, mentoring also included coaching, but MacLennan (2017) argued that a mentor would never be a coach until the individual adopts the skill of successful coaching

Collectively, training, coaching, and mentoring are associated with aim to support individual to learn (Rhodes, Stokes, & Hampton, 2004) even though different skills, approaches are required and different outcome may be generated. However, in a CPD programme, training, coaching, and mentoring could be applied in different stages for effective result on participants. One constraint of training is that is always limited for following up, therefore a training that supported by follow up coaching session one on one with participants would significantly increase training effectiveness (Abbott, Stening, Atkins, & Grant, 2006; Olivero, Bane, & Kopelman, 1997). At the same time, a coach could play a mentor role in finding out what works for the participants, since coaches do not provide direct advice like mentors (Abbott et al., 2006).

In education setting, CPD of instructors is vital in building successful institution and in uplifting the quality of learner's achievement (Rhodes et al., 2004). Therefore, CPD development in education has been "associated with improving classroom performance, engaging with opportunities created by change of initiatives, preparing teachers for specialist roles within the organization, preparing teachers for roles in management and leadership, and enabling the sharing of good practices, through networking arrangements." (Rhodes et al., 2004, p.2).

Data from several articles have identified that, most CPD programmes were focusing on primary and secondary school teachers professional development in area of Pedagogical Knowledge, PCK (Bergh, Ros, & Beijaard, 2015; Murphy & Paor, 2017; Sabah, Fayez, Alshamrani, & Mansour, 2014); Technology Knowledge, TK

(Dalal, Archambault, & Shelton, 2017; Harris & Hofer, 2017; Murphy & Paor, 2017; Toci et al., 2015); personal development (Valdmann, Rannikmae, & Holbrook, 2016; Vries, Grift, & Jansen, 2013) and assessment (Murphy & Paor, 2017). However, the findings from this research could only be generalized within the primary and secondary school levels not in higher education setting.

In higher education, most of the instructors are not necessarily trained as teachers, but a scientist with a diverse workload and pedagogical approaches, facing challenges in integrating an element of technology, pedagogy, and content in their fields (Gast, Schildkamp, & Veen, 2017; Kinchin, 2012). Besides that, instructor's responsibilities and duties are mutually enhancing or competing such as, a subject expertise developer, researcher, communicator, administrator and knowledgeable in technological usage (Skelton, 2005). Due to that, instructors in higher education are exposed to more professional development and obtained a higher academic degree (Gitterman & Germain, 2008; Hixon & Buckenmeyer, 2009).

CPD programmes for instructors in higher education over the past years have focused on developing Pedagogical Knowledge, PK (Azam & Zainurin, 2011; Keevers et al., 2014; King, 2004; Kosnik et al., 2015; Leak, 2017; Roblin & Margalef, 2013) ; technical knowledge in the specialist subject, CK (Roscoe, 2002); personal development skills (Roscoe, 2002) general managerial skills (Roscoe, 2002) and Technology Knowledge, TK (Ansyari, 2015; Cochrane & Narayan, 2012; Hu & McGrath, 2011; Rienties et al., 2013a; Rienties, Brouwer, & Lygo-Baker, 2013b; Wu et al., 2016).

Several studies thus, far have focused on developing instructor's technology knowledge (TK) through professional development, due to instructor's lack of knowledge and skills in integrating technology in teaching and learning (Ansyari, 2015; Rienties et al., 2013b). This is because, instructors teaching in the tertiary level are considered as experts in their subjects area however, do not always have pedagogical or technological experiences (Dysart & Weckerle, 2015).

Besides that, instructors are required to familiarize with the new learning environment with technology tools eventually adds to the complexity faced (Rienties et al., 2013a). Therefore, there is need to develop a specific CPD for instructors to develop their technology competencies along with appropriate pedagogical skill, since instructors play an important role in ensuring that, technology integration could promote effective teaching and learning (Boza & Conde, 2015).

However, past literature reveals that, instructors found out that, the current CPD programmes are designed with ineffective and irrelevant activities because, the CPD topic rarely addressed the instructors needs and concerns (Rodrigues, Marks, & Steel, 2003). This view is also supported by Kenny (2002), that, only a few instructors extended their current knowledge to teach with technology, since most CPD have been designed didactically and out of context delivery. At the same time, the instruction design of CPD activities is likely to be ineffective, if not be designed conscientiously that, will impact instructors' knowledge, skills, and attitudes (Guskey, 2000; Merrill, 2013). Furthermore, some CPDs are lacking conceptual framework guiding underpinning the planning, designing and implementation process of CPD (Rodrigues et al., 2003) that resulted to passive and didactic forms of CPD delivery.

Hence, when designing CPD for instructors using TPACK model, technology integration needs to take consideration of interweaving content and pedagogy. This is because, it is important to adjust content (C) of specific module to be in line with technology (TK) selected to be integrated with appropriate pedagogy (PK). Most CPDs that focus on technology often lack incorporate pedagogy and content. That means that, the CPD either concentrates more on the pedagogical aspect of technologies or emphasize more on technological aside from content and pedagogy, that leads to unstructured way of supporting the instructors (Dysart & Weckerle, 2015; Goh & Kale, 2015)

This shows that, planning an appropriate pedagogy with right educational technologies into instruction is very challenging, since instructors need to embed this practice daily in teaching/learning and not for certain context or settings (Harris & Hofer, 2009; Rienties et al., 2013b). At the same time, there is lack of professional development that focuses on simultaneously developing instructors' TPACK, in higher education (Dysart & Weckerle, 2015). Thus, there is need for an effective CPD that aware the complex interplay between technology, pedagogy, and content to overcome these issues.

In addition to all mentioned above, even though, professional development that focuses on successful technology use in teaching have been provided to the instructors. However, many institutions do not provide the ongoing opportunities for instructors to continue to develop professionally in the area of technological, pedagogical, and content knowledge, while they are in the process of integrating technology in teaching (Dysart & Weckerle, 2015).

In the context of Malaysian higher education, to improve the quality of teaching in the universities, various strategies at the national level have been executed for examples auditing, accrediting, certification for quality programs. At the faculty level, staff development took place in the form of an in-service workshop, courses, training session and conference (Deni et al., 2013). One of the professional development training offered by MOHE is known as Basic Teaching Methodology Course (BTMC), which is focusing on equipping instructors with knowledge and skills in teaching such as current pedagogy, assessment, and educational technology (Azam & Zainurin, 2011).

However, this module has been designed by focusing on teaching and learning as a separate entity from the technology, and no emphasis is given to the content. Deni et al., (2013) added that, even though, by providing comprehensive training, instructors were unable to enhance their pedagogical practices since their believes on the best teaching approach mismatch with what is being exposed in training thus, a minimal impact was found in actual teaching practice. In addition to the issue mentioned above, professional development developers often designed module, without taking into consideration of learning needs of instructors from the different faculties and the module are usually designed in a manner, the developer considers important (Deni et al., 2013).

Moreover, neglecting instructor needs in training means that, the developers failed to tackle different challenges faced by the instructors from different faculties. Therefore, instructors may not equip themselves with relevant and significant knowledge and skill, which would influence the teaching practice (Deni et al., 2013). In Malaysia higher education, professional development is a replica of traditional behaviourist models, based on didactic and transmission-oriented approaches whereby, the training module is mainly spreading teaching skills and knowledge and no room for inquiry or reflection on instructors actual teaching approaches (Deni et al., 2013). Professional development designed based on this approach is usually produced instructors, who may not discover weakness or resistant to change their teaching practises since they assume teaching as skills to be mastered (Deni et al., 2013).

A study conducted among 1,635 instructors in the Malaysia higher education on e-learning training showed that, topic of training instructors interested were on online assessment, e-content development, content management, and less training focused on pedagogy related to e-Learning (Hussin, Embi, & Atan, 2011). Researchers suggested that there was a need for specialized training programmes in e-Learning pedagogy and instructors should be exposed and trained by using new technologies such as Web 2.0, Web 3.0, Web 4.0, and mobile technologies, since the quality of teaching and learning could be enhanced through the integration of technologies (Hussin et al., 2011). It is crucial to ensure that, new technology integration interweaving with content and pedagogy in designing CPD for instructors which is lacking in the Malaysia higher education professional development.

In addition, a study conducted among primary school teachers on provision of training, virtually through an online training system known as electronic Continuous Professional Development (e- CPD) (Razak, Yusop, Halili, & Chukumaram, 2015).The e-CPD system implemented the four levels of mentoring; coaching, self-coaching, fossilization and applications so that, teachers would be able to enhance their daily tasks by applying their learning in real workplace context (Razak et al., 2015). e-CPD is an alternative form of traditional mentoring which was done by face to face and factors, such as internet availability, software programs, time and process of mentoring (consultation) needs to be taken into consideration before implementation.

Furthermore, higher education institutions with collaboration with the Higher Education Leadership Academy or *Akademi Kepimpinan Pendidikan Tinggi (AKEPT*) focuses on developing academic and institutional leaders. At the university levels, the training programs are focusing on problem-based learning, e-learning, case teaching, curriculum design, pedagogy and the modular approach and method of teaching.

(MOHE, n.d.). Meanwhile, AKEPT through its Academic Leadership program (AL), is offering training based on teaching and learning, research, and professional practice (MOHE, n.d.).However, all the training programs mentioned above have been designed for instructors to form an idea of their preferences and strengths in a suitable career pathway of teaching, research, professional practice, and institutional leadership.

In recent years, there has been substantive change in types of CPD, models and practices, that influence the development of pedagogical practices (Sabah et al., 2014). Based on Kennedy (2005), he proposed nine categories of CPD models: (1) training; (2) award-bearing; (3) deficit; (4) Cascade; (5) standard-based; (6) coaching/ mentoring;(7) community of practice; (8) action research; and (9) transformative model. Kennedy also grouped the nine models into three categories, transmission; transitional and transformative based on the professional autonomy the model provides for the instructors.

Training, award-bearing, deficit, and cascade models were categorized under the transmission category, where instructors seem to have less control over their learning. In training model, instructors play passive role as a recipient of specific knowledge (Kelly & McDiarmid, 2002). The award-bearing model relies on the completion of award-bearing programmes of study (Kennedy, 2005) and deficit model are based on perceived deficit in instructor’s performance (Kennedy, 2005) and the cascade models based on individual instructors attending training event and circulate the information’s or share their own successful learning skills to other colleagues (Day, 1999; Kennedy, 2005).

Then, the standard- based, the coaching/ mentoring, and the community of practice models were categorized under the transitional. The standards-based model referred to teaching standards, that instructors should have knowledge about and heavily depends on behaviourist perspective by focusing on the competence of individual teachers, that leads to reward system (Kennedy, 2005). The coaching/mentoring model is a one-to-one relationship between two instructors whereby, a novice instructor gain support, guidance, feedback, and shares resources form experienced instructors in form of mentor-mentee or coach and coaches (Kennedy, 2005; Robbins, 1999). The community of practice model is based on mutual relationship that involves more than two people who engage in a process of collective learning, and not necessarily to be confidentiality like coaching/mentoring (Wenger, 1999).

Finally, the third category, transformative, involves the action research model that offers instructors more professional autonomy. In action research model, instructors themselves as researchers have the freedom to observe, ask critical questions, reflect, and improve their own teaching practices (Kennedy, 2005). Therefore, the transformative model of CPD is the combination of process and condition which has been extracted from other models such as action research (Kennedy, 2005).

According to Hoban (2002) training approach with context-specific approach of a communities of practice model might not generate new forms of knowledge, but he suggested that, CPD intention was not about moving towards teacher-centred or context-specific but there was need to balance between transmission; transitional and transformative focused model. At the same time, Sabah et al., (2014) highlighted the nature of educational system of countries will determine the implementation of the

CPD models either the educational institution or the ministry of education is responsible in organizing the CPD activities for the instructors in a particular context.

There are few studies that proposed certain model for CPD that provides instructors with the ability to meaningfully integrate technology into their teaching practices (Dysart & Weckerle, 2015; Jang & Chen, 2010; Tai, 2015). All proposed model in the studies are focusing on equal participants, role and contribution from both trainer and instructors throughout the CPD session that emphasizes on learning-by-doing approach/ practice-based approach base.

Transformative Model proposed by (Jang & Chen, 2010) and (Tai, 2015) consists of four phases mainly; comprehension, demonstration/modelling, application and reflection. The demonstration or modelling of technological and pedagogical practices by the trainer as part of the CPD, was highlighted in the proposed model since modelling would give instructors the opportunity to experience TPACK before implementing in the real teaching process. However, CPD model proposed by the researchers end at the reflection phase, when instructors were given opportunities to debrief and reflect on their learning. This seems no mechanism for providing ongoing development of TPACK, after the reflection phase. In contrary CPD model proposed by (Dysart & Weckerle, 2015) community of practice whereby instructors could develop their own expertise by sharing, engaging and observing peers in the practice of effectively teaching with technology.

Despite the potential value and benefits that community of practice offer the instructors, there are some challenges such as, insufficient time for instructors to engage in the activities to continue sustain in the community of practice, psychological dimension such as fear of exposure or criticism by peers, and lack of leadership support from department or faculty (Akinyemi & Rembe, 2017). Therefore, there is need for meaningful activities for transferring of knowledge and the retention of expertise that, cultivate instructors TPACK.

Regarding future practices, a few types of research offer practical recommendations for effective design of CDP. Littlejohn (2002) proposed four recommendations for effective CPD involving online course design; encourage focus on outcomes which could be evaluated rather than content, provide a practical introduction to educational theory which places dialogue and feedback central to course design, develop project-based CPD in which academics' plan students' activities before choosing the medium for delivery and offer technology skills on a 'need to know' basis (p.170).

Wu et al., (2016) in their studies claimed that, when instructors did not acquire any pedagogy knowledge and teaching the diverse subject, exposing instructors with knowledge of TPACK would be very challenging. Therefore, they proposed a better solution based on (Schrum, 1999) work; a skill-based course where teachers learn to use different types of ICT tools, a method course where teachers learn to use ICT tools in different subject areas, and an ICT-rich field environment where, teachers could receive on-going guidance (p.26).

Ansyari (2015) also suggested that, when designing CPD, the learning task or activities are needed to be based on curriculum attainments and content. This is important to establish consistency of classroom and professional practices. This view was also supported by Nicholas and Ng (2012) that, instructors would be able to see the connection between professional learning activities that connect their experiences in actual classroom practices. During this stage, instructors are encouraged to take ownership of CPD by identifying individual need over activities and personal desire for CPD (Brown, Edmonds, & Lee, 2002).

Besides that, some researchers found that, most CPD have a mismatch between what the instructors perceived and actual needs (Charalambous & Karagiorgi, 2002; McCarney, 2004). Due to that, it is crucial to identify instructors needs and analysed it before designing the CPD program (Huston & Weaver, 2008). This followed by CPD implementation, delivery, content, and evaluation need to be carefully identified (Hansson, 2006; Karagiorgi & Charalambous, 2006).

Some researchers stressed out the need for CPD to be done collaboratively (Gast, Schildkamp, & Veen, 2017; Rienties et al., 2013b; Sherwood, 1993). Sherwood highlighted the concern of the most instructors, when faced with CPD that supposed to be assisting them on how technology integration takes place in the real classroom practice, turned out to be a simple information sharing on technology usage.

Instructors are looking forward to classroom strategies, that demonstrate effective use of technologies. This could be achieved through collaborative way of critical reflection in teaching practice, readjusting teaching approach towards more students centred, gained new pedagogical knowledge and reflected the teacher identity and their roles (Gast et al., 2017). When the quality and innovative ways of teaching improves, students learning experiences will also improve (Alexander, 2006; Schuck, Aubusson, Kearney, & Burden, 2013; Smyth, 1995).

Moreover, instructors differ greatly in the extent of engaging in CPD activities and prefer learning patterns they adopt (Vermunt & Endedijk, 2011; Vries et al., 2013). Due to this, instructors need a different type of scaffolding and CPD programs to promote self-regulation activities, that direct their learning activities (Endedijk, Vermunt, Verloop, & Brekelmans, 2012). A study by Williams et al. (2000) suggested that, an effective CPD should comprise more comprehensive approach by incorporating skills, knowledge, and relevance to educational goals, priorities and delivery, ready access to the necessary ICT resources, and ongoing supports and advice to encourage progression beyond formalized training (p. 319).

Also, Rienties et al. (2013a) pointed out that, creating an effective design and pedagogical sound CPD as mentioned above, could be very demanding, but understanding the impact of CPD on the instructors is very important to explore. It is important to know, whether instructors gain some pertinent, useful, and appropriate knowledge form CPD to be implemented in their daily practices (Rienties et al., 2013b). This is to make sure that, the CPD program is focused on preparing instructors to provide the best learning experience for students instead of prioritizing CPD to achieve institutional goals (Rienties et al., 2013b). Stes, Maeyer, Gijbels and Petegem (2011) suggested that, this could be achieved by identifying the success rate of instructors who continue and complete the CPD with that dropout.

The evidence presented in this section indicated that, the current CPD in Malaysia higher education setting in based on transmission approach, since instructors have less control over their learning that lead to a minimal impact in actual teaching practice. At the same time, some CPD are based on and transitional approach (model of standard-based) heavily depends on traditional behaviourist perspective by focusing on the competence of individual instructors that lead to reward system. Therefore, in this study, a transformative model of CPD was implemented to develop instructors collaborative TPACK underpinning the social constructivism learning theory and an eclectic instructional design model for CPD content development.

Theoretical Foundation of This Research

Two major theories used in this study were instructional design and learning. Instructional design theories are used to design the learning environment. In addition to that, an eclectic instructional design model would be used to design the module content. The theory of learning determined the overall approach for the learning and instruction.

Instructional Design

Instructional Design (ID) is a systematic process, usually used to develop an educational and training program with the aim of improving learning (Reiser & Dempsey, 2007). ID can be defined as "the systematic and reflective process of translating principles of learning and instructions into plans for instructional materials, activities, information resources, and evaluation" (Smith & Ragan, 2005, p.4). According to Tennyson and Scott (1997) to improve learning, ID is more concerned with elements of process and product of instruction.

According to Merrill (2013), not all learning that occurred need to be goal directed however, instruction is a goal directed activities, so that, a specific skill or knowledge instructors would be acquired from the structured CPD programme. He added that, the aim of instruction either in training or teaching/learning is to promote learning to be more efficient, effective, and engaging with proper intervention. In another word, the instruction is a set of events, that affect learners based on how learning would be facilitated (Gagné, Wager, Golas, & Keller, 2005).

The training instruction may take place between the instructors (trainee) and colleague, trainer and instructors (trainee) through media tools such as, video, audio or even books (Schott & Driscoll, 1997). Merrill (2013) highlighted that, instruction not always trainer- directed activities but instructors as trainee, could select the goal to be achieved as well as selecting appropriate learning strategies to accomplish the goals. Nowadays, instructional design need to take account of integration of knowledge from various discipline, such as, psychology, computer sciences, communication, and social science to form the foundation of instructional design (Tennyson & Scott, 1997). Brown and Green (2016) listed three steps process in designing instruction; trainer needs to analyse the current situation and identifies necessary instructions and steps needed to deliver the instruction; (trainer) needs to develop or produce and implement the ID; finally, the implemented ID needs to be evaluated for future enhancement.

Reigeluth (1983, 1999) highlighted, in any instruction, the purpose of the activity is always to devise optimal means to achieve desired ends and the learning may include cognitive, emotion, social physical and spiritual. This view was supported by Schott and Driscoll (1997) that, the instruction could be a carefully planned effort in providing instructors, the opportunity to acquire knowledge and skills since instruction itself is a technology for a means to end.

Several well-established and respected models for ID provide guidelines that, could be applied to the CPD programme. ID model is a well-structured set of rules that is used in addressing specific needs and goal (Andrews & Goodson, 1995; Schott & Driscoll, 1997; Seel, 1997). ID models are based on ID theory, and it is divided into descriptive and prescriptive (Andrews & Goodson, 1995; Reigeluth, 1999). Based on the descriptive, the model describes the components or activities in the instruction whereas, in the prescriptive, models prescribe necessary activities and predict the effective instructional learning outcomes. For example, Gagné and Briggs (1974) generated the first prescriptive model of instructional design (Seel, Lehmann, Blumschein, & Podolskiy, 2017). Seel et al. (2017) draw attention that, a model should also explain causes and effects not to be purely descriptive.

ADDIE is one of the most popular ID description processes, with an acronym that divides the three steps described above into five actions: analyse, design, develop, implement, and evaluate. ADDIE model is not a specific ID model but an illustration of the conceptual components of many instructional designs (Brown & Green, 2016). Another model is ASSURE developed by (Heinich, Molenda, Russell, & Smaldino, 1999) with following steps: analyse the learners, state standards and objectives, select strategies, technology, media, and materials, utilize technology, media, and materials, requires the learner's participation to evaluate and revise. Besides ADDIE model, Dick and Carey (1996) systems approach model and Kemp ID Model (Morrison, Ross, & Kemp, 2004) are intended to guide the instructional designer through the ADDIE process (Brown & Green, 2016).

In the traditional approach, the trainee is completely focusing on the information to be integrated into the training module, but with the ID, trainer need to consider organizing the information and present it based on the instructors (trainee) learning abilities and styles (Brown & Green, 2016). In the same vein, Gagne (1970) in his book Gagne's Conditions of Learning, stated that the design of lesson is to ensure that the learning outcome is achieved. This shows that most of the traditional ID's are still focusing on the outcome based. Afari, Aldridge, Fraser, and Khine (2013) argue that even though the condition where instruction take place is related to psychological, emotional as well as social and cultural influences among learners and environment, none of Gagne nine level of instruction addressed those needs.

CPD is involve with acquiring and developing a specific set of knowledge and skills (Merrill, 2013) therefore ID needs to shift its paradigm to focusing more in developing instructional strategies that is necessary for effective, efficient, and engaging learning of specific skills and knowledge. To achieve this, and support learning processes, trainers are required to apply ID by taking account into adult learner characteristics such as, experience, motivation, physiological barriers, and memory (Ilie, 2014) to guide them in the tools and system development. This view was supported by DeWitt (2010) that, the trainer need to develop both instructional and learning environment where instructors (trainee) and colleagues together with the trainer will interact with the learning material and creates a social support environment.

Instructional Design Theory: First Principles of Instruction

Reigeluth and Frick (1999) highlighted when selecting an appropriate ID theory; instructors need to identify how the selected ID fits with the available existing ID and the contribution of selected ID to the body of knowledge. In this study, an eclectic theory of instruction would be used to explain the ID process. An eclectic approach allows the instructors to choose a specific element from a variety of sources.

This approach could be viewed as both "taking the best there is to offer and taking things out of context." (Brown & Green, 2017, p.18). Some authors describe eclectic ID, as a tool box with a combination of instructional methods and learning theories (Honebein & Sink, 2012 & Seel et al., 2017). Due to that, electric ID could be used for a general condition which can be easily changed accordingly and used with different instruction and learning approaches (Snelbecker, 1987).

Snelbecker (1999) listed some examples of eclectic theories; Component Display Theory (Merrill, 1983), Elaboration Theory (Reigeluth & Merrill, 1983) Gagne and Briggs Instructional Theory (Perry, Mouton, & Reigeluth, 1983). First Principles of Instruction (Merrill, 2002) also another example of eclectic theory.

The ID theory in this research is based on an eclectic theory known as the First Principles of Instruction developed by, Merill's (2002). Before further elaboration on the theory, Merill highlighted that, the principle is a relation that is always true under appropriate condition regardless of any instructional activities (Merrill, 2002, 2013). This is what Reigeluth (1999) identified as a basic method, but Merill preferred to address it as the first principles of instruction.

Thus, the instructional principle could be implemented by different models and method that promote learning to achieve desired goal (Merrill, 2002, 2013). The first principles of instruction is a prescriptive ID principle with various design theories and models that are incorporated (Merrill, 2002, 2013).

This principle promotes more effective, efficient, or engaging learning in solving real world problems; learning is promoted, when learner prior knowledge is activated as a foundation for new knowledge that would be applied by the learner. Finally learning is promoted when learners could integrate new knowledge in solving a real-world problem (Merrill, 2002).

Therefore, instead of looking at how learners acquire knowledge or skills, this principle creates a learning environment, that is problem-centred involving the learner in a cycle of learning that involves four distinct phases: "activation of prior experience; demonstration of skills; application of skills and integration of these skills into the real-world activities." (Merrill, 2002, p. 2).

Hence, Merrill's First Principles of Instruction (2013) says the first principles of instruction would be referred in designing the CPD instruction. Figure 2.2 provides a conceptual framework relating to the first principles of instruction. This framework represents a four- phase cycle of instruction, activation, demonstration, application, and integration. This circle of instruction illustrated to be the most effective, in solving the real-world task due to the emphasizes on the problem-centred principle. Merrill's First Principles of Instruction is believed to facilitate learning in any instructional situation, but the learning result derived from this principle might be difficult to be identified by assessing learners through recall of information only (Gagné & Merrill, 1990). Therefore, to perform a complex task requires the learner to produce an artefact or solve a problem. To achieve this, a variety of knowledge and skills need to be blended (Gagne & Merrill, 1990).

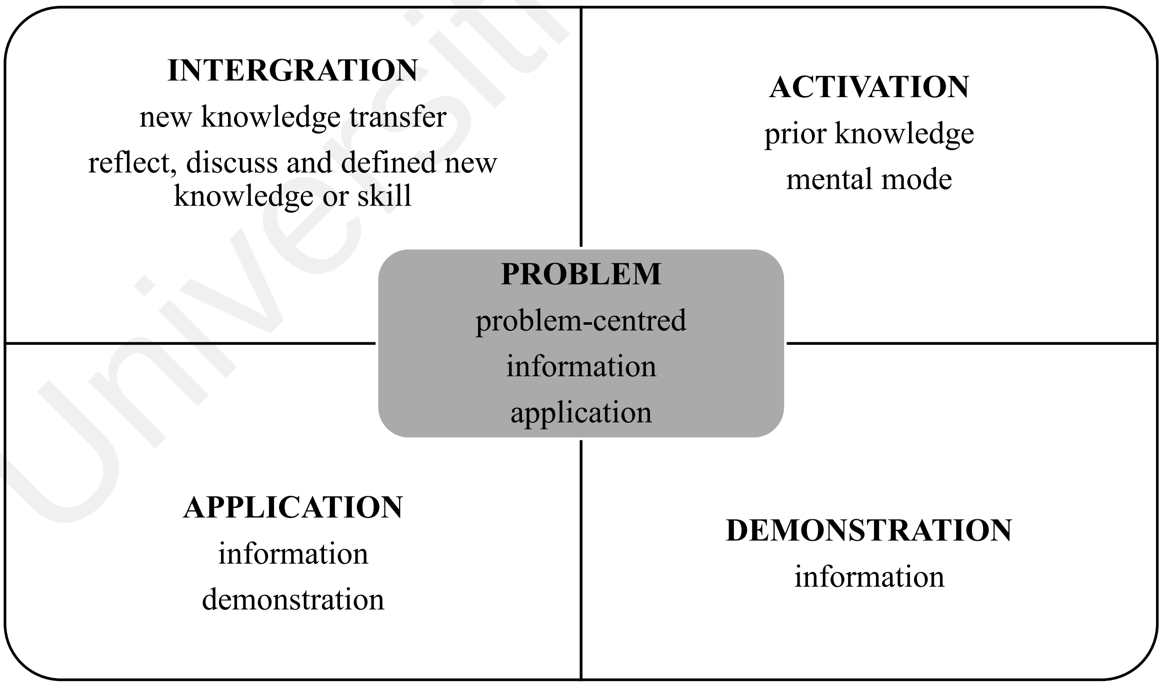

Figure 2.2 First Principles of Instruction synthesized (Merrill, 2013)

Merrill believes complex tasks allow for many levels of performance.

> "At first the learner may only be able to complete simple versions of the task. As the skill increases, the learner can complete more and more complex versions of the task. In solving problems, the early solutions may be unsophisticated with only a portion of the factors involved. As the learner gains skills, the solutions become more elegant, more complex and more factors will be taking into consideration." (Merrill, 2006, p.4).

Instructional strategies could also be scaled so that, the level of the instructional strategy employed correlates with the level of effective and efficient performance on scaled complex tasks. This begins with a demonstration principle, application principle and including problem-centred principle as the third level. Adding the activation principle and integrating principle for effectiveness and enhancement to the instruction (Merrill, 2006, 2013).

Level 0 instructional strategy – Information only. This assumed to be the baseline (level 0) instructional strategy, as most of the instruction are presentation oriented, either the information tells the learner about associations, description definition, process, steps, sequence, condition, and consequence for the instructional activity. Recalling ask the learner to remember that information is very common in the most educational environment, but this instructional strategy is only good for passing a large amount of information and most definitely ineffective for performing a complex task (Merill, 2002, 2006, 2013).

Level 1 Instructional Strategy 1 -- Information-only plus demonstration. This level emphasizes more on "show me" instead of "tell me" and the demonstration is not just about presenting information but about showing learner the method on applying the information to a particular context. The demonstration principle stated that, "learning is promoted when the learner observed a demonstration of the knowledge and skills to be learned" (Merrill, 2016, p.23). For "tell me" instruction, different kind of strategies are used for concepts, procedures, and process while appropriate guidance is provided so that, the learners can relate to the information and its application to the prior knowledge and skill. If multimedia tools are being used in an intention to create interest or as a form of attraction, it will probably end as a distraction. Hence, to prevent cognitive overloaded, appropriate integration of multimedia tools are most likely to facilitate learning (Mayer, 2001; Merrill, 2002, 2006, 2007, 2013).

Level 2 Instructional Strategy -- Information-only plus demonstration plus application. At Level 2, the application is added to the information plus demonstration strategy. In the application or "let me do it" learner use their knowledge or skills to complete specific problem. For kinds of tasks is (concepts), how-to tasks (steps and procedures), what-happens tasks (the process of predicting the consequence). In this stage, instructor (trainee) will receive information and trainer will provide consistent demonstration of knowledge and skills to assist instructor (trainee) to form mental mode of the skills to be learned. Merrill (2013) pointed out that, "using the skills to do new problem requires leaners to check the completeness and adequacy of their mental models for solving the problem." (p, 24-25). Therefore, learners are able to adjust their mental modes accordingly, when mistakes happen in learning after been given corrective feedback. Merrill concern is finding new problem for application, because, too much challenging or less challenging would influence the mental mode condition.

The application principle stated, “learning is promoted when the learner applies their newly acquired knowledge and skills.” (Merrill, 2013, p.25). Learning will only take place, when the application is consistent with the type of skills to be learned, inconsistent application with the intended goal of instruction would only lead to ineffectiveness, therefore, providing coaching and feedback after that was considered not useful. This means that, since there are different kind of skills to be learned, each skill needs its specific content elements and distinctive presentation strategies.

Learner guidance is given through scaffolding to provide intrinsic and corrective feedback enabling the learner to understand the result of their actions and have an idea on how they should have acted in a better way. Coaching is very effective at the early stage of the application, but as the learner gradually gain more experience in solving the problem, this scaffolding would be slowly withdrawn until the learners can perform without any additional assistance (Merrill, 2002, 2006, 2007, 2013).

Level 3 Instructional Strategy -- Problem-centred with demonstration and application. At level 3, problem- centred strategy has been added to the demonstration and application. This “let me do the whole task” is where learner would be able to solve the problem after being shown (demonstration) and actively involved in solving the problem. Next is showing the learner how this problem could be solved (application) until the learners could complete the tasks on their own.

A problem-centred approach differs from a problem-based learning or case-based learning because, it is more structured. In the beginning stage, a learner only exposed to a simple problem task and then moving forward to the more complex problem-solving task. The problem-centred principle states “learning is promoted when learner acquires knowledge and skills in the context of real-world problems or tasks.” (Merrill, 2013, p.26).

Besides that, before the new knowledge is demonstrated or integrated into the learner's world, learner's prior knowledge must be activated, to build new knowledge and skills (Merrill, 2002, 2006, 2007, 2013).

Activation as an enhancement of an instructional strategy. Very often, instructions moved immediately into learning new material with an insufficient foundation for the learners. When the learners already have prior knowledge, then the instructors need to activate a relevant information, but if it was otherwise, learning a new skill should provide a real-world experience as a foundation for new knowledge. Merrill (2013) pointed out that, common mistakes instructors tend to do by giving information-oriented pre-test on content in intention to activate learner prior knowledge. Learners found this method to be very irritating, since they are unable to remember therefore Andre (1997) suggested instructors could do simple recall to prior knowledge by adding activation to an information-only strategy.

This activation to relevant experience is illustrated in Gagne's Nine Events of Instruction to gain learner attention and recall prior knowledge (Gagne,1970). Dick and Carey (1985) by identifying the learners' entry behaviours before moving to next phase.

Activation is more than helping the learner to recall the prior experience. Through, activation, a mental model can be changed, so that, the learners can incorporate their new knowledge into the existing knowledge. However, often, the learner is not efficient in structuring new learnt knowledge, so it left for the learner to organize that knowledge. The activation principle states "learning is promoted when learner activates a mental mode of their prior knowledge and skills as a foundation for new skills." (Merrill, 2013, p.28).

Integration. In the "watch me" phase learners integrate the new knowledge and skill in their real lives, instead of merely acquiring the skills. Effective instruction creates an opportunity for learners to reflect, discuss and defence on their new knowledge or skills. In Gagne (1970), integration of knowledge into learner's personal experience is to ensure that, transfer of learning has taken place. Merrill (2013) identified that, when learners were able to monitor their progress, learning becomes the most motivating aspect. Therefore, learners are eager to show their peers, colleagues, or anyone their newly learned skills. So, this is where peers-collaboration and peer-critiques would take shape when learner share their works with others through reflection and discussion. Then later peers, colleagues or anyone learners relate can criticise the work so that, learners can defend their newly learned skills.

Based on Nelson (1999) collaborative problem-solving theory, integration activities are learning gains, personal experiences, group, and personal reflection on learning. According to Jonassen (1999) in a constructivist learning environment, integration is done through coaching since it is create opportunity for monitoring and analysing learner's achievement. The integration principle states that "learning is promoted when learners reflect, discuss and defend their newly acquired knowledge and skill." (Merrill, 2013).

Social Constructivist Theory

In this study, the main theory used to describe the learning approaches, that focused on communication and collaboration is a social constructivist theory. The reason for using this theory is because, it highlights the role of social interaction and cultural when students collaborate and share information in an authentic context (Vygotsky, 1978). Social constructivism referring to the thought that learners were able to construct their knowledge, through the process of negotiating meanings with peers (So & Brush, 2008).

Some studies reported the usage of the social constructivist learning theory as a theoretical framework, emphasizing the transformation from a teacher-centred methodology to a student-centred methodology (Amhag & Jakobsson, 2009; Wolff, 2010). The social constructivism proposed by Lev Vygotsky continues to enormously shape the field of education (Lee, Said, & Tan, 2016).

Learners do not learn in isolation and learning is not an individual process (Lemke, 2001; Rogoff, 1998; Vygotsky, 1978). Learning is a social process (Springer, Stanne, & Donovan, 1999), with two-level of interaction; instructors or peers on the social level and the individual level (Palmer, 2005; Vygotsky, 1978).

The collaborative is substantial to any online learning environment especially in technology-intense era (Kear, 2011) where students are actively constructing knowledge, in a community of practice (Laat & Lally, 2003; Lave & Wenger, 1991; Vygotsky, 1978). Knowledge construction is achieved through discussion and argumentation by deep learning and conceptual changes (Bereiter, 2002; Bruffee, 1993).

This theory emphasized that; the higher mental functions such as attention, sensation, perception, and memory are found in social interaction. Learning occurs while using mediator tools and signs such as, spoken and written words so that, the learners can advance within the Zone of Proximal Development, ZPD (Lemke, 2001; Wertsch, 1998) where learner's cognitive development is extremely dependent on social interaction and collaboration with more capable peers (So & Brush, 2008).

According to Vygotsky (1978), human uses tools, that are developed from a culture such as, speech and writing to mediate in a social environment. Without signs and symbol, the cognitive function from the student's social interactions in cultural context may be obstructed (Brunings, Schraw, & Ronning, 1990). In social interaction, cultural tools are being internalized for higher thinking skills (Brunings et al., 1995, Vygotsky, 1978)

The community of learners developed some personal meaning as they use the discussion forum, wiki, blog, text messaging for being engaged in social practices (Bruner, 1966; Huizen, Oers, & Wubbels, 2005; Kafai & Resnick, 1996).

The instructional task design in this study will focus on the social and cultural factors in an online learning environment. Instruction should allow for modelling and instructional scaffolding.

Instructional Scaffolding

In education, instructional scaffolding was proposed in describing how parents and teachers provide dynamic supports for the learners (toddler) in the process of learning to structure pyramids with wooden block (Wood, Bruner, & Ross, 1976). Scaffolding is a process that enables novice learner to tackle complex and difficult problems which could not be acquired without assistance (Belland, 2016; Bull et al., 1999; Pea, 2004).

Usually, scaffolding is provided to the learners by more capable experts, instructors, or even peers to validate what they were learning (DeWitt et al., 2014; Smet, Keer, & Valcke, 2008) through learning agents, visual aids, and reference sources (Clark, 2010). According to Wood et al. (1976) scaffolding metaphor has been central in constructivist approaches. Learners as active agents construct their knowledge by reflecting on their thoughts, through social and material resources, while the instructors provide modelling and scaffolding.

Besides that, Schunk (2000) highlighted that, the instructors provide selective assistance by cognitive mediators such as sign, symbol, and language. Instructors at the same time incorporate guided questions, drawing attention to important aspect, providing guidance, emphasize on a specific technique to be used to reduce the Zone of Proximal Development, ZPD (Jonassen, Lee, Yang, & Laffey, 2005; Schunk, 2000; Vygotsky, 1978).

In ZPD, learners have a particular knowledge and skills which they are ready to learn, but they do not have enough prior knowledge to acquire the information without assistance (Bull et al., 1999). In this sense, a temporary intellectual scaffolds task support is provided, as the learners engaging themselves with the problem (Arnseth & Krange, 2016; Belland, 2014; Collins, Brown, & Newman, 1989). Due to that, misconceptions may occur as a result of the students' lack of adequate prior knowledge (Hannafin et al., 2009; Kirschner, Sweller, & Clark, 2006). Recently, the focus on the individual has been extended to how collaborative activities could be scaffolded (Tabak, 2004).

In this study, a collaborative learning environment would be designed, where the learners interact with the problems or tasks assigned. The learners would also be interacting with peers via CL tools such as, forum discussion, wikis, blog, and text messaging. To support learning, it required some technique, which includes offering explanations in understanding new information, resolving questions which come up during a learning process, use of extensive examples and contributed ideas which help learners to see the concepts and processes which are important to this study.

Modeling Instruction

Based on the social learning theory by Bandura (1977, 1986) which highlighted that, through the process of observation, imitation, and modelling, a learner could acquire knowledge from each other. Spector (2016) draws attention that, a modelling is most likely to be grounded from behaviourism, since it emphasizes on watching or observing someone demonstrating certain skills or knowledge which learners would learn from. This statement is supported by Seel et al. (2017) that, through modelling process, learners would adapt in the conceptual model of the content they intend to learn by observing the behaviour of a social actor and the mental processes involved in learning (Trif, 2015).

The learners would experience the learning process, based on actual problem situation, and as they gained more experienced and self-assured, they would involve into collaborative phase with peers, where discussion becomes paramount (Ertmer & Newby, 2013). Thus, the learner's experience would enable them to articulate their understandings and solve tasks independently from novices to the higher developmental stage (Ertmer & Newby, 2013).

Seel et al. (2017) mentioned that when instructors apply modelling process, it should lead learners towards the subject knowledge construction through, the procedure of analysis, experimentation, and simulation rather just add-on activities. Instructors could do this at the beginning of the activities or when learners are facing any difficulties (Tennyson, 2010). In addition to that, learners need to learn, practice until they master the basic concepts consciously. Therefore, instructors can divide the major tasks into part-task approach or several chunks (Spector, 2016).

Vygotsky (1974) also believed that, appropriate assistance and modelling would promote learners for a better understanding of learning concepts because, there is a huge difference when learners achieved and acquired through their interactions, compare with assistance provided by a knowledgeable person. This gap is known as ZPD when what learners understand, and able to perform by themselves, compare to when they receive assistance from an expert (Vygotsky,1978).

In summary, learners can advance within the ZPD through cognitive development by collaborating with peers. Hence, appropriate guidance from instructors or peers would challenge the learner towards higher thinking skills and lead to next cognitive development stage.

A Taxonomy of Learning

According to Bruner (1960) learning is an act of developing new information that would later be transformed and evaluated to identify, if it fits with the related tasks. Therefore, identifying the learning types would help instructors to determine and analyse the learning goals or outcome (Smith & Ragan, 2005). This process would provide an opportunity in changing pedagogical approach and assessing students' learning goal (Smith & Ragan, 2005). Learning task differs from one another, depending on the amount of cognitive effort required, appropriate learning condition and ways of assessing learner's achievement (Smith & Ragan, 2005).

In everyday lives, learning becomes prominent either through formal or informal by developing declarative (knowledge about what), procedural (knowledge about how), strategic or tacit (knowledge about which, when, and why) (Gagné, 1985; Kraiger, Ford, & Salas, 1993). All of the knowledge mentioned above is impossible to be observed on the learners since, some of the learners imply a different kind of knowledge. (e.g., composing letter with writing device and reading textbooks require different skills) (Driscoll, 2005).

Thus, to facilitate learning, researchers had distinguished the variety of human capabilities required in a different learning condition. In addition to that, "learning is a change in human disposition or capability that persists for a long time, and it is not the result of growth (Gagne, 1977, p.3). This evidence by particular performances is known as learning outcome (Gredler, 2009).

Bloom et al. (1956) developed three major domains which comprise human learned capabilities that consists of cognitive, affective, and psychomotor. Bloom later extended the taxonomy of level with a cognitive domain that comprises of knowledge, comprehension, application, analysis, synthesis, and evaluation. Also, Krathwohl, Bloom and Masia (1964) developed a taxonomy of outcome within the affective domain which are receiving, responding, valuing, organization, and characterization by value. Afterward, Simpson (1966) designed a taxonomy of psychomotor outcome. Despite this development, Gagne (1972) was the first to propose an integrated taxonomy of learning outcome that comprises of domain cognitive, affective, and psychomotor.

Moreover, Gagne (1972) highlighted the need for learning domains; to distinguish content area with instructional method relating to the instructional procedures of one subject to the other and to the assessment of learning outcome. Since there is no single way of measuring what was learned (Bloom,1956; Krathwohl et al.,1964).

Gagne (1972) divided learning outcome into five major domains: verbal information, intellectual skills, cognitive strategies, attitude, and motor skills. This aligned with Gagne definition of "learning as a process of acquiring modification in existing knowledge, skill, habits, or action tendencies" (Gagne, 1971, p.1), based on these domains, most of the learning objectives could be developed.

Furthermore, he stressed out that, different domains required a different type of mental processing and activities to achieve the outcomes. Hence, each type of instructional method is differing in all domains (Smith & Ragan, 2005). Five categories of learning domains are further discussed in detail.

Verbal information. This domain is also known as a declarative knowledge, in "knowing that" a learner can "declare "or "state" what was learned in the material, such as facts, concepts, principles, and procedures (Driscoll, 2005; Gagné, 1984). Usually a verbal information is referring to the vast bodies of knowledge, that the learners acquired through a formal education, books, media tool or other means (Gagné, 1985; Gagne & Driscoll, 1988), learners are not necessarily required to apply the knowledge, but are expected to recall, recognize, or state what was learned by using their own words (Gagné, Wager, Golas, & Keller, 2005; Smith & Ragan, 2005).

This is similar to Bloom (1956) taxonomy of knowledge and comprehension as well as Ausubel (1963) information-processing and schema theories that, the learners organize their knowledge in theme. Driscoll (2005) indicated that, information learned would also assist the learners in problem-solving even though, the problem solving is not a verbal information, but the success is based on the learner's ability to apply a learned knowledge to the problem. According to Merrill (2013) verbal information is also known as information-about or part-of component skills, which might play a supportive role in learning a course.

Instructors can confirm, if the learners have mastered the verbal information when one reinstates the words or sequence of words in the form of speech/writing in the same order as presented, or paraphrase the ideas in a meaningful schema (Gagné, 1984).

Intellectual skills. This domain is also known as procedural knowledge of "knowing how" a learner interacts with a symbol like classifying things, applying rules and principles, and solving problems (Gagne et al.,2005; Gagne, 1985 & Smith & Ragan, 2005). Gagne emphasizes the need to distinguish intellectual skills with a verbal information. When the learners can recall and reinstate a definition verbally, is opposite to, when the learners can demonstrate the use of definition. Learning intellectual skills require learners to have a prior learning of prerequisite skill which was obviously irrelevant for learning verbal information (Gagne, 1971).

Gagne (1984) highlighted that, before learning complex skills, there were set of component skills that a learner must master such as discrimination, concrete concepts, defined concepts, rules, and higher order rules. According to the learning hierarchies, each skill is immediate pre-requisite. For example, a learner must be able to master discrimination component, by distinguishing the object before being able to move to a concrete concept by identifying the characteristic of the object (Gagne, 1977).

Although Gagne's intellectual skills could be incorporated into the four level of Bloom taxonomy of where the application is demonstrated in the concept and rule level, analysis, synthesis, and evaluation to some certain extent are represented in the higher order rules (Driscoll, 2005). Hence, when the learners could apply a sequence of concepts representing condition and action to a general situation, it indicates that, they have acquired an intellectual skill (Gagne, 1984). Based on Merrill (2013), intellectual skills also know as kind-of component skills, that is consist of classes, categories of objects, symbol, or events to be able to solve complex problems.

Cognitive strategies. This domain is known as learning strategies of "how to learn," "how to remember and "how to carry out reflection and analytical thinking that leads to more learning" (Gagne, 1977). Cognitive strategies are also known as "methemagenic behaviour" by Rothkopf (1971) and "self-management behaviour by Skinner (1968). The learner uses cognitive strategies to take responsibilities towards their learning, thinking, acting, and feeling (Gagne, 1985; Smith & Ragan, 2005) which is also emphasized by Bruner.

Cognitive strategies assist the learner to remember what was learned by constructing an image to words, underlines key sentences and the use of self-questioning to check own understanding (Gredler, 2009). The learners arrived at cognitive strategies through their own experiences (Driscoll, 2005; Gagne et al.,2005) or explicit taught strategies, that have been proven to be effective on the other learner (Driscoll, 2005). Moreover, cognitive strategies enable the learners to manage their thinking, by identifying the appropriate time the intellectual skills and verbal information could be integrated into the learning process (Gagne, 1984). Merrill (2013) identifies cognitive strategies as how-to component skills which are the primary goals of instruction. How-to content specific order of activities that learners need to achieve some goals or generate some consequences.

Attitude. When verbal information, intellectual skills, and cognitive strategies are part of a cognitive domain, attitude is known to be in an affective domain (Krathwohl et al., 1964; Gagne, 1985) which are not learned by practice (Gagne, 19871). Attitude is the reason that influences a learner's behaviour, but attitude does not directly determine performance like verbal information, intellectual skills, and cognitive strategies (Gredler, 2009).

Gagne et al. (2005) identified the learner's capabilities as an attitude, this was because a learner had their preferences for different kind of activities to participate, preferring certain peers to work with, indicate interest in the certain event when others were not. Gagne’s definition of attitude could be incorporated with the two level of Krathwohl taxonomy of affective; receiving and responding. Gagne (1971) suggested that, the most effective ways of changing the learner’s attitude are through human model/modelling as also described by Bandura (1969).

Finally, the way instruction is being conducted influences the learner’s attitude towards the material learned. Instruction with affective objective may positively influenced the learners towards the content and learning process (Smith & Ragan, 2005).

Motor skills. Motor skills are corresponding to the psychomotor domain whereby to certain extend all performances required an action, that involves a coordination of muscular movement (Gagne & Driscoll, 1988; Gagne, 1985). Motor skills are one of the most obvious human capabilities, as some of the motor skills are acquired from a formal setting like school which will later lead to future learning (Gagne et al., 2005). Driscoll (2005) highlighted that, motor skills required a combination of various cognitive strategies and intellectual skills depending on the learning content. Learning motor skills takes practice, therefore with repetition of the exact movements along with feedback from the instructor would ensure a quality of performance, smoothness of action, precision, and timing.

Conceptual Framework for the Study

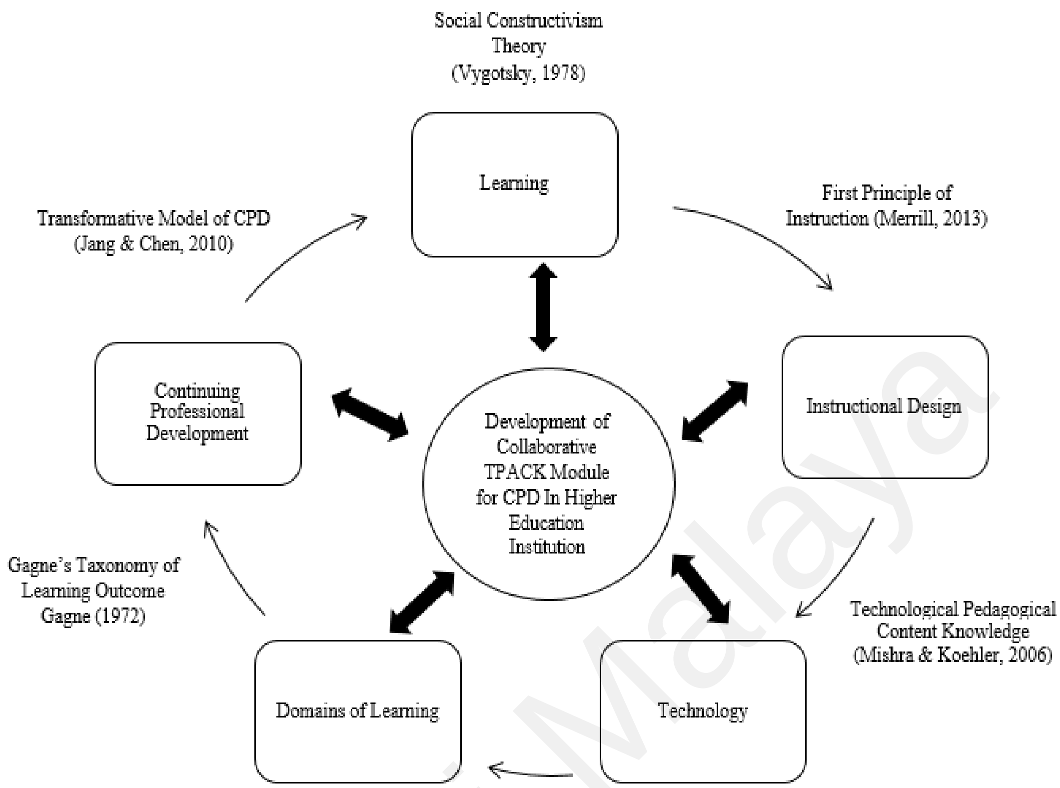

Figure 2.3 Conceptual Framework

The theories that underpin this study are based on two major theories which are; the instructional design and learning. The Collaborative TPACK module synthesized from the main theory used to describe the learning approaches that is focused on communication and collaboration is a Social Constructivism Theory (Vygotsky, 1978) and eclectic Instructional design model, First Principles of Instruction (Merrill, 2013) are used to design the learning environment. Besides that, Technological Pedagogical Content Knowledge, TPACK model (Mishra & Koehler, 2006), Taxonomy of Learning Outcome (Gagne,1972) are also referred to a guide to develop the module content and Transformative Model of CPD (Jang & Chen, 2010) is adopted in the implementation phase of the module that emphasizes on learning-by-doing approach/ practice-based approach base.

Conclusion

The literature review provides a synthesis of the need of CPD in the area of collaborative TPACK for instructors in higher education. The literature on CSCL has documented the use of various computer applications, to promote collaborative learning and benefits of CSCL in teaching and learning environment. This study further explores its potential in an area that has not been fully utilised, which is the integration of CL tools to teach different taxonomy of learning. The learning theory, TPACK framework, First Principles of Instruction and CPD Transformative Models are important to serve as a backbone for the development of the module by using the same method and principles. Next chapter describes, the methodology of the study by providing a comprehensive documentation of sample selection, data collection methods, instruments used and the data analysis procedures.

CHAPTER 3

METHODOLOGY

In this study, Design and Developmental Research (DDR) approach was used for designing, developing and evaluating instructional programs (Richey & Klein, 2007). DDR approach was conducted through three phases; need analysis design and development as well as, evaluation for the development of Collaborative TPACK module for CPD in higher education. This chapter provides a comprehensive documentation of objectives and methodology of each phase. The sample selection, data collection methods and procedures, instruments and the data analysis from phases one till three were explained.

Design and Development Research (DDR)

DDR is also known as developmental or development research, where data is systematically gathered from actual practice (Richey, Klein, & Nelson, 2004; Seels & Richey, 1994; van den Akker, 1999). In its simplest way, DDR could be either "study of the process and impact of specific design and development efforts, the study of the design and development process as a whole or particular process components." (Richey & Klein, 2007, p.7).

There are two types of DDR. Type 1 DDR which consists of product and tool development and Type 2 DDR is the model development (Richey & Klein, 2007). Product and tool development are the comprehensive design and development project for instructional/ non-instructional products and programmes to the study of specific product/tool design and development projects (Richey & Klein, 2007). This means that, DDR type 1 focuses on the process of product development such as, a module, or a training programme (Alias, Siraj, Rahman & DeWitt, 2013). There are three stages involved in product and tool development; need analysis, design, and development as well as, evaluation as illustrated in Figure 3.1.

Product and tool development outcome are the experience learned from developing specific products and analyzing the conditions that facilitate the usage (Richey & Klein, 2007). DDR type 2 which is the model development is focusing on development of model component, validation or use (Richey & Klein, 2007). Model development involved internal and external validation of model components and its impact. Through model development, new design and development procedures and conditions, which facilitate the usage would be identified (Richey & Klein, 2007).

In this study, Type 1 DDR which involves the development of a Collaborative TPACK module through the process of need analysis, design and development, as well as, evaluation would be carried out since type 1 DDR is suitable for module development or training programme. All the three phases employed different methodologies for data collections. Since design and development phases depends on the need analysis outcome, hence, the findings were unique to the context of this study (Alias et al., 2013). The outcome of the evaluation stage would be used to determine the effectiveness of the module.

In recent years, there has been an increasing amount of research which utilised the DDR approach in context of Malaysia. From these studies, different type of data collections were employed in all three phases. In phase 1, need analysis, data collection method such as interviews, survey and content analysis were employed to identify the development need of the online web application based on Arabic vocabulary using an educational game prototype (Sharir, Alis, Ismail & Osman, 2012) and the same data collection method was used for development of collaborative mobile learning, for the Form Two Science in need analysis phase (DeWitt, 2010).

In phase 2, design and development, two-round modified Delphi and interview was employed in development of pedagogical module based on Felder-Silverman's learning style for secondary school Physics (Alias, 2010). Written records and interviews were used as data collection method for development of collaborative mobile learning for the Form Two Science in need analysis phase (DeWitt, 2010).

Finally, in phase 3 evaluation, peer review, expert review, cooperative evaluation, and experimental design were used as data collection method for development of Web-Based Learning Module on Computer Networking for secondary school (Hashim, 2012) and development of teaching module for Chinese English as Foreign Language (EFL) learner (Ma Ping, 2012) Besides that, usability evaluation to test the effectiveness of the module, also, one of the data collection method was employed in development of pedagogical module based on Felder-Silverman's learning style for secondary school Physics (Alias, 2010). Interview with experts and field observation were used in development of a digital story pedagogical module, to facilitate reading among indigenous primary school students (Thanabalan, 2011).Hence, there are different methodologies, that could be employed for data collection during each phase. This data collection can be either qualitative or quantitative depending on the context of the study.

In this study, DDR was selected because it was known for a systematic approach as well as, flexible methodology that could be used to improved educational practices, through need analysis; design and development; implementation and evaluation among researcher and industry practitioners through collaboration (Wang

& Hannafin, 2005). In addition, DDR was also reliable for creating practical, context-specific knowledge and solutions (Richey & Klein, 2005).

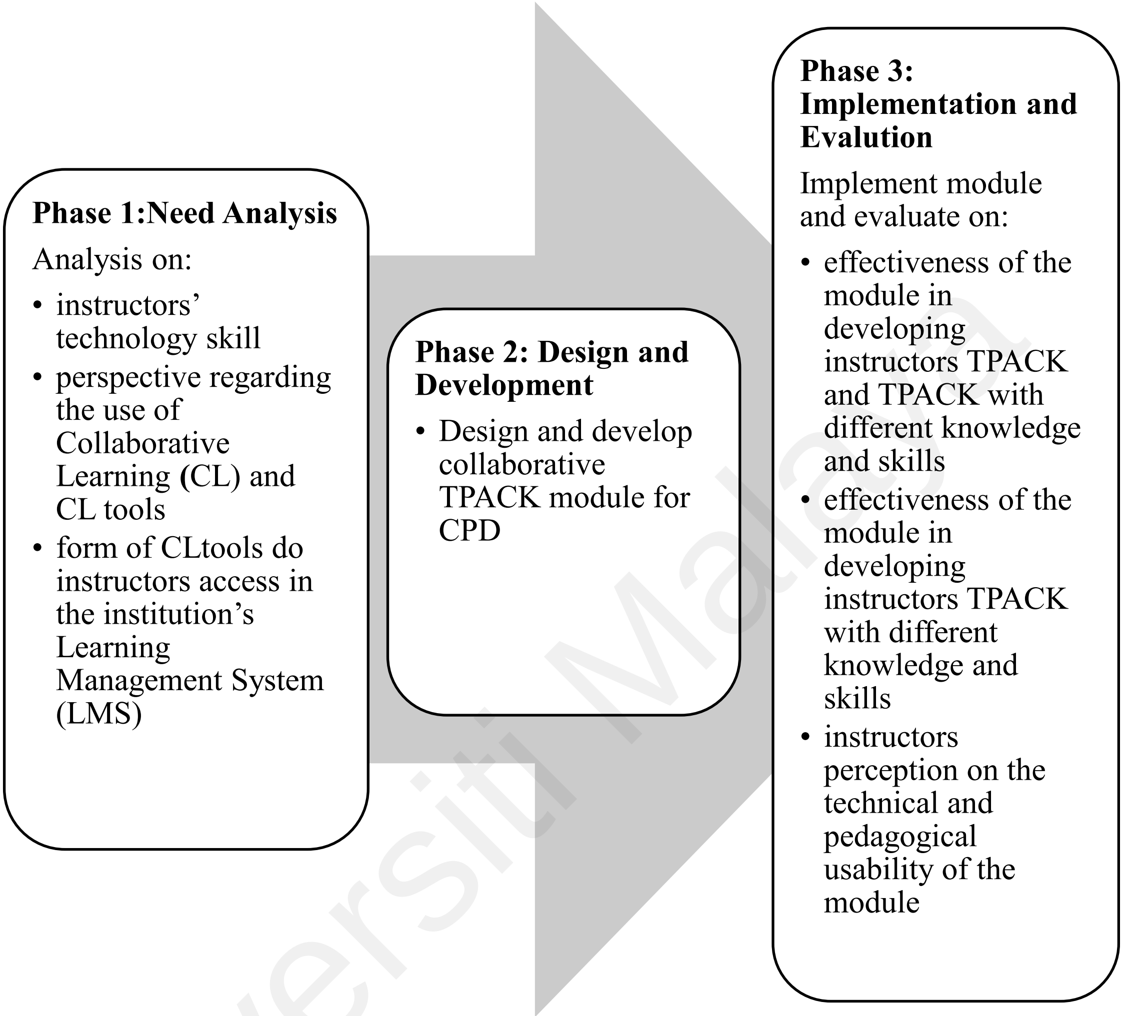

Figure 3.1 Phases of Design and Developmental Research for Collaborative TPACK module for CPD

Phase 1: Need Analysis

The main objective of this phase was to discover the need for Collaborative TPACK module for instructors. This phase set as an initial stage for developmental research, where information on the context and environment of study was being gathered as illustrated in Figure 3.2. Need analysis was the initial inquiry of information about the situation (Rossett, 1995). The purposes of need analysis was to determine, if learning was the solution for identified problem, determine the instructional system goal, as well as, identifying the current capability of the learner and desired outcome and its disparity. Moreover, based on the output from need analysis, it would be used as recommendations for solving the problem (Rossett, 1995).

Based on the research questions, the analysis was to discover instructors' technology skill regarding the use of the CL tools in the institution's Learning Management System (LMS); instructors' current perspective regarding the use of collaborative learning **(**CL) and CL tools in the institution's Learning Management System (LMS); and form of tools that instructors' access in the institution's Learning Management System (LMS).

Sample of the study. Participants in the need analysis phase involved three categories that were selected through purposive sampling. Since purposive sampling allows researcher to intentionally select participants, who possessed appropriate knowledge and experience with the central phenomenon that was being explored through participation of small number of samples, to provide in-depth information about research that was being investigated (Creswell & Clark, 2011). The first category of the participants consisted of seven instructors from different field of studies as shown in Table 3.1. The seven instructors were selected during the pilot TPACK course to determine their technology skills and perspective regarding the use of collaborative learning and CL tools in the LMS. By identifying instructor's technology skills and their perspectives regarding collaborative learning and CL tools would ultimately provide an in-depth insight for Collaborative TPACK module development. All seven instructors must possess a doctorate degree in a related field, with at least minimum of one-year experience in teaching and learning

Table 3.1
Summary of Instructors' Background

Instructor	Disciplines	Field	Years of Experience in Teaching and Learning
Dr. A	Sciences	Medicine	5
Dr. B	Humanities	Computer System and Technology	10
Dr.C	Humanities	English Language	5
Dr.D	Sciences	Chemistry	2
Dr.E	Humanities	Islamic History and Civilization	5
Dr.F	Humanities	Economics	2
Dr.G	Sciences	Orthopedic Surgery	5

Second category of participants were the Head of Training Units and the third category of participant was a trainer who involved in delivering the current TPACK course for the instructors as shown in Table 3.2. The selection of Head of Training Units and a trainer were based on at least minimum of 5 years experiences in conducting training for academic staff in the higher education setting. They must possess a doctoral degree in a related field with at least minimum of 5 years' experience in teaching and learning. The Head of Training Units and the trainer's opinion and suggestion were important to identify the need for the Collaborative TPACK module development. All the participants in the need analysis had published academic books or journal article in International Scientific Indexing (ISI) and SCOPUS.

Table 3.2
Summary of Head of Training Unit and a TPACK trainer

Participants	**Training Area**	**Years of Experience in Training**
Head of Training Unit	LEADWELL	5
Head of Training Unit	e-LEARNING	5
Trainer	TPACK and Pedagogical Instructional Strategy	6

The Instrument. Data collection was carried out using the qualitative method using interview and document analysis. For interview protocol, the instrument was designed by translating the need analysis objective into questions that, adequately reflecting on the variables that were measured such as technology skills, collaborative learning and CL tools. As Tuckman (1972) stated as an initial step in constructing interview questions was through a specific variable.

In order to gather relevant information on context and environment of this study, semi- structured interview and document analysis were conducted. Semi structured interview was designed to collect information about numerous issues, opinion and viewpoint of the interviewees (Naimie, Leng, DeWitt, Akma, & Mohajer, 2013). By implementing semi-structured interview, researcher were expecting certain information from the participant, through a guided list of questions or issues to be explored (Merriam, 2009).

In addition, semi structured interview was used in this stage because the questions were flexibly worded, that allowed researcher to respond to the situation or to the emerging view and new idea on the topic of discussion from the participant. For example, some other questions might arise and require clarification during the interview session besides the predetermined questions. Hence, semi structured interview provides more flexibility in gaining a deep understanding of the topic of discussion by expanding expert's responses, since the structure of the questions could be open ended, close ended and other questions might be created during the session (Naimie et al., 2013).

In this study, three sets of interview questions were used in gathering information from seven instructors *(see Appendix A)*, two Head of Training Units (*see Appendix B)* and a trainer *(see Appendix C).* All the interviewees were provided with consent form before the interview session *(see Appendix D).* All the interview questions were designed in capturing instructors' technology skill, regarding the use of the CL tools, instructors' perspective regarding the use of collaborative learning and CL tools and form of tools that instructors' access in institutional LMS.

Besides that, the interview questions were framed according to TPACK framework (Mishra & Koehler, 2006) and e-Learning Guidelines for Malaysian Higher Education Institutions when referred to digital pedagogy (MOHE, 2014). The input of the interviews was transcribed and analyzed thematically by using qualitative data analysis software (MAXQDA).

Document analysis was used to gain insight into instructional activity that took place. Examining trend and pattern, that emerged from instructional documents such as, previous TPACK course evaluation and instructor's LMS activity. This information was used to evaluate the previous training effectiveness and its downfall, thus it provided a preliminary study for constructing interview questions. Document review could be used as a supplementary technique for triangulation purpose (Tobi, 2016).

Reliability and validity. To confirm the content validity of the need analysis interview, the interview protocols were examined by two experts in the area of educational technology who had more than five years of teaching experience *(see Appendix D).* In order to ensuring trustworthiness in a qualitative research the transcribe interview were validated through member checking, whereby, the participants of the need analysis were asked to read the transcription in which they have participated to strengthen the study's credibility (Lincoln & Guba, 1985; Merriam, 2009).

On the other hand, to ensure transferability in qualitative study, researcher provided thick description in which the conclusions drawn about instructor's technology skills were transferable to other settings and people (Lincoln & Guba, 1985). Besides that, to ensure the need analysis' findings were rich, robust, and well developed, triangulation technique using multiple data sources from the instructors, trainer, Head of Training Units and data collection method such as interview and survey data and LMS activities data were used to create greater understanding (Merriam, 2009).

Procedure and data analysis. First, participants of the interview were determined based on what they could contribute to the study. In need analysis' phase, seven instructors, two Head of Training Units and a trainer were selected based on voluntary participation. Secondly, a week before the interview, a set of semi- structred questions were presented to the participants so that, they would have enough time to reflect upon the questions before the day of face to- face interview. To get the interview started, participants demographic information were collected followed by descriptive information about topic of discussion. Finally, all the answers were recorded and noted down. After the interview process end, all interview scripts were transcribed by using MAXQDA for coding purposes.

Next researcher conducted document analysis by reviewing existing documents such as previous TPACK course evaluation and instructor's LMS activity, which served as supplementary technique for triangulating the data collection process. Document review technique allowed the researcher to obtain written words and language of the participants that were involved at any time as unobtrusive information (Creswell, 2014).

Foremost, document review was conducted according to the university research ethical procedures at the same time permission from Head of Training Units were obtained *(see Appendix E).* Next, once documents have been located, their authenticity were assessed. According to Merriam (2009) by determining authenticity and accuracy of the documents, researcher was able to identify the origins, the reason for being written, its author and context. Finally, documents were coded then sorted into categories using MAXQDA.

The first step in the analysis procedure was to code the verbal transcripts by using qualitative data analysis software MAXQDA. Coding means dividing the data into meaningful units or segments. Initially, open coding was used for categorization, along with open coding, axial coding was used to make connections between various data categories or to subdivide a category. For example, open coding "tools for teaching" and "basic learner". These code later were linked through an axial coding "less knowledge in technology application". These initial findings were tabulated, in a matrix that makes it more organized. This formed the initial categorization. The summary of coded segments was generated with the first verbal matrix as shown in Table 3.3 which had the code labelled in one column, and exact excerpts in another column

Table 3.3
Verbal Matrix

Initial Code	Excerpts
Tools for teaching	I usually use presentation like Power Point, using laptop and internet devices. [Dr. A:11-11] Most of the times I use PowerPoint, sometimes I will show my students videos in YouTube. [Dr. D: 13-13]

The segments identified was constantly compared with other categories, to determine that, these segments were in the most appropriate category, then rearranging the segments, and refining the categories. This technique of analysis is known as constant comparative method of analysis. The constant comparison of these segments was to ensure that, the meaning of each category was clearly defined, clear distinction between each category, and categories which were the most important to the study (Glaser & Strauss, 1967).

This technique was used to identify the themes, develop categories, and explored similarities and differences in the data, and relationships among them. Initially, a total of 110 initial code emerged from the first verbal matrix. The initial codes then were sorted out, refined and condensed to 17 axials, later into discreet and mutually exclusive categories for example "Less knowledge in technology application" and "Low skill using CL tools" these two categories were grouped under a new category labelled as "Basic knowledge pertaining to the usage of technology". To facilitate analysis, a second matrix as shown in Table 3.4 was created.

Table 3.4
Second Matrix of the Verbal Data

Category	Excerpts
Basic Knowledge in Technology Usage in Education	
Less knowledge in technology application	For basic and simple application is okay for example I use LMS and everything is uploaded, and I run quite a bit of forums, I also use YouTube videos. [Dr. C: 3-5]
Low skill using CL tools	No, I don't use any tools (Wikis, discussion forum, blog) in my teaching and learning. Most time I use power point. Sometimes I do use whiteboard, diagram or video [Dr. A: 52-52]

All categories reflecting basic knowledge pertaining to the usage of technology were grouped. The basic knowledge in using technology was identified, since the excerpts reflected instructors have knowledge in using basic application, such as, power point and uploading material. In addition, instructor claimed that, due to less opportunity using technology in teaching, his/her skill is at very basic level. Similar procedure was carried out for the other categories. Categories that merged from interview and document analysis such as, previous TPACK training evaluation and individual lecturers' LMS activities were compared and refined to ensure these categories were mutually exclusive from each other.

Data analysis in the present study involved two stages as presented in Figure 3.2. The first stage involved analysis of verbal data, during data collection. Initial findings led to the refinement to interview guide, as well as, interview with trainer and management of training provider. These initial findings also provided some insights to the study. This then led to the second phase of analysis, to answer the research questions and provide the main matrix. The summary of need analysis phase presented in Table 3.5 and Figure 3.3 illustrate the research procedure in need analysis phase.

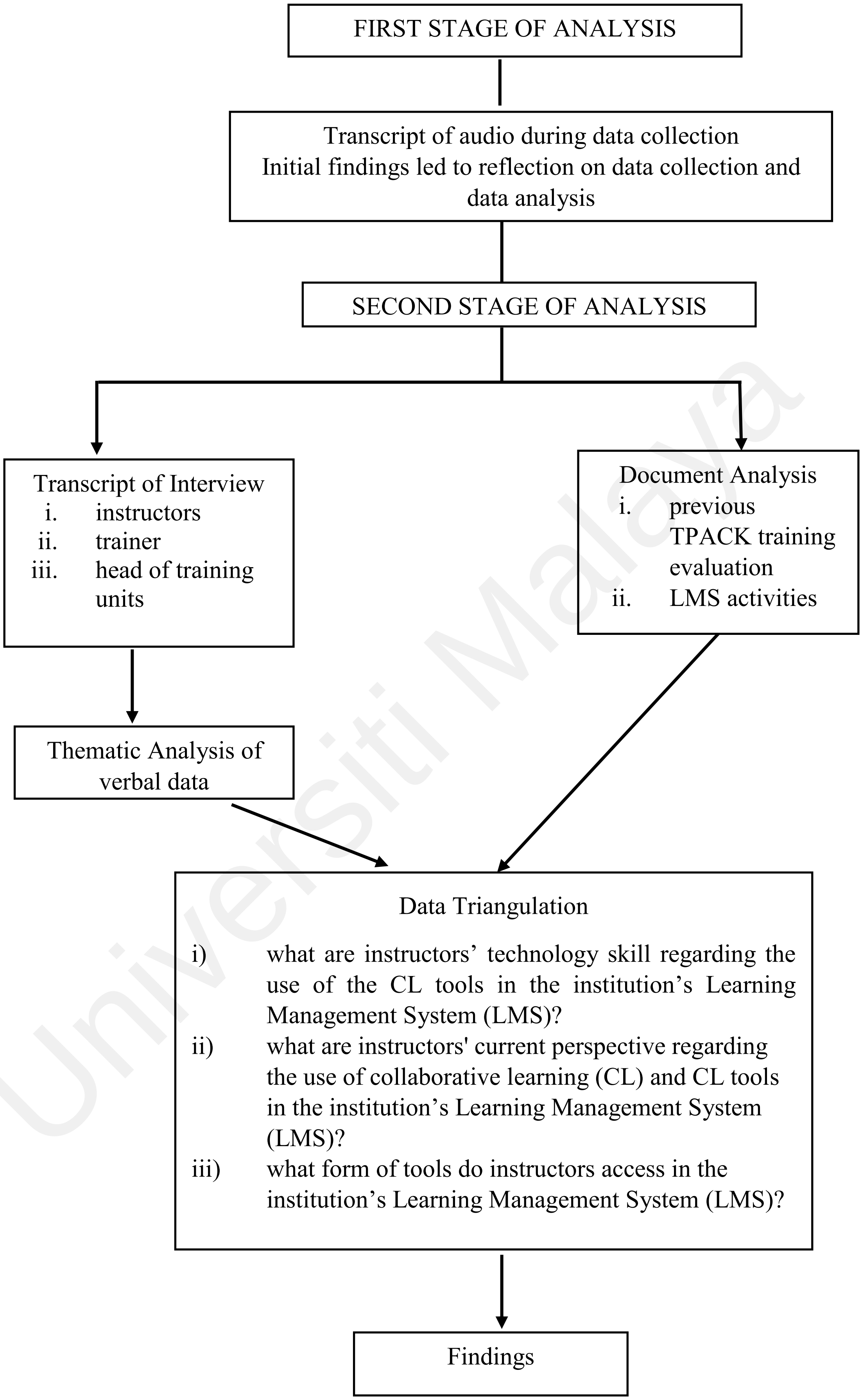

Figure 3.2 Framework of Data Analysis

Table 3.5
Summary of Data Collection for Needs Analysis Phase

Research Questions	Data Collection Method	Sample (N)
1. what are instructors' technology skill regarding the use of the CL tools in the institution's Learning Management System (LMS)? 2. what are instructors' current perspective regarding the use of collaborative learning (CL) and CT tools in the institution's Learning Management System (LMS)?	i. semi-structed interview ii. document analysis (previous TPACK course evaluation)	i. instructors (*n*=7) ii. Head of Training Units (*n*=2) iii. trainer (*n*=1)
3. what form of tools do instructors access in the institution's Learning Management System (LMS)?	i. semi-structed interview ii. document analysis (instructors LMS activities)	

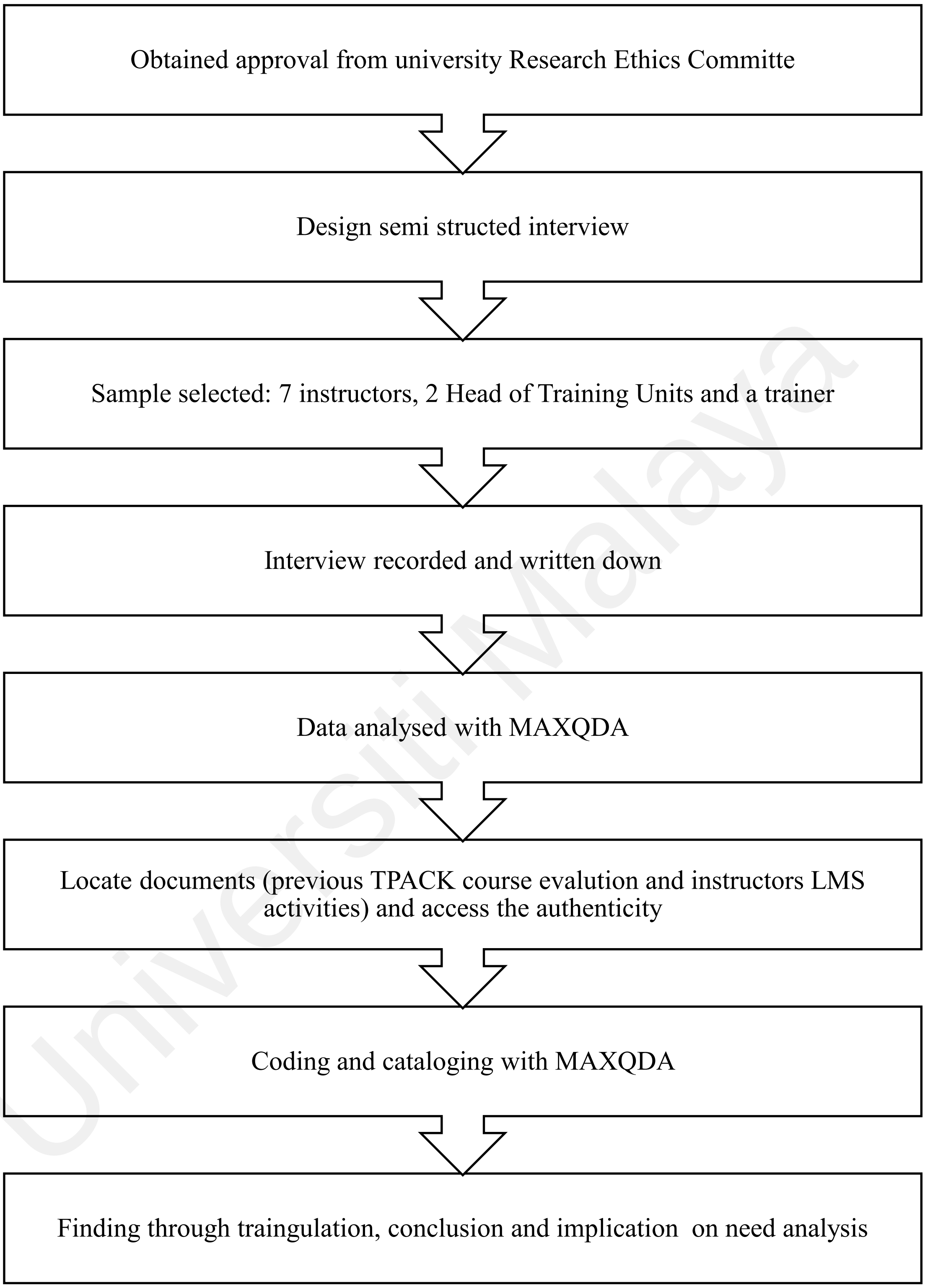

Figure 3.3 Research procedure in Phase 1 Need Analysis

Phase 2: Design and Development

In the second phase, the information and findings from need analysis was used to guide the design. The objective of the second phase was to design and develop the Collaborative TPACK module for CPD in higher education, based on the opinions of the panel experts from the aspect of learning objective, content (instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery. Based on the experts' consensus, the elements should be included in the Collaborative TPACK module for CPD was identified. The data collection of this phase is based on Fuzzy Delphi Method (FDM).

Sample of the study. The participants in the second phase of the study consisted of experts, that involved in the interview as well as, in the FDM. For interview session, participants were consisting of four experts in the areas of Educational Technology, Instructional Design (ID) and CPD to get their views on the aspect of learning objectives, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery for the Collaborative TPACK module.

Experts are referred to an individual that have professional qualification, experience or knowledge that distinguishes the expert from the novice in a specific field due to the training, practice and exposure they had (Donohoe & Needham, 2009; Needham & Loë, 1990). Therefore, experts could be a reliable resource based on their potential to evaluate and provide judgment pertaining to relevant knowledge and experience of a particular topic. In FDM, selection of experts is very important, based on certain criteria to ensure the reliability and validity of the data output and findings (Mustapha & Darulsalam, 2018).

Criteria that should be considered before selection of experts such as expertise, certification, term and experience. In most cases, years of experience become prominent in expert's selection. Participants with many years of experience in certain field were categorize as experts, but individual with little experience was classified as novice (Shanteau, Weiss, Thomas, & Pounds, 2002). In certain professions, an individual received a form of title as recognition or accreditation that was given by universities such as, Medical Doctors, Doctor of Philosophy (Prof, Assoc Prof, Dr). Therefore, an individual that is certified is likely to be an experts compared to someone who is not certified (Shanteau et al., 2002). In education, experts who have knowledge in subject area and teaching experience in field of specialisation is very vital. Group of experts such as universities lecturers and teachers consider an experts when they have experiences in the field of education for 10 to 15 years (Leng et al., 2013). In previous studies, researchers indicated that, an individual could be classified as an expert, if he/she possess experience in related field for 4-7 years (Akbari & Yazdanmehr, 2014; Berliner, 2001; Mullen, 2003).

In this study, the experts for FDM panel were selected based on certain criteria. Educational Technology and ID experts need to have relevance of experience in area of ID and knowledge of implementing latest technologies in teaching and learning. Besides that, Educational Technology and ID experts must have timeliness of experience in making sure the experts remain updated with current knowledge in the area of ID and technology within the past six to twelve months. For CPD experts, the additional criteria are, to have at least minimum of five years' experience in conducting training for academic staff in higher education setting. All experts must possess a doctoral degree in a related field and have published academic books or journal article in International Scientific Indexing (ISI) and SCOPUS as well as must to have teaching experiences at least minimum of five years in the field of Curriculum and Instruction. Experts also need to be willing to participate in the study. At the same time experts who are willing to participate in the study were issued with appointment letters *(see Appendix F)* and a consent form was given to all the experts to obtain their commitments to participate in the study *(see Appendix G)*. The summary of experts for interview is in the Table 3.6.

Table 3.6
Summary of the Panel of Experts for Interview

Number of experts	**Position**	**Area of expertise**	**Elements**
1	Professor	Instructional Design, and ICT in education	1. Learning Objective 2. Module Content i. CL tools ii. taxonomy of learning iii. instructional strategies iv. resources/media v. evaluation 3. Assessment (real world problems) 4. Module Delivery
1	Professor	Continuing Professional Education and Teacher Education	
2	Senior Lectures	Educational Technology (collaborative learning, online learning, Web 2.0 and TPACK)	

After data gathering, from the interview with four experts, the elements were listed in the FDM questionnaire for selection by all other panel experts. Based on Adler and Ziglio (1996) the ideal number of experts involved in Delphi method were around 10-15 to maintain the high level of consistency among panel of experts. Jones and Twiss (1978) suggested 10-50 as an ideal number of experts involved in Delphi method. Hence, after taking into consideration of the availability of experts in the area of Educational Technology, ID and CPD and acceptance of sixteen experts, the FDM questionnaire was given to determine the most preferred learning objective, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery for the Collaborative TPACK module as shown in Table 3.7.

Table 3.7
Summary of the Panel of Experts for FDM

Number of experts	Position	Area of expertise	Years of Experience	Elements
1	Professor	Pedagogical Content Knowledge	21	1. Learning Objective 2. Module Content i. CL tools ii. taxonomy of learning iii. instructional strategies iv. resources/media v. evaluation 3. Assessment (real world problems) 4. Module Delivery
1	Professor	Information Communication Technology (ICT) Applications in Education	40	
1	Professor	Continuing Professional Education and Teacher Education	28	
1	Associate Professors	Instructional Technology and Multimedia	24	
1	Associate Professors	Educational Technology	30	
1	Associate Professors	Instructional Technology/ICT in Education	28	
1	Associate Professors	Instructional Design, and Professional and Continuing Education.	27	
9	Senior Lectures	Educational Technology (collaborative learning, online learning, Web 2.0 and TPACK)	15-27	

The Fuzzy Delphi Method (FDM) instrument. In order to gather panel of experts' views on the aspect of learning objective, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery for the Collaborative TPACK module a semi-structured interview protocol were designed as a guidance for the interview *session (see Appendix H).*

Along the session, as the interview progresses, emerging questions were asked to gain more insight into understand expert's opinion and view on the areas been discussed. The interview questions were framed according to TPACK framework, First Principles of Instruction and Gagne Taxonomy of Learning. After the interview process ended, all interview scripts were transcribed by using MAXQDA for coding purposes. From the interview data, elements were generated to develop the Fuzzy Delphi instrument *(see Appendix I)*

Fuzzy Delphi Method (FDM). In this study, Fuzzy Delphi Method (FDM) was used to obtain the consensus of panel experts regarding the elements of learning objective, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery for the Collaborative TPACK module. FDM consist of fuzzy set numbering, fuzzy set theory and traditional Delphi method which was introduced by Murray, Pipino and Gigch (1985). Hence, FDM was not a new method but it has been improved upon to be more effective measurement tool from the traditional Delphi method. Later in 1988 FDM was improved upon by Kaufman and Gupta in 1988 and made FDM to be more effective measurement tools since FDM could be used to solve problems with particular context. FDM mainly used to obtain the consensus among panel of experts (Jamil, Hussin, Noh, Sapar, & Alias, 2013)

In the traditional Delphi method, researcher gathers opinion, agreement and expert consensus which means there was a need for consensus from a group of experts. Therefore, it required more round of interview to obtain more accurate and precise data from experts (Jamil et al., 2013). Traditional Delphi method is facing many weaknesses; failure in choosing right expert would lead in questioning validity of data, due to recurring round of feedback will lead to boredom among expert and finally using small number of expert's opinion is not suitable for measuring in -depth study (Siraj, 2008). Thus, FDM has been developed in overcoming above mentioned issues. FDM techniques allow expert to fully express their opinions, original opinion by an expert is retained, to ensure completeness and consistency of opinion (Jamil et al., 2013).

Methodology for data process was analysed based on FDM focuses on two main points in the triangular FDM namely; triangular fuzzy number and defuzzification process. Triangular fuzzy number carries three values of m1, m2, and m3 and whereby the minimum value represents by m1; the most reasonable value represents by m2 and m3 represent the maximum value. Figure 3.4 illustrate all three values.

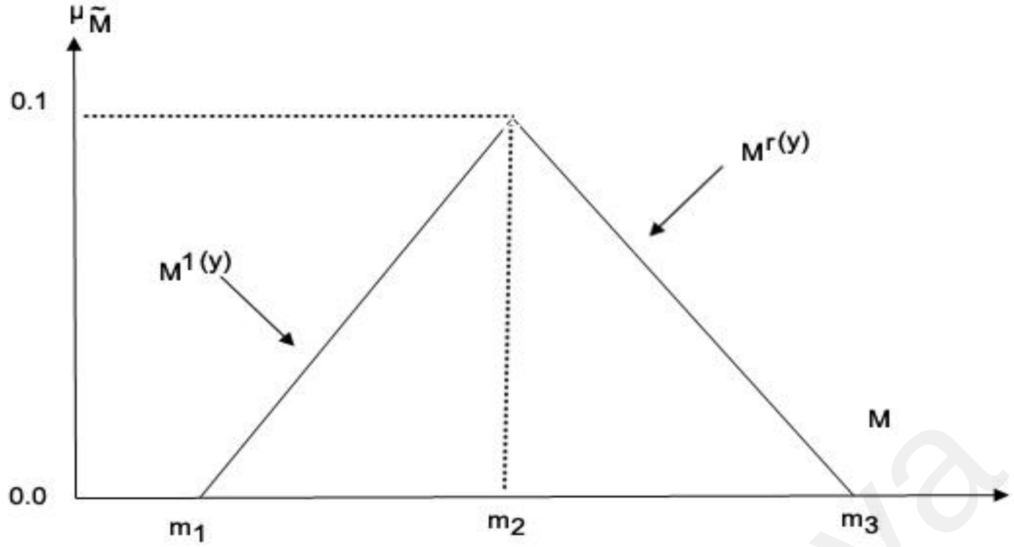

Figure 3.4 Graph of the triangles mean against the triangles

While implementing FDM a study, there were sequences to be followed. There are 4 steps in the FDM as suggested by Jamil et al. (2013) that was adopted in this study. Step 1 was the selection of the linguistic variable. Table 3.8 and 3.9 shows the seven and five-point scale of a linguistic variable. The different between seven and five-point scale of a linguistic variable were the higher the number of scales, the more accurate and precise the data. Based on the need of the research objectives, researcher could decide either seven or five-point scale of a linguistic variable (Jamil et al., 2013)

Table 3.8
Seven-Point Scale of Linguistic variable

Linguistic variable	**Fuzzy scale**
very strongly disagree	(0.0, 0.0, 0.1)
strongly disagree	(0.0, 0.1, 0.3)
disagree	(0.1, 0.3, 0.5)
not sure	(0.3, 0.5, 0.7)
agree	(0.5, 0.7, 0.9)
strongly agree	(0.7, 0.9, 1.0)
very strongly agree	(0.9, 1.0, 1.0)

Table 3.9
Five-Point Scale of Linguistic variable

Linguistic variable	**Fuzzy scale**
strongly disagree	(0.0, 0.1, 0.2)
disagree	(0.1, 0.2, 0.4)
not sure	(0.2, 0.4, 0.6)
agree	(0.4, 0.6, 0.8)
strongly agree	(0.6, 0.8, 1.0)

Step 2 was to obtain the average value (a1, am, a2). The vertex method was used to calculate the average distance between r_{ij} for each expert (Chen, 2000). Later the a1, am, a2 value and the threshold value were calculated by using the average. The spacing between two fuzzy numbers m = (m1, m2, m3) and n = (m1, m2, m3) is calculated using the formula:

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

Step 3 is to determine the threshold value (d). Expert consensus was reached when the threshold value less than 0.2 (d< 0.2) or 75% and above (Cheng & Lin, 2002).Furthermore, when the percentage of group consensus among the experts is more than 75%, it means that, the threshold value is less than 0.2 d (d< 0.2). 75% of group consensus need to be achieved, among experts to proceed to the next step (Jamil et al., 2013). Finally, in step 4, is the defuzzication process flow in determining the ranking of each variable and sub variable. There are three formulas that researcher could choose from to determine their ranking in the study;

i. $A_{max} = 1/3 * (a_1 + a_m + a_2)$

ii. $A_{max} = 1/4 * (a_1 + a_2 + 2_{am})$

iii. $A_{max} = 1/6 * (a_1 + 4_{am} + a_2)$

In this study, formula 1 for the defuzzification process was selected. Next, the FDM findings on the elements significant to the module were used as a guide for the development of the Collaborative TPACK module for CPD in higher education institutions. Figure 3.5 shows the sequence of FDM, followed in this study and Figure 3.6 shows the research procedure in design and development phase.

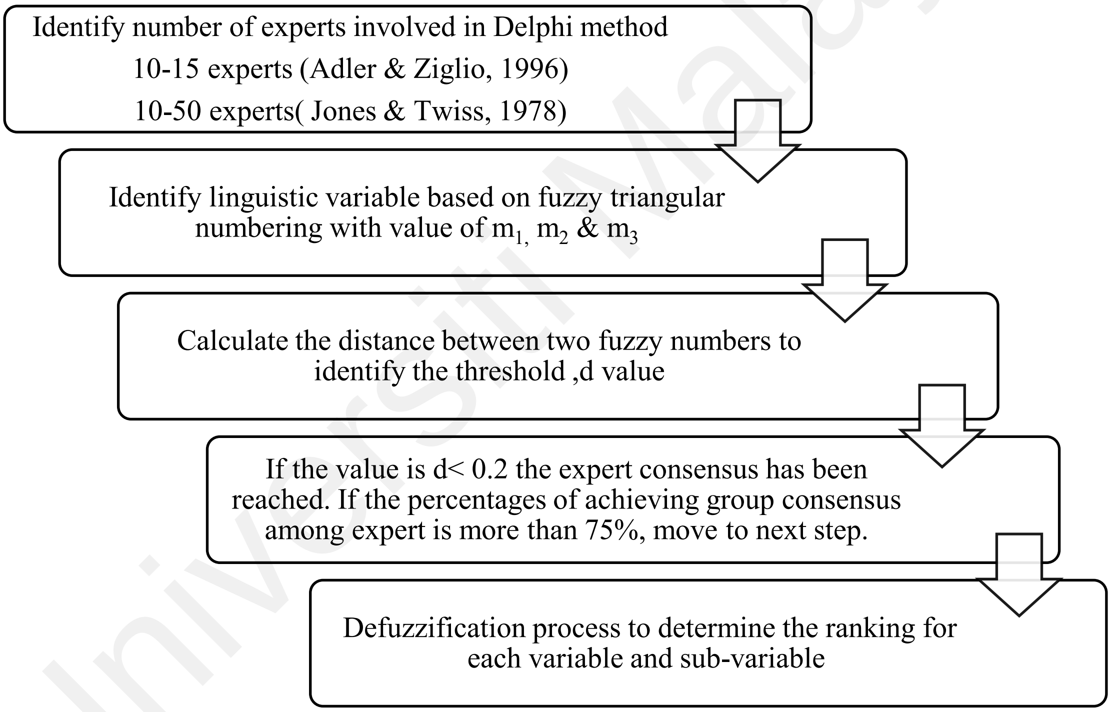

Figure 3.5 Steps in conducting research using FDM

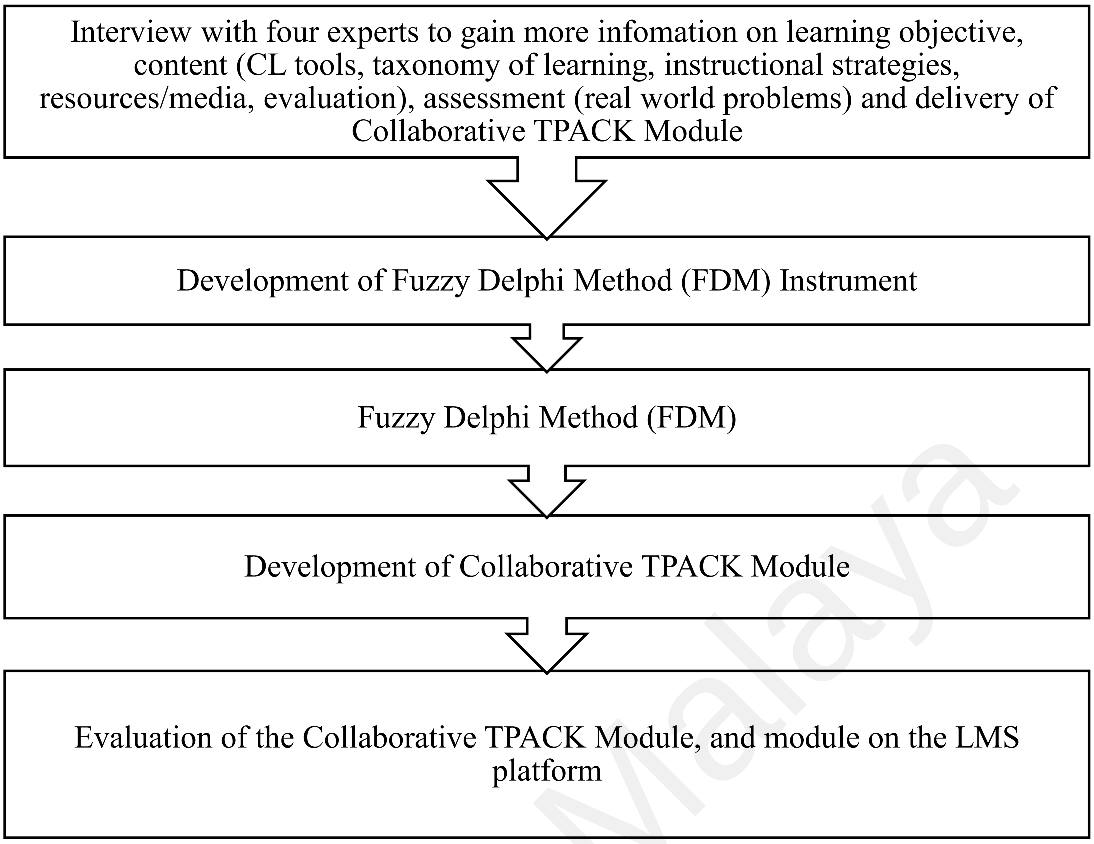

Figure 3.6 Research procedure in Phase 2 Design and Development

Phase 3: Implementation and Evaluation

In this phase, the effectiveness of the Collaborative TPACK module for CPD in developing instructors TPACK and TPACK for different domains of learning were evaluated. In addition, instructors' perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD were identified.

Sample of the study. The participants in this phase were selected from one of the public higher education institutions in Klang Valley. Selection of the participants were based on certain criteria. All participant must possess a doctoral degree in a related field and have teaching experiences at least of 1 year in any field of study. According to G-power software version 3.1, the recommended sample size is thirty-four (n= 34) instructors for both the pre and post survey, as well as, for module perception survey. Therefore, data was collected in two cohorts as presented in Table

3.10 to fulfil the sample size. This group were treated as one group participation without any control group hence, no random assignment to either the treatment or the control group to evaluate the effectiveness of the intervention. Therefore, this study was considered as one-group pre-test and post-test design with thirty-four instructors with one trainer and an assistant trainer, that designed to assess the effectiveness of the Collaborative TPACK module in developing instructors' TPACK, as well as, TPACK for different domains of learning.

Table 3.10
Sample size for Collaborative TPACK module implementation

Cohort	**Participant Registered**	**Participant Attended**	**Complete Pre-Post Test and surveys**
Cohort 1	36	29	23
Cohort 2	32	25	20

Instrument. In order to investigate the effectiveness of Collaborative TPACK module in developing instructors TPACK, a pre and post survey instrument was adapted from TPACK survey, designed by (Chai, Koh, et al., 2013; Graham et al., 2009; Sahin, 2011; Schmidt et al., 2009). Next, a pre-test and post-test were designed, based on CL tools to investigate the effectiveness of Collaborative TPACK module, in developing instructors TPACK for different domains of learning.

The third aim of the study was to explore the instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module, hence, a perception survey is implemented. Next sections discussed in detail, the pre-TPACK and post-TPACK survey; pre-test and post-test pertaining to knowledge on CL Tool; and survey regarding to instructor's perception on the technical and pedagogical usability of the module. Reliability and validity of each instrument were also highlighted.

Pre-TPACK and Post- TPACK Survey. The instrument used in this study was adapted from TPACK survey designed by (Chai, Ng, Li, Hong, & Koh, 2013; Schmidt et al., 2009) illustrated in Table 3.11. The self-assessment TPACK survey consists of thirty-five items with seven-point Likert-type scale: (1) strongly disagree; (2) disagree; (3) slightly disagree; (4) neither agree nor disagree; (5) slightly agree; (6) strongly agree and (7) strongly agree were used to investigate the effectiveness of Collaborative TPACK module in developing instructors TPACK *(see Appendix J).*

Table 3.11
Items in TPACK Instrument

Subscales	**Number of items**	**Sample of items**	**Source**
TPK	4	i. I can choose CL tools that enhance the teaching approaches for a lesson. ii. I can adapt the use of the CL tools that I have learned about to different teaching activities.	(Schmidt et al., 2009)
	3	i. I am able to use CL tools to introduce my students to real world scenarios ii. I am able to facilitate my students to use CL tools to plan and monitor their own learning	(Chai, Ng, et al., 2013)
TCK	5	i. I know about CL tools that I can use teach verbal information ii. I know about CL tools that I can use teach intellectual skills	(Schmidt et al., 2009)
	3	i. I can use CL tools that are created specifically for content creation (e.g. wikis, blog, podcast) ii. I can use CL tools that are created specifically for communication (e.g. Instant Messaging and discussion forum)	(Chai, Ng, et al., 2013)

Table 3.11 (continue)

Subscales	Number of items		Sample of items	Source
TPACK	3	i. ii.	I can teach lessons that appropriately combine CL tools and teaching approaches I can select CL tools to use in my lesson that enhance what I teach, how I teach and what students learn	(Schmidt et al., 2009)
	7	i. ii.	I can design activities based on CL tools to address students' misconception about the content knowledge I can create self-directed learning activities of the content knowledge with appropriate CL tools (e.g. Blog, Wiki, Podcasts)	(Chai, Ng, et al., 2013)

Reliability and validity. A pilot test was carried out among thirty-seven instructors to ensure the reliability of the questionnaire. The participants of the pilot study were selected based on voluntary and the samples for the pilot study were not the same as participants in the implementation phase. Based on data obtained from the pilot test, the Cronbach Alpha reliability coefficients were determined by using the Statistical Package for Social Sciences (SPSS) software. The Cronbach Alpha scores for each item show in Table 3.12 indicated that, the items in the questionnaire was internally consistent, since all the items have alpha value that is more than .70. because according to Lee Cronbach (1951), the acceptable values of alpha, ranging from 0.70 to 0.95. Thus, no items were removed, since the internal consistency was high.

Table 3.12
Cronbach's Alpha for Pilot TPACK Instrument

Subscales	**Number of items**	**Cronbach's Alpha**
Technology Pedagogical Knowledge (TPK)	7	.898
Technological Content Knowledge (TCK)	8	.948
Technological Pedagogical Content Knowledge (TPACK)	10	.967

Pre-Test Post-Test: Knowledge on collaborative learning tool. To assess the instructors' knowledge on the CL tools, a pre-test and post-test were designed based on Gagne's Taxonomy of Learning Outcomes and CL tool. From the test, researcher would be able to determine, if instructors were able to apply appropriate CL tools to teach specific skills and knowledge based on taxonomy of learning outcome, before and after the module implementation. The test consisted of three sections, Section A was the demographics details of the participants; Section B contained fourteen multiple choices of CL tool, that instructors had implemented for teaching and learning, Section C also contained fourteen multiple choices of CL tool used to teach different taxonomy of learning and finally Section D consisted of seven open-ended questions pertaining to the use of CL tools for collaboration purpose in teaching different taxonomy of learning outcome *(see Appendix K)*

In order to score the pre-test post-test, a rubric was developed based on the TPACK model. When the instructor was able to identify more than two (2) CL tools to teach certain domain of learning, 3 points would be awarded, followed by 2 points when the instructor was able to identify at least two (2) CL tools to teach certain domain of learning, 1 point would be awarded when the instructor was able to identify at least one (1) CL tool to teach certain domain of learning. Finally, 0 point would be awarded when the instructor was unable to identify any CL tools to teach certain domain of learning. All the scores were recorded and analysed, to determine each individual's score and converted into percentages. The percentages would be later matched with the overall performance rubric with the rating scale of (75%-100%) for outstanding, (49%-74%) for satisfactory, followed by (23%-48%) for improvement needed and finally (0%-22%) for below expectation depending on the total score of instructor's ability to identify/select CL tools and use CL tools for the purpose of collaboration to teach certain domain of learning *(see Appendix L).*

Reliability and validity. To confirm the content validity of the pre-test and post-test questions, as well as, the marking rubric were examined by four experts from the area of Instructional Design, Educational Technology and TPACK who had more than five years' experience in teaching and training. The experts were given module outline to review the questions listed in test to ensure the questions were related to the module content. As a result, the experts' comments on the choice of words, as well as, order of questions. Hence, minor modification was made to enhance the final version of the test.

Perception on the technical and pedagogical usability survey. The perception survey instrument was adapted from Pedagogically Meaningful Learning Questionnaire (PMLQ) by (Nokelainen, 2006) and USE Questionnaire designed by (Lund, 2001) shown in Table 3.13. The perception survey consisted of twenty-six items with seven-point Likert-type scale: (1) strongly disagree; (2) disagree; (3) slightly disagree; (4) neither agree nor disagree; (5) slightly agree; (6) strongly agree and (7) strongly agree were used to explore the instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module *(see Appendix M).*

Table 3.13
Items of Perception of the Technical and Pedagogical Usability Instrument

Subscales	Number of items	Sample of items	Source
Usefulness	8	i. This module helps me to be more effective in teaching with CL tools ii. This module helps me to be more innovative in teaching with CL tools	(Lund, 2001)
Ease of use	6	i. This module is easy to be implemented among instructors ii. This module is accessible from different browsers (e.g. Google Chrome, Safari, Firefox etc) and devices (PC, laptop, smartphone etc)	(Lund, 2001)
Satisfaction	6	i. This module has been designed for my purpose ii. I would recommend to my colleague to undergo this training (with this module)	(Lund, 2001)
Pedagogical Usability	11	i. This module has been divided into sections that allows me to learn in pre-defined order and respond to the assessment ii. This module allows me to participate in collaborative learning with my colleagues (Definition: collaborate using e.g. Wiki, Kahoot, Lucidchart)	(Nokelainen, 2006)

Reliability and validity. A pilot test was carried out among thirty-seven instructors to ensure the reliability of the questionnaire. The participants of the pilot study were selected based on voluntary and the samples for the pilot study were not the same as participants in the implementation phase. Based on data obtained from the pilot test, the Cronbach Alpha reliability coefficients were determined by using the Statistical Package for Social Sciences (SPSS) software. The Cronbach Alpha scores for each item show in Table 3.14 indicated that, the items in the questionnaire was internally consistent, since, all the items have alpha value that is more than .70. because, according to Lee Cronbach (1951), the acceptable values of alpha, ranging from 0.70 to 0.95. Thus, no items were removed, since the internal consistency was high.

Table 3.14
Cronbach's Alpha for Perception of the Technical and Pedagogical Usability Instrument

Subscales	**Number of items**	**Cronbach's Alpha**
Usefulness	8	.980
Ease of use	6	.941
Satisfaction	6	.976
Pedagogical Usability	10	.954

Procedure of data collection. In this phase, the study was carried out in three different stages, mainly, before the implementation of the Collaborative TPACK module, during the implementation of the module and after the implementation of module. In each stage, different data sources were collected to assess the instructors' TPACK development.

Procedure before the Collaborative TPACK module implementation. Permission and written consent were obtained from the University Research Ethics Committee prior to implementing the Collaborative TPACK module to fulfil the ethical procedure *(see Appendix N)*. Three days before the module's implementation, the trainer and the assistant trainer attended the welcoming session of the Teaching and Learning CPD programme. After introducing themselves and purpose of the study, an informed consent form was distributed to all participants of the study as part of ensuring the credibility of the study *(see Appendix O)*. Credibility involves "intellectual rigor, professional integrity and methodological competence," (Patton, 2002, p.570).

In the consent form, details such as the aim of the study, brief details of the study, participants involvement, risk of the study, potential benefits, protection of confidentiality and researcher contact information. Due to the voluntary nature of this study, instructors were informed that, they might choose not to participate, and they might withdraw their consents to participate at any time.

After that, instructors were requested to log in into their LMS systems to access the Google Form link to the Pre-Test: Knowledge on CL Tools and TPACK self-assessment survey. They were given two days to complete the test and the survey before the implementation of the Collaborative TPACK module.

Quasi experimental one group pre-test post-test design study. In educational research, it is quite impracticable for a researcher to undertake true experimental study by randomly assign participants to control or experimental groups (Cohen, Manion, & Morrison, 2011). Due to that, quasi experimental design was implemented in this study, when a random selection of participants was impossible.

This is known as "compromise design" when a few challenges were identified in this study, such as the participants were unable to be assigned randomly for a one-group like true experiments, due to intact participants involved in this study, finding suitable comparison group to treat as control group, the duration of the CPD programme and number of days Collaborative TPACK module was offered probably could impact the outcome of the evaluation.

On the other hand, this study also identified potential thread to internal validity and biases that, might exist such as participants maturation, mortality, selection or regression and selection of history thus, causal claims become very difficult to conclude and likely to limit the degree to which the result from this study could be generalized to a wider population (Campbell & Stanley, 2015; Cohen et al., 2011). Meanwhile, thread to the external validity were the experiments variables, since only fewer variables were able to be controlled ,since quasi experimental design were pre-existing constructions and the participants reaction or less sensitivity, towards the intervention that might jeopardize the external validity (Campbell & Stanley, 2015; Cohen et al., 2011).

However, from the aspect of maturation and history, less likely to happen considering the short duration of the module implementation. Even though, participants were not randomly allocated and grouped equivalently, that could lead to threat to internal validity, but, experimental design had great level of originality, not deliberately created, designed or artificial (Bryman, 2008).

In this design, the researcher measured a group on a dependent variable, TPACK development (O_1) and then introduced an experimental intervention or manipulation of Collaborative TPACK module (X). Following the experimental treatment, the researcher again measured the group TPACK development (O_2) and identified the differences between the pre-test and post-test scores by the reference to the effects of (X) the Collaborative TPACK module. Next, by measuring the difference score between pre-test and the post-test showed the effect of the treatment of a group (Cohen, Manion, & Morrison, 2011). The design of the one group pre-test and post-test in this study shown in Table 3.15.

Table 3.15
One-group Pre-Test and Post-Test Quasi Experimental Design

One group	**Pre-Test Score**	**Collaborative TPACK module (Treatment)**	**Post-Test Score**
Experimental Group	O_1	X	O_2

Effect of the Treatment= $(O_2 - O_1)$

Procedure during implementation. The Collaborative TPACK module implemented face to face for total of fourteen hours conducted in University Training Centre. The module was implemented over three sessions within a week, which exposed the instructors to the theoretical component and practical sessions. During the CPD, instructors were engaging in various hands-one activities such as, group discussion, producing interactive charts/diagram, evaluating previous lesson plans and produce own lesson plans, as a group project.

The lesson plan was design based on applying Merrill's First Principles of Instruction template by (Gardner, 2010). Before the end of the CPD, the lesson plans were presented by the instructors for peer assessment. Before the end of every session, instructors share their reflection, regarding their learning experiences in the interactive wall, Padlet using the QR code. Potential data collected during the CPD sessions were the visual material, produced by the instructors such as, Lucid charts, lesson plans and Padlet's responses which could be referred to the source of data in a study other than interview and observation (Merriam, 2009).

Procedure after implementation. After the CPD session, using the resource links provided in the University LMS, the instructors worked independently to explore their new learning from the Collaborative TPACK modules and provided reflection on their learning, after the exposure and hands-on activities in the CPD. Instructors were provided Google Form link on the Post-Test: Knowledge on CL tools and Post-TPACK self-assessment survey. In addition to that, to assess instructors' perception on the technical and pedagogical usability of the module, a survey instruments were administered via a Google Form in University LMS.

They were given two days to complete the post-test, post TPACK and usability survey before the follow up session began. In a follow-up session, instructors were requested to prepare a lesson plan, based on the content they are teaching in the University. Based on the designed lesson plan, they delivered the lesson in a real class setting. During the teaching and learning session, students were given publicity informed consent form *(see Appendix P)* since the classes were observed by the researcher. The lesson observation checklist used in this stage were based on Applying Merrill's First Principles of Instruction by (Gardner, 2010) *(see Appendix Q)*. Meanwhile, the lesson plan rubric implemented were based on Technology Integration Assessment Instrument (TIAI) by (Harris et al., 2010) *(see Appendix R).*

After that, instructors participated in post-lesson observation interview, to share in detail about their experiences and opinion teaching with collaborative TPACK (*(see Appendix S).*In order to show the best practices with TPACK, instructors with the assistant of the researcher produced an e-portfolio by using Microsoft Sway, that contained individual lesson plans, artefacts (evidence of students work/assignment) and personal reflection on Collaborative TPACK module in developing their own TPACK *(see Appendix T).*

Reliability and validity. To confirm the content validity of the post-lesson observation interview, the interview protocol was examined by two experts in the area of educational technology, who had more than five years of teaching experience. Both lesson plan, lesson observation template, rubric and reflection questions were evaluated by four experts from the area of Instructional Design, Educational Technology and TPACK who have more than five years' experience in teaching and training.

The experts were given module outline, to review both lesson plan, lesson observation template and its rubric, to ensure the templates were related to the assessment in the module. Since both lesson plan, lesson observation template and its rubric were adapted from past literature, so no modification suggested by the experts. However, for the reflection questions, one expert suggested that, reconstruct 'self-reflection questions' based on (Campbell & Deed, 2009). Hence, minor modification was made to enhance the final version of the reflection questions.

In order to ensuring trustworthiness in a qualitative research, the transcribe interview were validated through member checking whereby the participants of the need analysis asked to read the transcription, where they had participated to strengthen the study's credibility (Lincoln & Guba, 1985; Merriam, 2009). Besides that, to ensure the evaluation findings were rich, robust, and well developed, triangulation technique using multiple data collection method such as interview, observation, survey data, pre-test and post-test data, reflection, e-portfolio and document review such as lesson plans were used to create greater understanding (Merriam, 2009).

Data analysis. In this study, the instructors were measured by obtaining two difference score during the pre-test and post-test. Therefore, before tracing, if there exist any significant differences in instructor's knowledge on CL tools and their TPACK level before and after the module implementation, several normality tests were conducted to determine if the differences between the pre-test and post-test could be identified through a parametric test or a non-parametric one. If the assumption of normality was fulfilled, the data were normally distributed in a symmetric bell shaped curve and therefore normality test were required to check if this assumption was violated (Cohen et al., 2011).

In this study, the pre-TPACK and post TPACK survey were ordinal data hence it was considered to be as non-parametric which is often derived from questionnaires and survey (Cohen et al., 2011). When the assumption was violated and the use of the dependent t-test was inappropriate, Wilcoxon Matched Pairs Signed-Rank Test was used to compare the pre-TPACK score and the post-TPACK scores that come from the same participants (Cohen et al., 2011). Besides that, the pre-test and post-test pertaining to Knowledge in CL tools were parametric data based on Skewness and Kurtosis value. Therefore, Shapiro-Wilk normality test was employed and to compare the pre-test and post-test scores before and after the module implementation, the paired t-test was conducted.

Next, descriptive statistics include frequencies, measure of dispersal (standard deviation) and measure of central tendency (means, mode, medians) were determined for the perception of the technical and pedagogical usability survey. In the descriptive statistics the visual techniques of the data presentation such as frequency, percentages tables and bar charts were included in the analysis.

Conclusion

This study employed the DDR method to be able to design and develop the Collaborative TPACK module for CPD in higher education institution. In this study, the researcher was the participant observer as the facilitator (assistant trainer) for the implementation of the Collaborative TPACK module so that researcher could play "an active membership role by involved in the setting's central activities, assuming responsibilities that advance the group, but without fully committing themselves to members' value and goals," (Merriam, 20009, p.124).

In DDR, the researcher often a participant in order to ensure the internal validity of the study being objective (Richey, Klein, & Nelson, 2004). Data collected systematically during all three phases of the research and triangulation of data was conducted as part of research credibility. The design of this study was based on several phases of data collection as summarized in Table 3.16 to Table 3.18

In the needs analysis phase, the instructors need was investigated so that, Collaborative TPACK module would be developed to base on their TPACK and CL tools knowledge, as well as, to cater the University's need based on MOHE policy. Based on the need analysis findings, the design of the module was determined. In the second phase the Collaborative TPACK module was designed and developed, based on sixteen experts' opinion through FDM approach. Throughout this phase, experts' input, and opinion were gathered to identify the aspect of learning objective, content, assessment and delivery for the design of the Collaborative TPACK module according to experts' consensus.

After the module was developed, four experts review and provide suggestion to improve the module before the implementation phase. In the third phase, the Collaborative TPACK module was implemented in one group of instructors in a public university, with one trainer and an assistant trainer. Since the study employed quasi experimental, one group pre-test post- test study was designed to evaluate the effectiveness of the Collaborative TPACK module in developing instructors TPACK for different domains of learning.

Then, instructors also participated in a self-assessment TPACK survey to evaluate their TPACK development before and after the module implementation. Following this, a survey was administered to gather instructors' perception on the technical and pedagogical usability of the module. In evaluation phase, follow up sessions were conducted among seven instructors over period of a month to provide technical support so that, they were able to design lesson based on Collaborative TPACK and delivered it in a real class setting.

Throughout the follow up session, each instructor class was observed and subsequently instructors participated in the post-lesson observation to gather more data on their experiences and opinion on teaching with collaborative TPACK. Next, to show the best practices with TPACK, instructors with the assistant of the researcher produced an e-portfolio documented all the visual material of their teaching with collaborative TPACK. The summary of data collection procedure for phase 3 is illustrated in Figure 3.7. The next chapters discussed in detail the analysis of data according to need analysis; design and development; implementation and evaluation.

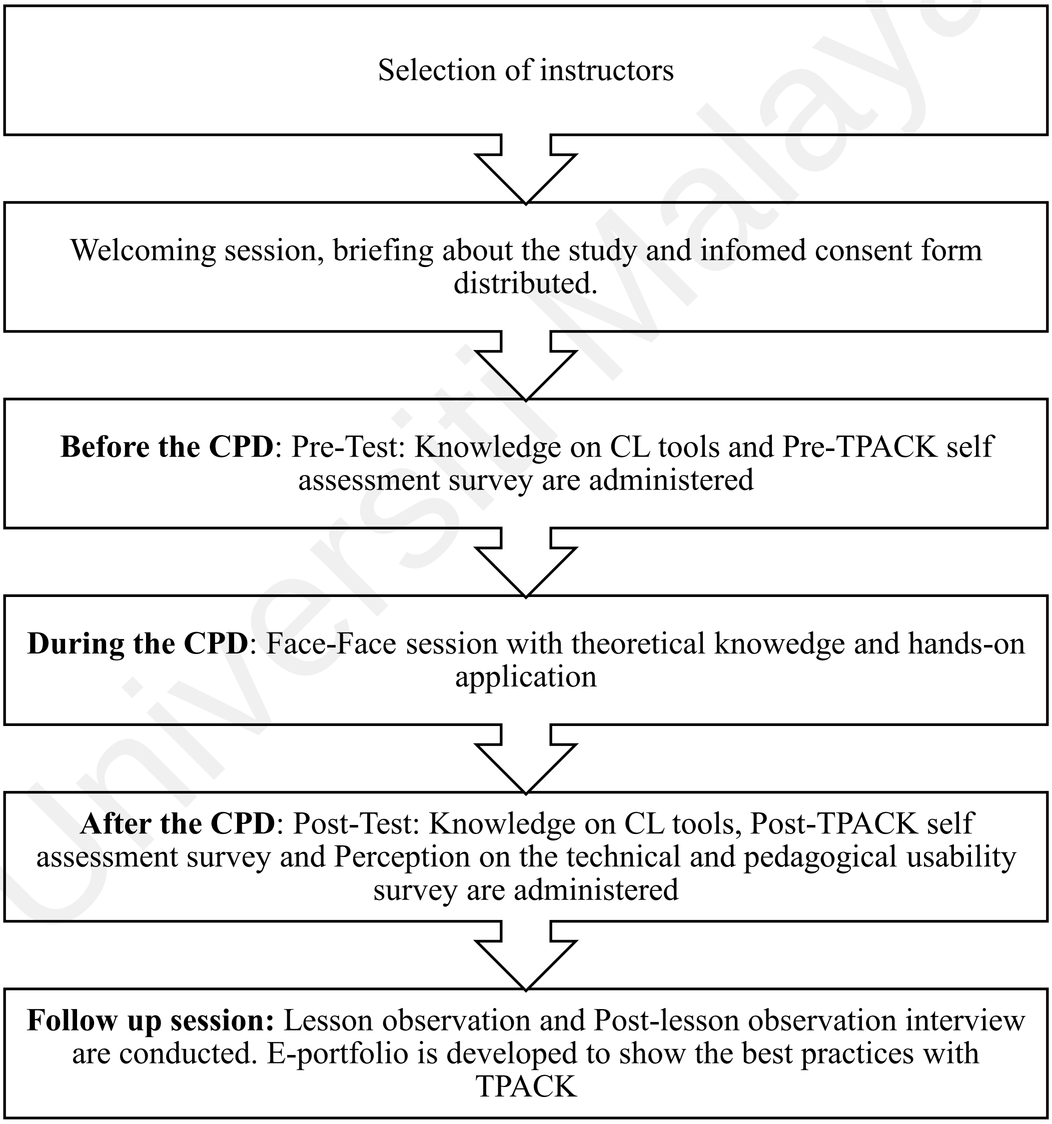

Figure 3.7 Procedure for data collection in Phase 3 of implementation and evaluation

Table 3.16
Research Matrix for Phase 1: Need Analysis

Phase	Research Objectives	Research Question	Sample	Data Collection/ Analyses
Phase 1: Need Analysis	i. To discover instructors' technology skill regarding the use of the collaborative learning (CL) tools in the institution's Learning Management System (LMS). ii. To discover are instructors' current perspective regarding the use of Collaborative Learning **(**CL) and CL tools in the institution's Learning Management System (LMS) iii. To discover form of tools that instructors' access in the institution's Learning Management System (LMS).	i. what are instructors' technology skill regarding the use of the collaborative learning (CL) tools in the institution's Learning Management System (LMS)? ii. what are instructors' current perspective regarding the use of Collaborative Learning **(**CL) and CL tools in the institution's Learning Management System (LMS)? iii. what form of tools that instructors' access in the institution's Learning Management System (LMS)?	i. instructors (*n*=7) ii. Head of Training Units (*n*=2) iii. trainer (*n*=1)	Semi Structured Interview Document Analysis Thematic Analysis with MAXQDA

Table 3.17
Research Matrix for Phase 2: Design and Development

Phase	Research Objectives	Research Question	Sample	Data Collection/ Analyses
Phase 2: Design and Development	i. To design and develop the Collaborative TPACK module for CPD in higher education based on the opinions of the panel experts from the aspect of learning objectives, content CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery.	i. What are the experts' opinions on the learning objectives, content (CL tools, taxonomy of learning, instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery that should be incorporated into Collaborative TPACK module for CPD?	i. Professor expertise in Pedagogical Content Knowledge ii. (*n*=1) iii. Professor expertise in Information Communication Technology (ICT) Applications in Education iv. (*n*=1) v. Professor expertise in Continuing Professional Education and Teacher Education (*n*=1) vi. Associate Professors expertise in Curriculum Development, Instructional Design, and ICT in education (*n*=4) vii. Senior Lectures expertise in Educational Technology (collaborative learning, online learning, Web 2.0 and TPACK) (*n*=9)	Fuzzy Delphi Method (FDM) analysed using MS Excel (*n*=16)

Table 3.18

Research Matrix for Phase 3: Implementation and Evaluation

Phase	Research Objectives	Research Question	Sample	Data Collection/ Analyses
	i. To assess the effectiveness of Collaborative TPACK module for in developing instructors TPACK	i. Is the Collaborative TPACK module for CPD effective in developing instructors TPACK?	Instructors (*n*=34)	One group Pre-test and Post-test Quasi experiment Wilcoxon Matched Pairs Signed Rank Test
			Instructors (*n*=7) (Voluntary for follow-up)	Classroom Observation (Analysis with Rubric) Lesson Plan Evaluation (Analysis with Rubric) Semi Structured Post-Lesson Observation Interview (Thematic Analysis with MAXQDA) TPACK e-portfolio

Table 3.18 (continue)

Phase		Research Objectives		Research Question	Sample	Data Collection/ Analyses
	ii.	To assess the effectiveness of Collaborative TPACK module for CPD in developing instructors TPACK for different domains of learning outcome	iii.	Is the Collaborative TPACK module for CPD effective in developing instructors TPACK for different domains of learning outcome	Instructors (*n*=34)	One group Pre-test and Post-test Quasi experiment Paired sample t-test
					Instructors (*n*=7) (Voluntary for follow-up)	Classroom Observation (Analysis with Rubric) Lesson Plan Evaluation (Analysis with Rubric) Semi Structured Post-Lesson Observation Interview (Thematic Analysis with MAXQDA) TPACK e-portfolio
	ii.	To explore the instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD	iii.	What are the instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD?	Instructors (*n*=34)	Survey with Descriptive Analysis

CHAPTER 4

FINDINGS OF PHASE 1: THE NEED ANALYSIS

Introduction

This chapter focuses on the findings in phase 1 the need analysis which to investigate the need for a collaborative TPACK module for continuous professional development (CPD) in higher education. Hence, this chapter seeks to answer three research questions i) what are instructors' technology skill regarding the use of the collaborative learning (CL) tools in the institution's Learning Management System (LMS)? ii) what are instructors' current perspective regarding the use of collaborative learning **(**CL) and CL tools in the institution's Learning Management System (LMS)? iii) what tools do instructors access in the institution's Learning Management System (LMS)?

The findings regarding the situation on the use of technology and CL and CL tools among instructors in the higher education was reported according to the following areas: instructors' background, instructors' technology skill; their perspective on CL and CL tools and tools do instructors access.

Instructors' Background

In the need analysis phase, seven instructors from two different academic disciplines: humanities and sciences were interviewed to identify the need for a collaborative TPACK module for CPD in higher education as shown in Table 4.1. All the seven instructors have a doctoral degree in a related field with at least minimum of two years' experience in teaching and learning. Brief description about the instructors' background is discussed next.

Table 4.1 *Summary of Instructors' Details Background*

Instructor	Discipline	Field	Years of Experience in Teaching and Learning
Dr. A	Sciences	Medicine	5
Dr. B	Humanities	Computer System and Technology	10
Dr. C	Humanities	English Language	5
Dr. D	Sciences	Chemistry	2
Dr. E	Humanities	Islamic History and Civilization	5
Dr. F	Humanities	Economics	2
Dr. G	Sciences	Orthopedic Surgery	5

Dr.A is working as a Senior Lecturer in the Department of Surgery, Faculty of Medicine and has almost 5 years of teaching experience. He is also a General Surgeon based at University Malaya Medical Centre in Kuala Lumpur. Dr. B is a Senior Lecturer in the Department of Electrical Engineering, Faculty of Science Computer & IT been teaching the undergraduate and postgraduate level for 10 years. Dr. C is a Senior Lecturer in the Department of English, Faculty of Arts and Social Sciences and has been teaching the undergraduate and postgraduate for 5 years.

Dr. D is working as a Senior Lecturer in the Department of Chemistry, Faculty of Science. She has been actively teaching about 2 years in the various field in chemistry. Dr. E is working as a Senior Lecturer in the Department of Islamic History and Civilization, Academy of Islamic Studies. She has been teaching the undergraduate level about 5 years. Dr. F is a Senior Lecturer in the Department of Economics, Faculty of Economics and Administration. She has been actively teaching about 2 years for postgraduate, undergraduate and diploma level. Dr.G is working as a Senior Lecturer in the Department of Orthopaedic Surgery, Faculty of Medicine and has been teaching postgraduate level more than 5 years He also practises as an Orthopaedic (hand surgeon) at University Malaya Medical Centre.

Instructors from different field of studies selected to provide insight pertaining to their technology skills; their perspective on CL and CL tools and tools that, they do access. Hence, the findings from various field illustrated the need for collaborative TPACK module development for CPD in higher education.

Background of the TPACK Trainer and Management of Training Provider

In addition to that, the researcher also interviewed the Head of Training Units and a trainer to discover the need for the module as shown in Table 4.2. Two Head of Training Unit were involved in training and development in the area of leadership and wellbeing; and technology embedded teaching and learning They have a doctoral degree in a related field with at least minimum of 5 years' experience in teaching and training academic staff in a higher education setting. Besides that, a trainer involved in the area of Pedagogy and Instructional Strategies as well as in TPACK. She has a doctoral degree in a related field with at least minimum of 5 years' experience in teaching and training academic staff in a higher education setting.

Table 4.2 *Summary of officers from the management of training provider and a TPACK trainer*

Participants	**Training Area**	**Years of Experience in Training**
Head of Training Unit 1	Leadership and Wellbeing	5
Head of Training Unit 2	Technology Embedded Teaching and Learning.	5
Trainer	TPACK and Pedagogical Instructional Strategy.	6

Trainer is a Senior Lecturer in the Curriculum and Instructional Technology Department, Faculty of Education. She has been teaching and supervising the undergraduate and postgraduate level for 6 years. She has been actively involved in providing training and development for instructors in higher education in the areas of TPACK, Pedagogy and Instructional Strategy. Head of Training Unit 1 is also a Senior Lecturer in the Department of Building Surveying, Faculty of Built Environment. He has been actively involved in training and development for new lecturer and students, that focus on technology embedded teaching and learning. Head of Training Unit 2 is also a Senior Lecturer in the Department of Media Studies, Faculty of Arts & Social Sciences. She has been actively involved in training and development in Leadership and Wellbeing.

Instructors' Technology Skill Regarding the use of the CL Tools in the Institution's Learning Management System (LMS)

In order to answer the first research question, instructors' technology skill regarding the use of the CL tools in the institution's Learning Management System (LMS) data were analysed from interviews. Interview data collected from the instructors and the TPACK trainer were used for triangulation purpose. In addition, TPACK pre-course survey was also used to give more insight pertaining to instructors' technology skills.

The themes that emerged from the data indicated that, instructors had a **basic knowledge pertaining to the usage of technology in education** and **limited knowledge of CL tools and its usage.** Quotations with pseudonym from the transcripts were presented to highlight the needs that were important to instructors.

Basic knowledge pertaining to the usage of technology in education. From the interview data, almost all the instructors mentioned that, they had knowledge to use fundamental technology for teaching and learning.

I usually use presentation like Power Point, using laptop and internet devices. [Dr.A:11-11]

For basic and simple application is okay for example I use LMS and everything is uploaded, and I run quite a bit of forums, I also use YouTube videos. [Dr. C: 3-5]

Most of the times I use PowerPoint, sometimes I will show my students videos in YouTube. [Dr. D: 13-13]

I think my technology knowledge in where I work, and practice is okay, okay meaning I do use some technology mainly PowerPoint and videos but not a video that I recorded by myself because in my field I have not been taught to teach formally so a lot of ways I teach is based on whatever experiences I have [Dr. G: 3-5]

Dr. A preferred to use PowerPoint presentation for his teaching and learning. Dr. C seems to use technology that was simple and easy to be integrated in LMS. She felt she had the basic skills of downloading and uploading materials, such as, notes and video as resources for her class. She also integrates discussion forum sometimes. Dr. D also preferred to use PowerPoint slides and sometimes shows video to her students. Dr. G seemed only using PowerPoint and video as a main teaching tools, since in his field of expertise he has not been exposed to teach using technology. This may indicate, Dr. G only has fundamental knowledge and skills to use technology and software like PowerPoint and video from YouTube.

This indicates that, instructor seemed to have basic technology skills in teaching and learning process. Besides that, the analysis of pre-course survey on TPACK for the item "*I have the technical skills I need to use technology"*, shows that 72% (*n*=22) of the instructors claimed that, they have the technical skills to use technology in their teaching and learning. This indicate that, instructors have the abilities and knowledge to certain degree to perform specific tasks using basic technology and software such as, Internet, laptop, video, and PowerPoint slides.

Data from the trainer also shows that, instructors have the technological knowledge to understand how technology integration could improve instructional strategies. However, there were very minimum technology integration in teaching process and limited to PowerPoint and video as a medium of information transmission since only 1 out of 7 instructors claimed that, she combined her lesson with discussion forum.

> *Instructors have knowledge of technology but less on application in teaching and learning*: [Trainer:97-97]

As a result, data from the interview with instructors, trainer and pre-course survey shows that, instructors seem to have the TK limited to hardware and software such as, Power Point, video, Internet and laptop. Having TK means instructors have the ability to operate technologies for work. However, instructors need to have the skills and knowledge to identify specific technologies were best suited for addressing subject-matter in their fields instead of just having TK.

Limited knowledge of collaborative learning tools and its usage. From the interview data, the instructors seemed to have limited knowledge in differentiating the types of CL tools available. At the same time, the instructors were uncertain about CL tools usage for collaboration purpose.

> *No, I don't use any tools (Wikis, discussion forum, blog) in my teaching and learning. Most time I use power point. Sometimes I do use whiteboard, diagram or video [Dr. A: 52-52]*
>
> *Ooh I see, maybe I don't understand the terminology. I know about Wikis, but I use a lot of forum, so it is the major tools that I kind of I like to use it* [Dr. C: 54-54]
>
> *Uhmm, am not quite sure about collaborative learning tools. So how about online notes? Is it a collaborative learning tool?* [Dr. D: 38-38]
>
> *Inside the classroom, so far, I just implemented Kahoot and Ed Puzzle. I ask them (student) to see the video and I ask questions in the class. So, far I have implemented these 2 tools* [Dr. E: 78-79]

Dr. A indicated that, he was not using any CL tools. However, he seemed to be using Power Point, diagram, and video for teaching. Dr .C seemed to know about Wiki as a collaborative learning tool, but she never used Wikis in her teaching practises at the moment. Nevertheless, she was actively using discussion forum for teaching. On the other hand, Dr. D seemed uncertain about collaborative learning tools and unsure, if online notes could be considered, as one of the collaborative learning tools. Besides that, Dr E seemed to be using game base learning, Kahoot and interactive lesson with Ed puzzle.

This might indicate that, two out of seven instructors were only using forum discussion and other tools such as, Kahoot and Ed Puzzle for teaching. The rest seemed to lack knowledge about CL tools, thus lead to less application in teaching and learning. On the other hand, analysis of the pre-course survey on TPACK for the item "*I am able to use website Editors to create and /or modify web pages"* also shows that, only 55% (*n*=22) of the instructors could use application for content curation. This might indicate that, half of the instructors' lack skills of using tools such as Wikis, blogs, podcasts for content curation. As a result, data from the interview with instructors and also pre-course survey showed that, overall knowledge of CL tools and its usage among the instructors were still limited. They seemed to have difficulty to identify types of CL tools and its usage for collaboration.

In summary, instructors' technology skills regarding the use of CL tools for teaching and learning were at very basic level. Their knowledge of CL tools and its usage also seemed limited. Hence, it was important for instructors to be equipped not only with knowledge of technology, but, to have the appropriate skills and knowledge to identify the right CL tools, that could improve instructional strategies and strengthen content knowledge for learners. This is also because instructors need to stay ahead in the global market to be competitive with other higher education institution, so that, learners would able to continue at collective knowledge.

Instructors' Current Perspective Regarding the use of CL and CL tools in Institution's Learning Management System (LMS)

In order to answer the second research question, instructors' current perspective regarding the use of CL and tools in the institution's Learning Management System (LMS), data was analysed from interviews. Interview data collected from the instructors and the TPACK trainer were used for triangulation purpose. In addition, TPACK pre-test was also used to give more insight pertaining to instructor's perception regarding CL tools.

The themes that emerged from the data indicated two perspectives related to the use of CL and CL tools in LMS, as follow; **lack of knowledge on CL concepts and implementation in the teaching process and misconception about CL concepts.** Quotations with pseudonym from the transcripts were presented to highlight needs, that were important to instructors.

Lack of knowledge on CL concepts and implementation in the teaching process. The instructors seemed to have little knowledge on CL concepts in the teaching process. They claimed they were uncertain about CL meaning and the proper integration to support students learning.

> *I think Dr.X was mentioning something about it just now, but I do not have enough knowledge to talk about it* [Dr. C: 43-43]
>
> *The collaborative learning, I might have heard about it but I'm not really sure about it. Collaborative comes from the word collaboration. Is it collaborate with other or what?* [Dr.B: 54-55]
>
> *Collaborative learning, not really. Is it like working network in terms of learning? They (students) have assignment, but am not sure*

if its call collaborative learning, like putting the students in a group, but for students they are doing the work together.
[Dr.E: 52-57]

Two of the instructors said they had incorporated social media such as Facebook to engage students in the learning process

Sometimes I just use Facebook recording live or something or maybe like a screen recording using a power point. [Dr. B:20-21]

In teaching, basically I use videos and there is one semester, last semester, due to my research grant, 4-5 week doing the online class, so I use FB live to deliver the lecture to the students. [Dr. E:7-7]

Even though, Dr. B was not sure about CL, but he was using Facebook live video as well as screencasts. Dr. E also integrated Facebook Live for delivering lecturer for her research purpose. This is also evident from the analysis of pre-course survey on TPACK when instructors were asked, if they were able to incorporate collaborative learning teaching approach "*I can use a wide range of teaching approaches in a classroom setting (collaborative learning, direct instruction inquiry learning, project-based learning, etc.)"* only 62% (*n*=22) instructors indicated agreement. This shows that, not all the lecturers have skills and knowledge to apply especially CL teaching approach to support students learning.

Although the instructors used Facebook and screencasts to deliver lecture, they still lack the knowledge to incorporate Facebook and screencast with appropriate tasks, that could promote CL among students. Simply using technology as medium of transmitting information would not promote collaboration among students. Instructors should incorporate tasks, that will allow students to express and use their skills on hands-on activities in group settings, that would encourage knowledge creation.

Misconception about CL. Instructors seemed to have a misconception regarding CL and CL tools, that were used to support learning. Three instructors have a misconception about CL versus cooperative learning. According to one of them, once lecturer uploaded documents and shared it in an online learning platform, students can always download the materials anytime, anyway and work on the given task as a group

> *I've been using LMS to upload some online notes. I have embedded the notes using URL, so I just share the URL link in my spectrum so that my students can access it. I think this also way of collaborating with each other* [Dr.D: 44-45]

Dr. D assumed that as long as the lecture notes were online, and students can access in in the learning, platform mean that, CL was being conducted. In another situation, two instructors believed that, when students were divided into a small group and working together on a given tasks is called CL

> *Give students to work together. I already give them class slides, notes to refer when doing their work. They just need to submit the code and results, I try to reduce usage of papers, mostly I would ask students to send off the softcopy in the files (java, C++).* [Dr. B: 59-64]

> *Usually we base on the case discussion, like problem solving. So, we divided the students in a smaller group for a discussion based on certain situation or a problem, so I will tell them how we solve the problem, sometime like guided content, sometimes they read beforehand, so we guide them through the things that they did not cover well* [Dr. A: 38-41]

This shows the activities that were given to students were structured and lecturers directed. Instructors seem supplied all the information for students to read or sometimes provide them guided content. At the end of the day, students submit their group assignments for evaluation/assessment purposes. This is more to cooperative learning compared to collaborative learning.

This is also evident from interview with the TPACK trainer, that in order to develop collective knowledge through the use of CL tools, instructors need to know how to design lesson based on collaborative strategy and discover multiple dimensions of the instructors' role while preparing for CL.

> *Everyone need to be aware of technology, they may be using it but not in the right direction. Collaborative tools are one of the way instructors create room for collective knowledge building however it cannot be achieved when instructors fail to understand the concept of CL. Instructors are not just informants but facilitators, modeling, and coaching in collaborative environment*. {Trainer: 68-71]

Therefore, instructors need to have the knowledge to differentiate between collaborative and cooperative learning, as well as, identifying their roles before, during, and after the teaching and learning process.

In summary, instructors seemed to lack knowledge about CL concepts and CL tools implementation in the teaching process. Even though, a number of them incorporated tools such as Facebook Live, screencasts, but, without appropriate instructional strategies and techniques, it was difficult to help students to learn effectively to accomplish given tasks. Therefore, it was important for instructors to have the skills and knowledge to design lesson with incorporated task so that, students have the opportunity to build new knowledge instead of being a passive learner.

Tools That Instructors Access in The Institution's Learning Management System (LMS)

In order to answer the last research question, tools that instructors' access in the institution's Learning Management System (LMS) data was analysed from interviews with the instructors and triangulate with data from LMS activities. The themes that emerged from the data indicated that, CL tools instructors' access mainly in the LMS were **tools for communication (discussion forums and chat)** and the **non-collaborative tools** mainly used were uploading videos and material for lesson. Quotations with pseudonym from the transcripts were presented to highlight the needs, that were important to instructors.

Tools for communication. Instructors seemed familiar and frequently using the **discussion forums** and chat in the LMS, as a platform for students to share their thoughts and ideas with peers pertaining to the topic given by the lecturers.

> *Usually I use discussion forums toward to end of the lesson. Once the students have sufficient exposure to the text or materials, we will discuss some ideas during the tutorials and I will create the discussion forums, so that when the students go back they can reflect on it, so they can discuss with their friends as well [Dr. C: 67-70]*

This is also evident from the LMS activities that, Dr. C has been actively using discussion forums, as one of the activities in the LMS.

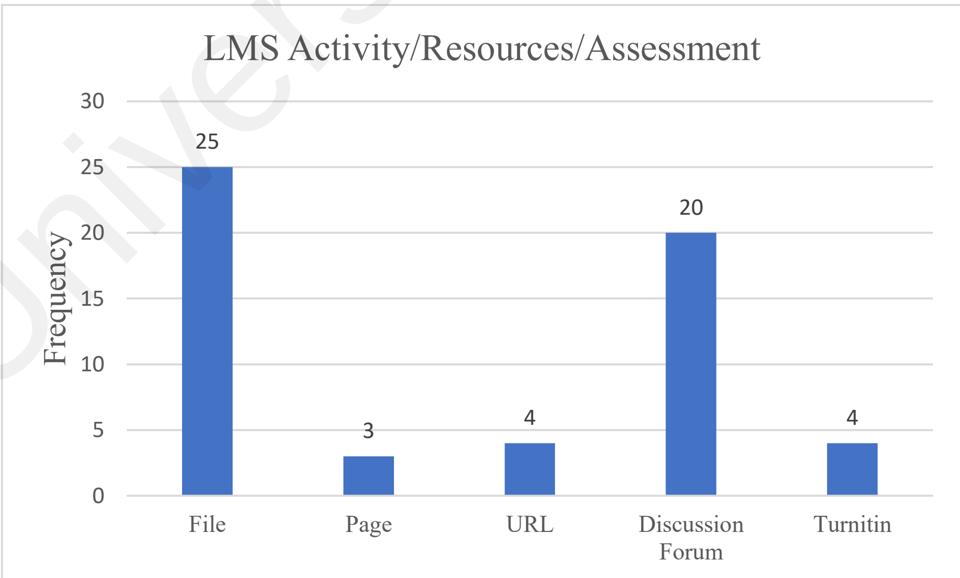

Figure 4.1 Summary of LMS Activity/Resources/Assessment by Dr C

Data from the LMS and interviews indicated that, Dr. B has been utilizing discussion forums in his teaching and learning to create blended learning environment

Most time I use forum to make announcement, sometimes I also post assignment questions. During one semester, I post some questions and ask the students to answer. Nowadays lecturer need to create blended learning, so I try to do that. [Dr.B.32-33]

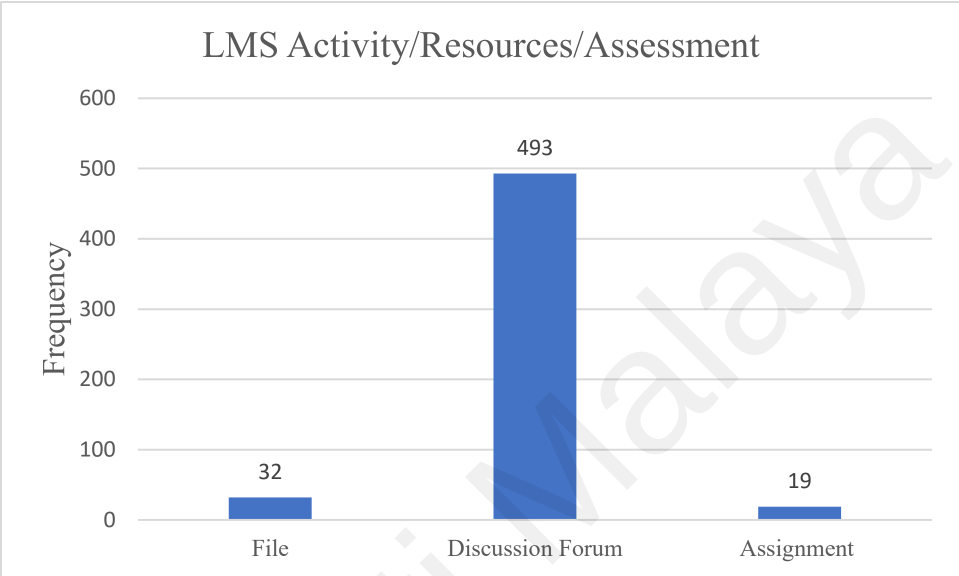

Figure 4.2 Summary of LMS Activity/Resources/Assessment by Dr.B

Besides that, Dr. E used discussion forums to introduce the course, assessment, as well as, platform to welcome the students to the course

I use discussion forums for introduction like ice-breaking session, introduction to the course am teaching. [Dr. E:8-9]

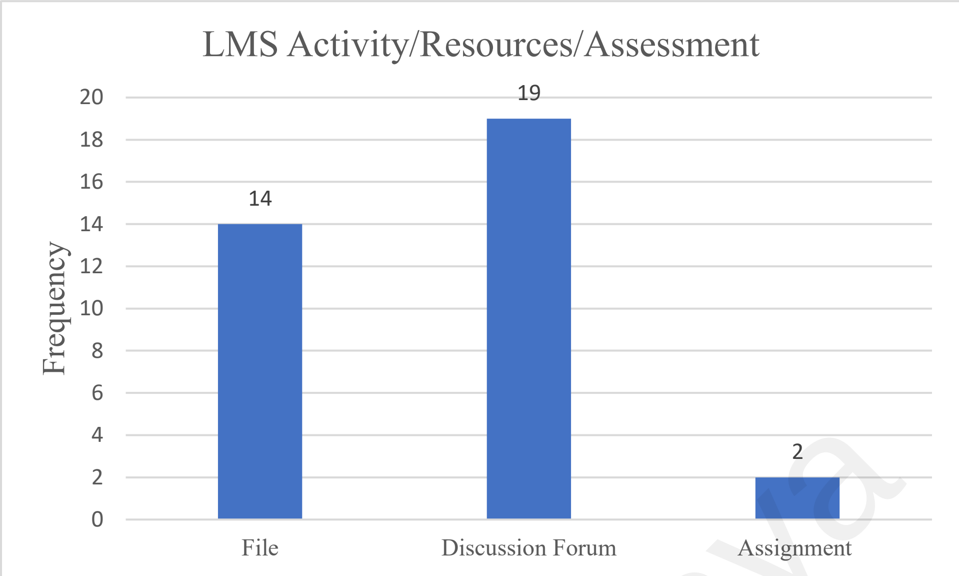

Figure 4.3 Summary of LMS Activity/Resources/Assessment by Dr. E

Non-collaborative tools. Instructors seem to use LMS mainly as a platform for **sharing videos and lesson materials**

> *For example, it's a readymade video. Sometimes I make my own video using Powtoon. I use some animation when though I have to pay to download the full clips in order for me to upload in Spectrum for example*. [Dr. F:104-106]

> *I use spectrum a little bit, and everything is uploaded like notes, files, material for teaching.* [Dr.C:4-4]

> *I have embedded online lecture notes, so I just link to spectrum, so my students can access it.* [Dr D: 44-45]

> *So, in the class, teaching it's more like using video I uploaded in the LMS, discussion, delivery of lecturer and if there is a time we will go out (trip) but not every semester.* [Dr. E: 84:85]

Dr. F had been utilizing the resources, activities, and assessment in the LMS in very minimal way. Besides forum discussion, she also uses the chat activity. It seemed she used LMS in higher frequencies to upload resources (File)

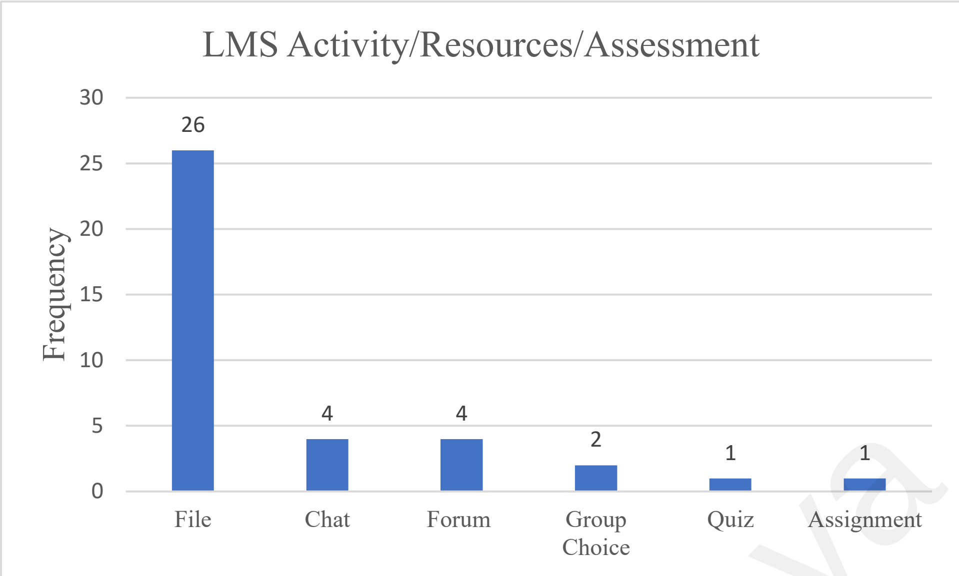

Figure 4.4 Summary of LMS Activity/Resources/Assessment by Dr. F

In summary, tools that instructors' access in the LMS were mainly discussion forums for the purpose of sharing thoughts and ideas among students, that makes announcements, post questions, and introduction session for new semester. There are tools in LMS which are underutilized, and they are: Wiki, Chat, Web Page, Quizzes and many more. Hence, instructors need to be aware of the underexploited tools and well equipped themselves with knowledge and skills by using those tools in an appropriate manner for innovative teaching with technology.

Other Emergent Themes

Current TPACK training and assessment. In order to investigate the need for the collaborative TPACK module for the instructors, data were analysed from interviews with a trainer and officers from the management of training provider and triangulate with previous TPACK training evaluation feedback from April 2016 till July 2018.

The themes that emerged from the data indicated three needs, related to TPACK training as follow; **lack of training specifically done on CL and CL tools, need for different teaching strategies with ICT** and **need for continuous assessment in CPD.** Quotations with pseudonym from the transcripts were presented to highlight needs that were important.

Lack of training specifically on collaborative learning/tools. The trainer indicated that, so far, the training programmes being delivered to the instructors in higher education comprised of TPACK, Pedagogy and Instructional Strategies for Higher Education. In this both training module, topic pertaining to collaborative learning was not taught as a separated content but was embedded in the Five-Stage Model of e-learning (Salmon, 2011) for Computer Supported Collaborative Learning (CSCL). At the same time, instructors have also been given the training to understand the concept of technology in teaching, however, no specific training is provided to repurpose the technology tool into a different domain of learning.

> *An exposure done through Salmon's 5 steps of online learning. Some generic skills such as teamwork, life-long learning, collaborative, project based/cased based been integrated in TPACK training*. [Trainer:84-87]

In addition, the Head of Training Unit 1 also indicated that collaborative approach been highlighted during training as part of the constructivism learning approach.

> *There's no specific training that appoint the collaborative learning, but we have a course on utilizing learning spaces indirectly. When you talk about learning space all in that is the support on collaborative learning.* [Head of Training Unit 1: 47-49]

However, learning space is just the infrastructure for CL. The infrastructure might be the first step, but, more importantly is the task, the assessment, and the pedagogies of CL for use in the learning space.

In addition to that, CL tools that was highly emphasized among the instructors were the online data storage tools for better collaboration. Online data storage for collaboration was different from collaboration for learning via collaborative tools such as, Wiki, discussion forum, blog, podcast and many more. Online data storage tools were more to file sharing that enable users to share big files easily, stored them in cloud, synchronize them with any devices and collaborate on them with others. However, through CL tools, most of the activities related to the education, such as, reading a text and discussing it online, writing online content, creating audio and video could be carried out. Hence, instructors need to know appropriate CL tools that are very important to promote students learning.

> *We have always been quite keen to promote the constructive approach, so and constructive approach it always been underpin by collaborative learning so even the tools that we teach or expose the lecturers in our training has quite large elements of collaborative learning in many ways, things like using drop box paper, word online, google docs and those are tools that helps people to collaborate*. [Head of Training Unit 1: 41-45]

This is also evident from the previous TPACK training evaluation that instructors are expecting opportunities to learn more on technology related to their teaching areas.

> *The trainer could show the participants the way she conducts her class by incorporating technology in her class so that we could learn from her*. [Participant Cohort 2016, April]

> *I was expecting to see the trainer to conduct a few lessons incorporating the online tools for us to learn before letting us do the presentation. I would prefer to see the examples first so that I have a clearer idea*. [Participant Cohort 2016, July]

> *More demonstrations on how to use the different technology, how and when to use the different technology in teaching*. [Participant Cohort 2018, July]

In summary, more opportunities for instructors to experience using CL tools through hands-on practical was required. Instructors seem to teach the way they were trained. Hence, exposing instructors to a training that covers a collaborative nature might develop these skills for the instructor.

Need for different teaching strategies with technology. The trainer also highlighted that, instructors seemed to have technological knowledge, but less skill on the application in teaching and learning.

> *Instructors have knowledge of technology but less on application in teaching and learning*: [Trainer:97-97]

That means, in this digital age, instructors need to know how to stay ahead in the global market to be competitive with other higher education institutions, so that, students would be able to contribute to collective knowledge

This further illustrated in another episode with Head of Training Unit 1 stated that, different type of learning taxonomies required different types of instruction. This is because, learning takes place in multiple domains and at various degrees of complexity. However, there is no specific training been provided to expose instructors to use various technology tools to teach in various domain.

> *Different way of learning in the classroom nowadays makes very important to the lecturers to have skills to actually tackle the different way of teaching rather than traditional ways. So, we need different teaching strategies when handling different subject*: [Head of Training Unit 1: 62-64]

This was also evident from the previous TPACK training evaluation that, instructors were expecting more opportunities to be given to them to work with different technology tools related to their teaching areas.

> *Perhaps everyone from the group able to present their own subject/subject/course using the different TPACK techniques or skills.* [Participant Cohort 2016, November]
> *I wish I could learn more about the applications and how to implement effectively in the lessons*. [Participant Cohort 2017, April]
>
> *More emphasis on using technology not just to add varieties to teaching or make teaching more interesting, but also to enhance the role of an instructor*. [Participant Cohort 2017, August]
>
> *To show more examples of new technologies in teaching (especially those that showed in the questionnaires-Taxonomy of Learning).* [Participant Cohort 2018, July]
>
> *Trainer able to do more demonstrations on how to use the different technology* [Participant Cohort 2018, July]

As a summary, instructors wanted training that allows them to learn different CL tools from examples and demonstration from trainer, as well as, adapting it into their teaching practices. By doing this, instructors were able to construct more holistic lessons by using all domains in constructing learning tasks. This diversity in learning help students to acquire greater experience in using different learning style and learning modalities.

Need for continuous assessment. There was need for a continuous assessment in CPD for transfer of knowledge and the retention of expertise, based on feedback given by the trainer and the Head of Training Units. According to the TPACK, trainer usually before the end of the training session, instructors used to be given a group task. During the presentation session, each group would be evaluating each other as peer assessment. The group that is able to illustrate good teaching practice with technology based on the lesson plan would be given rewards as a form of motivation. However, there was no follow up session or continuous assessment to evaluate the instructors teaching progress with TPACK after the training.

> *In the end of the training, application in form of group task been given but no follow up session. I think it is quite difficult to get the lectures back because everyone is very busy so maybe a system like training department did by providing grant to get these lecturers participate in their grants, in the conferences or teaching and learning. I think that's a good idea, that's one way to get them back [*Trainer: 264-267*]*

In addition, the Head of Training Unit 2 also indicated that, even though, follow up and continuous assessment seemed important, due to limited resources such as time and workforce they were unable to conduct any practical, workshops, lectures, projects, cases and any type of follow up.

> *Honestly, we don't have the manpower to do the follow up at the moment because following up and do continuous assessment we realize that is quite important and part of training framework but due to the numbers we have in the office we can't really follow up person to person basis because we have 2500 academic staff in the university and we are team of 17 or 16 people here.* [Head of Training Unit 2: *149-152*.]

This is also evident from the previous TPACK training evaluation that training programme should be extended for practical application from the theory and concepts.

> *Perhaps, she (trainer) can give one-day training and show us more teaching examples using TPACK as a continues session from the TPACK concepts*. [Participant Cohort 2016, April]

> *Focusing in one philosophical perspective in separate session for better understanding in TPACK and more hands-on activities for us to practise after training*. [Participant Cohort 2017, April]

> *The time was insufficient to cover everything. I suggest a separate course for blended learning*. [Participant Cohort 2018, July]
> *It would be better for us to reflect on the actual programs we are teaching and do something that we can actually use in our own classes* [Participant Cohort 2018, July]

In summary, continuous assessment is important as an ongoing inquiry into what and how the instructors are practicing their good teaching with technology. This systematic method of assessing and evaluating instructors progress would help the trainer and the training departments to help instructors to better understand their strengths and weaknesses in the certain training programmes. Besides that, the continuous assessment would be able to provide a comprehensive picture of each instructor over a period of time on their teaching practices.

Challenges in learning new technology tools. Instructors perceived learning new technology tools are quite challenging especially learning sophisticated technology and tools, time constraint due to busy schedule and colleagues influence.

> *I think it's slightly challenging, for basic and simple technology is okay or not I need to sort of do it for a few times, but I would not say that I'm so good at it using technology but, yes, I would like to practise more, try it morel earning new technology tools.* [Dr.C: 12-13]

> *Although I know about new technology or I heard about it, but to well equip myself about it hardly happen, sometime am too occupied with other things and I have to ignore about learning or keeping update on new technology.* [Dr. D:17-18]

> *Because my day to day work so busy with what we are doing today and technology is always changing, there is always new technology, so my day to day work there are lot of people I work with for example my peers, my senior also don't use that much of new technology we use technology that provided to us unless there is a need or problems I have to solve* [Dr.G: 46-49]

Insufficient time to learn and explore new tools seemed to be a challenge for some instructors, when it comes to immersing technology into learning. Dr. C seemed to be very positive about learning new technology, that would support their teaching and students learning. Dr D. indicated that, her busy schedule led to inadequate time to learn new technology tools for teaching.

On the other hand, Dr. G felt learning new tools only possible when there was a need to be integrated into the lessons and when time is not a barrier. At the same time, he also indicated that, his colleagues and peers were not using much technology tools, while teaching. Hence, this scenario might also influence Dr. G's intention of using new technology tools for teaching. Therefore, a CPD programme could be a platform whereby instructors can dive in and kick start teaching with TPACK gradually.

Conclusion

The analyses revealed that, instructors' technology skill regarding the use of the collaborative tools in the institution's Learning Management System (LMS) was identified in two themes; basic knowledge pertaining to the usage of technology in education and limited knowledge of CL tools and its usage. Second, instructors' current perspective regarding the use of Collaborative Learning (CL) and CL tools in the LMS identified in two themes; lack of knowledge on CL concepts and implementation in the teaching process and misconception about CL. Finally, form of CL tools the instructors' access in LMS were only discussion forum and chat. Other emerging themes identified in four themes; lack of training specifically on CL and CL tools, need for different teaching strategies with technology, need for continuous assessment in CPD and challenges in learning new technology tools. The findings presented were mostly supported by excerpts from the interviews and document analysis. Summary of need analysis as illustrated in Figure 4.5

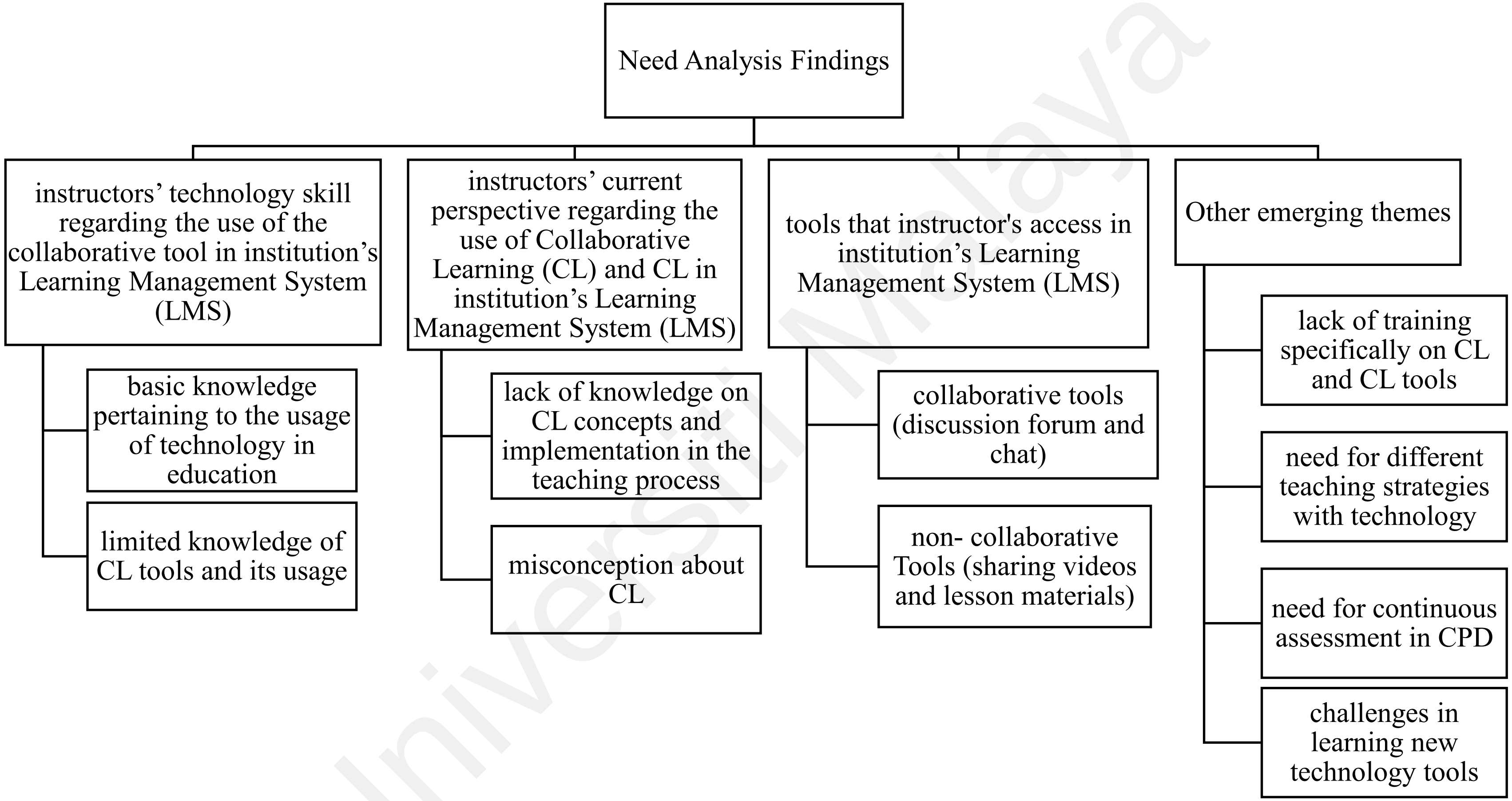

Figure 4.5 Summary of Need Analysis Finding

CHAPTER 5

FINDINGS OF PHASE 2: THE DESIGN AND DEVELOPMENT

Introduction

This chapter elaborates the findings of the processes undertaken in the design and development phase of the Collaborative TPACK module for Continuing Professional Development (CPD) in Higher Education. There are two parts in Phase Two of this design and developmental research. The first part of this chapter focuses more on the design aspects of the module. The second part is on the development of the module concentrated on the analysis and findings of the Fuzzy Delphi Method (FDM) and module development for evaluation. In the design stage, the researcher obtained the consensus of a panel of experts through FDM using interviews and the FDM Questionnaire.

The use of FDM was to determine the design of the module which was based on learning outcomes, content, assessment based on real-world problem and delivery required in the design of the collaborative TPACK module for CPD in higher education. This chapter reports the FDM findings, which was then used in the development of the Collaborative TPACK module. It attempts to provide the findings by answering the following research question; what are the experts' consensus on the elements (learning outcomes, content, assessment based on real-world problem and delivery) required in the design of the collaborative TPACK module for CPD in the higher education setting? In this chapter, the design and development of collaborative TPACK module was discussed based on

i) design of Fuzzy Delphi Method (FDM) Questionnaire

ii) Fuzzy Delphi Method (FDM) findings for the design of the module

iii) development of the Collaborative TPACK module

iv) experts' feedback of the Collaborative TPACK module

v) the Collaborative TPACK module on the University LMS platform

Design of Fuzzy Delphi Method (FDM) Questionnaire

As a first step, a critically review of literatures was conducted to gather information pertaining to the TPACK, collaborative tools, taxonomy of learning and First Principles of Instruction. The information gathered then transformed into semi-structured interview protocol with face to face interview with the experts. For the interview session, four experts were presented with the TPACK framework, First Principles of Instruction, Collaborative Tools and Gagne Taxonomy of learning. They were asked for their views on the learning outcome, content, instructional strategies, resources/media, assessment, and delivery for developing the collaborative TPACK module.

During the interviews, all the four panel members agreed on the five sections of expert's detail, module objectives, module content, module assessment and module delivery should be included in the module. However, during the interviews, several themes emerged to indicate that, there was a need to add some elements into the selected sections. First, the experts felt that, the module learning objectives should be replaced with learning outcomes. The experts stated that, learning outcomes were specific and clear statements of what learners were expected to learn and be able to demonstrate at the completion of the module however learning objectives were written from the lecturers' point of view about what they intended to teach. Hence, the learning objectives from the initial module was changed to learning outcomes.

Besides that, the experts suggested that, the module content with the collaborative tools should also include a three-dimensional (3D), such as computer-generated environment known as Virtual Reality (VR), as part of the collaborative tools. Hence, one of the VR applications, Second Life was added into the module. In addition, the experts also stressed the important of the continuing assessment. They stated that, instructors needed to have their own portfolios reflecting on their learning throughout the CPD. Besides that, recording their own teaching and learning that reflect the TPACK was also a method of assessing their TPACK. Not just that, but also, participating in a forum, a colloquium to presenting their discovery, reflection, and evidence-based effective teaching and student learning upon the completion of the CPD is also part of the on-going CPD, that needs to be included in the assessment section. Hence, the above-suggested tasks for the instructors were included in the assessment.

Then, the FDM questionnaire was developed from the perspectives gathered from the interview and items and sub-items in the FDM questionnaire was generated. A 7-point Likert scale questionnaire measuring preference was developed based on themes derived from the interview. The FDM questionnaire consisted of a five sections with subsections: Section A is about the experts' details, Section B is regarding the experts' views on the learning objectives of the module, Section C in the module comprises items of content, with a subsection of the collaborative tools and the Gagne Taxonomy of Learning, Section D and Section E respectively, are regarding the module assessment and delivery which consist of problem task, level of CPD, medium of instruction and structure of the module, that could make the module more effective.

All the items were listed in the survey questionnaire for the panel of experts to respond. Then, the FDM questionnaire was given to sixteen experts, who determined the learning outcome, content, assessment, and delivery elements of the module. After administering the FDM questionnaire to the panel of experts, they responded to the questionnaires to provide their views and opinion. Data obtained from the experts' responses was then analysed based on FDM using Microsoft Excel.

Fuzzy Delphi Method (FDM) Findings for The Design of The Module

As could be seen from the data in Table 5.1 till 5.10 shows the experts view on the elements for the collaborative TPACK module, based on the learning outcome, module content comprises of the collaborative tools; taxonomy of learning (verbal information, intellectual skills, cognitive strategy, attitude, motor skills); module assessment and delivery. As presented in Table 5.11, summary of the module elements to be included in the collaborative TPACK module for CPD programme based on the experts' consensus is reported.

Table 5.1
The Experts' View on the Learning Outcome for the Collaborative TPACK Module Based on the FDM

No	Learning Outcome	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value *(d)*	**Percentage of Expert Consensus (%)**	**m_1**	**m_2**	**m_3**	**Fuzzy Score (A)**	**Expert Consensus**	**Ranking**
	After participating in this CPD programme, the instructors will be able to:								
1.	apply suitable collaborative tools to teach a specified content area.	0.137	93.8%	0.763	0.913	0.969	0.881	ACCEPTED	2
2.	apply suitable collaborative tools to teach content area based on the Gagne's Taxonomy of Learning	0.155	87.5%	0.750	0.900	0.963	0.871	ACCEPTED	3
3.	understand the relationship of Technological Pedagogical Content Knowledge (TPACK) in a different type of the Gagne's Taxonomy of Learning.	0.324	68.8%	0.644	0.794	0.881	0.773	REJECTED	-
4.	design and develop lesson plans by integrating appropriate pedagogy and collaborative tools based on the Gagne's Taxonomy of Learning.	0.047	100%	0.863	0.981	1.000	0.948	ACCEPTED	1

Note: Condition to be met: Triangular Fuzzy Number: Threshold value *(d)*≤ 0.2Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the learning outcome for the collaborative TPACK module, according to the experts' consensus is shown in Table 5.1. The design and develop lesson plans with the collaborative tools based on the Gagne's Taxonomy of Learning using appropriate pedagogy and content was ranked the most important learning outcome for the module with the defuzzification value of 0.948. This is followed by applying suitable collaborative tools to teach a specified content area and applying suitable collaborative tools to teach content area based on the Gagne's Taxonomy of Learning with the defuzzification value of 0.969 and 0.963 respectively. The experts rejected learning outcome that state, after participating in this CPD programme, the instructors would be able to understand the relationship of the Technological Pedagogical Content Knowledge (TPACK) in a different type of the Gagne's Taxonomy of Learning. Hence, in this module, after participating in this CPD programme, the instructors would be able to design and develop lesson plans by integrating appropriate pedagogy and collaborative tools based on the Gagne's Taxonomy of Learning.

Table 5.2
The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Collaborative Tools)

No	Module Content (Collaborative Tools)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
Collaborative tools that can be integrated into this module for the instructors to use with their students:									
Main Tools in the module									
1.	discussion forum	0.072	100%	0.825	0.963	1.000	0.929	ACCEPTED	1
2.	Wikis	0.075	100%	0.788	0.944	1.000	0.910	ACCEPTED	2
3.	Blog *(e.g. blogger, WordPress)*	0.119	100%	0.750	0.906	0.981	0.879	ACCEPTED	4
4.	Podcasts	0.137	93.8%	0.725	0.888	0.969	0.860	ACCEPTED	5
5.	instant messaging *(*e.g. *LMS chat, WhatsApp)*	0.110	87.5%	0.800	0.938	0.988	0.908	ACCEPTED	3
Other tools that support the collaborative learning									
6.	YouTube	0.107	93.8%	0.825	0.950	0.981	0.919	ACCEPTED	4
7.	Microblogs (e.g. *Facebook*, *Twitter)*	0.110	87.5%	0.800	0.938	0.988	0.908	ACCEPTED	5
8.	Students Response system *(*e.g. *Kahoot, Socrative)*	0.080	93.8%	0.838	0.963	0.994	0.931	ACCEPTED	2
9.	Survey Tools *(*e.g. *Poll Everywhere, PollDaddy, Doodle*	0.066	100%	0.838	0.969	1.000	0.935	ACCEPTED	1
10.	Virtual Reality *(*e.g. *Second Life)*	0.149	93.8%	0.700	0.869	0.963	0.844	ACCEPTED	9
11.	Interactive walls (e.g. *Padlet, Wallwisher)*	0.086	93.8%	0.825	0.956	0.994	0.925	ACCEPTED	3

Table 5.2 (continue)

No	Module Content (Collaborative Tools)	Triangular Fuzzy Number: Threshold value (d)	Triangular Fuzzy Number: Percentage of Expert Consensus (%)	Defuzzification Value: m_1	Defuzzification Value: m_2	Defuzzification Value: m_3	Defuzzification Value: Fuzzy Score (A)	Result: Expert Consensus	Result: Ranking
12.	video development tools for animation/non-animation (e.g. *Animoto, Go!Animate, Powtoon, Edpuzzle, Camtasia Studio, Sreencast-O-Matic)*	0.165	93.8%	0.738	0.888	0.963	0.863	ACCEPTED	8
13.	infographic posters (e.g. *Canva, Glogster)*	0.124	100%	0.763	0.913	0.981	0.885	ACCEPTED	7
14.	Mind mapping (e.g. *Bubbl.us, MindMapple, Coggle)*	0.114	93.8%	0.800	0.938	0.981	0.906	ACCEPTED	6

Note: Condition to be met: Triangular Fuzzy Number: Threshold value *(d)*≤ 0.2 Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (collaborative tools) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.2, discussion forum was ranked the most important collaborative tool in this module, with the defuzzification value of 0.935. This is followed by Wikis with the defuzzification value of 0.910. Next is Instant Messaging with the defuzzification value of 0.908, Blog with the defuzzification value of 0.879 and Podcasts with the defuzzification value of 0.860.

According to the experts' consensus shown above, other tools that support collaborating learning are, Survey Tools which was ranked the most important collaborative tool with the defuzzification value of 0.935. This is followed by Students Response System with the defuzzification value of 0.931, Interactive Walls with the defuzzification value of 0.925. Next is YouTube with the defuzzification value of 0.919 and Microblogs with the defuzzification value of 0.908. Mind mapping with the defuzzification value of 0.906. After the mind mapping tools, is the infographic posters with the defuzzification value of 0.885. Finally, video development tools for animation/non-animation and Virtual Reality with the defuzzification value of 0.863 and 0.844 respectively. The experts accepted all the items.

Table 5.3

The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Taxonomy of Learning)

No	Module Content (Taxonomy of Learning)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
Components of the Gagne's Taxonomy of Learning that need be integrated into this module:									
1.	Instructors should be trained to teach their students verbal information (labels, facts, information. bodies of knowledge)	0.152	100%	0.725	0.881	0.969	0.858	ACCEPTED	5
2.	Instructors should be trained to teach their students intellectual skills (classifying things, applying rules and principles, and solving problems)	0.047	100%	0.863	0.981	1.000	0.948	ACCEPTED	1
3.	Instructors should be trained to teach their students cognitive strategies (developing the thinking and learning skills)	0.080	93.8%	0.838	0.963	0.994	0.931	ACCEPTED	2
4.	Instructors should be trained to develop suitable attitudes among students (affective domain)	0.086	93.8%	0.825	0.956	0.994	0.925	ACCEPTED	3
5.	Instructors should be trained to teach their students motor skills (psychomotor domain)	0.075	100%	0.813	0.956	1.000	0.923	ACCEPTED	4

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*≤ 0.2
Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (taxonomy of learning) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.3 Intellectual Skills were ranked the most important taxonomy of learning with the defuzzification value of 0.948. This is followed by Cognitive Strategies with the defuzzification value of 0.931. Next is developing Attitude and Motor Skills with the defuzzification value of 0.925 and 0.923 respectively. Finally, is Verbal Information with the defuzzification value of 0.858. The experts accepted all the items.

Thus, in this module, all taxonomy of learning outcome of intellectual skills, followed by cognitive skill, attitude, motor skills and verbal information are included. However, less emphasis was given to verbal information.

Table 5.4

The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Verbal Information)

No	Module Content (Verbal Information)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Thres hold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
Teaching verbal information (facts, memorizing concepts, principles, and procedures) can be done by:									
1.	giving students online test/quizzes to gain their attention and to recall prior knowledge. Collaborative Tools: *(e.g. Quizlet, EDPuzzle, Kahoot, Poll Everywhere)*	0.110	87.5%	0.800	0.938	0.988	0.908	ACCEPTED	Not Applicable
2.	showing video and interactive slides to present the content. Collaborative Tools *(e.g. YouTube Prezi, Screencast, Ed Puzzle)*	0.151	93.8%	0.738	0.894	0.963	0.865	ACCEPTED	
3.	lecturer design exercises to elicit student's performance in order for students to practise the new skill through online test/quizzes in form of multiple choices Collaborative Tools: (*e.g. Quizlet, EDPuzzle, Kahoot, Poll Everywhere)*	0.092	93.8%	0.788	0.938	0.994	0.906	ACCEPTED	
4.	students able to rehearsal, elaboration, and organize verbal knowledge. Collaborative Tools: (*e.g. Peerwise)*	0.107	87.5%	0.813	0.944	0.988	0.915	ACCEPTED	

Table 5.4 (continue)

No	Module Content (Verbal Information)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Thres hold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
Resources for teaching verbal information are:									
5.	videos	0.080	93.8%	0.838	0.963	0.994	0.931	ACCEPTED	1
6.	quiz	0.129	100%	0.788	0.925	0.981	0.898	ACCEPTED	2
7.	polls	0.108	100%	0.775	0.925	0.988	0.896	ACCEPTED	3
8.	interactive slides (visual, text, audio)	0.158	93.8%	0.825	0.825	0.825	0.825	ACCEPTED	4
Assessing verbal information among students can be done by:									
9.	give test with open-ended questions, short answers, matching answers, labelling diagrams	0.193	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	1
10.	give quiz based on level (basic to advance) in form of summative assessment	0.215	81.3%	0.775	0.775	0.775	0.775	ACCEPTED	2
11.	create platform for students to ask each other questions from what they have learnt.	0.229	81.3%	0.750	0.750	0.750	0.750	ACCEPTED	3
12.	writing comprehensive essay	0.317	43.8%	0.694	0.694	0.694	0.694	REJECTED	-
13.	giving a mini project for the students to research on certain topic and produce write-up	0.370	31.3%	0.663	0.663	0.663	0.663	REJECTED	-

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*≤ 0.2
Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (verbal information) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.4. The instructional strategies from item 1 to item 4 for teaching verbal information were accepted by the experts. No ranking was required for First Principles of Instruction since the phases were arranged accordingly from activation, demonstration, application, and integration.

The resources for teaching verbal information which comprises of videos, quiz, polls and interactive slides (visual, text, audio) were also accepted by the experts. Video and quizzes were ranked the most important resources in teaching verbal information with the defuzzification value of 0.931 and 0.898 respectively. This is followed by polls with the defuzzification value of 0.896 and interactive slides with the defuzzification value of 0.825. In order to assess the verbal information, giving test with open-ended questions, short answers, matching answers and labelling diagrams was ranked the most important assessment with the defuzzification value of 0.788. This is followed by giving quiz based on the level (basic to advance) in form of summative assessment with the defuzzification value of 0.775.

Next is create platform for students to ask each other questions from what they have learnt with the defuzzification value of 0.763. The experts rejected writing comprehensive essay and give a mini project for the students to research on certain topic and produce write-up as part of assessing verbal information.

Table 5.5

The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Intellectual Skills)

No	Module Content (Intellectual Skills)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
	Teaching intellectual skills (classifying things, applying rules and principles, and solving problems) can be done by:								
1.	giving students video and graphic diagram to gain their attention and to recall prior knowledge. Collaborative Tools: (e.g. *YouTube, Screencast, Mind Maps)*	0.167	93.8%	0.813	0.813	0.813	0.813	ACCEPTED	Not Applicable
2.	showing interactive slides, video, existing blogs and podcast to present the content Collaborative Tools: (*e.g. Prezi, Screencast, YouTube, Blogger)*	0.191	87.5%	0.800	0.800	0.800	0.800	ACCEPTED	
3.	student apply new knowledge by participating in an online discussion forum, chat Collaborative Tools: *(e.g. LMS discussion forum/chat/WhatsApp, Facebook)*	0.193	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	

Table 5.5 (continue)

No	Module Content (Intellectual Skills)	Triangular Fuzzy Number: Threshold value (d)	Triangular Fuzzy Number: Percentage of Expert Consensus (%)	Defuzzification Value: m_1	Defuzzification Value: m_2	Defuzzification Value: m_3	Defuzzification Value: Fuzzy Score (A)	Result: Expert Consensus	Result: Ranking
4.	students know 'how to do' by applying intellectual skills into personal contexts by developing content/product Collaborative Tools: *(e.g. Wikis, video development tools, infographic tool-Canva)*	0.158	93.8%	0.825	0.825	0.825	0.825	ACCEPTED	
Resources for teaching intellectual skills are:									
5.	videos	0.172	93.8%	0.788	0.788	0.788	0.788	ACCEPTED	1
6.	animation/graphics	0.167	93.8%	0.775	0.775	0.775	0.775	ACCEPTED	2
7.	quiz	0.217	75.0%	0.738	0.738	0.738	0.738	ACCEPTED	3
8.	printed text	0.309	56.3%	0.631	0.631	0.631	0.631	REJECTED	-
9.	interactive slides (visual, text, audio)	0.172	93.8%	0.788	0.788	0.788	0.788	ACCEPTED	1
Assessing intellectual skills among students can be done by:									
10.	give problem/task for students to develop content in form of video, infographic posters, interactive slides	0.150	100%	0.813	0.813	0.813	0.813	ACCEPTED	1
11.	give problem/task for students to design products based on principles	0.191	87.5%	0.775	0.775	0.775	0.775	ACCEPTED	2

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*≤ 0.2
Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (intellectual skills) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.5. The instructional strategies from item 1 to item 4 for teaching intellectual skills were accepted by the experts. No ranking was required for First Principles of Instruction since the phases were arranged accordingly from activation, demonstration, application, and integration.

The resources in teaching intellectual skills shows that video and interactive slides was ranked the most important resources with the defuzzification value of 0.788. This is followed by animation/graphics and quiz with the defuzzification value of 0.775 and 0.738. The experts rejected printed text for the resources in teaching intellectual skills.

Giving problem-task for students to develop content in form of video, infographic posters, interactive slides was ranked as the most important assessment for intellectual skills with the defuzzification value of 0.813. This is followed by giving problem–task for students to design products based on principles with the defuzzification value of 0.775

Table 5.6

The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Cognitive Strategies)

No	Module Content (Cognitive Strategy)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
	Teaching cognitive strategies (developing the thinking and learning skills) can be done by:								
1.	asking questions in form of pre-assessment to gain their attention and to recall prior knowledge to make sure students have mastered prerequisite skills Collaborative Tools: *(e.g. Kahoot, Poll Everywhere, Socrative, blog-reflective writing)*	0.172	87.5%	0.750	0.750	0.750	0.750	ACCEPTED	Not Applicable
2.	restructuring new knowledge through discussion forum, video, interactive slides) Collaborative Tools: *(e.g. discussion forum, YouTube, Screencast)* Scaffolding by providing support to the students when using cognitive strategy (e.g. Instant Messaging: LMS chat, WhatsApp)	0.167	93.8%	0.813	0.813	0.813	0.813	ACCEPTED	

Table 5.6 (continue)

No	Module Content (Cognitive Strategy)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
3.	student apply new knowledge by making a mind maps, concept mapping, associate new information with the existing one through paraphrasing, summarizing, note-taking, and questions and answers. Collaborative Tools: (*e.g. Coogle, iMindMap, discussion forum)*	0.193	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	
4.	students engaged in a complex problem solving so that students can design products Collaborative Tools: (*e.g. Wikis, video development tools, infographic tool-Canva, Wiki, discussion forum)*	0.167	93.8%	0.813	0.813	0.813	0.813	ACCEPTED	
Resources for teaching cognitive strategies are:									
5.	diagram/concept mapping	0.158	93.8%	0.825	0.825	0.825	0.825	ACCEPTED	1
6.	animation/graphics	0.167	93.8%	0.813	0.813	0.813	0.813	ACCEPTED	2
7.	quiz	0.329	37.5%	0.688	0.688	0.688	0.688	REJECTED	-
8.	printed text	0.334	50.0%	0.606	0.606	0.606	0.606	REJECTED	-
9.	readily available podcasts	0.265	62.5%	0.613	0.613	0.613	0.613	REJECTED	-
10.	readily available blogs	0.303	50.0%	0.613	0.613	0.613	0.613	REJECTED	-

Table 5.6 (continue)

No	Module Content (Cognitive Strategy)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
	Assessing cognitive strategies among students can be done by:								
11.	giving cognitively challenging problems to solve so that students need to design products based on analysis of existing situations using animation/graphics and infographic posters to show their own progress and to increases students sense of ownership	0.150	100%	0.813	0.813	0.813	0.813	ACCEPTED	1
12.	giving problem-task in form of project for students to develop products in group through Wikis, discussion forum (engaging in debate and argumentation	0.172	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	2

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*≤ 0.2
Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (cognitive strategies) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.6. All the instructional strategies from item 1 to item 4 for teaching cognitive skills were accepted by the experts. No ranking was required for First Principles of Instruction since the phases were arranged accordingly from activation, demonstration, application, and integration.

The resources in teaching cognitive strategies shows that, diagram/concept mapping were ranked the most important resources with the defuzzification value of 0.825. This is followed by animation/graphics with the defuzzification value of 0.813. The experts rejected quiz, printed text, readily available podcasts and readily available blogs as part of resources to teach cognitive skills.

Giving cognitively challenging problems to solve so that, students need to design products based on analysis of existing situations by using animation/graphics and infographic posters to show their own progress and to increases students sense of ownership was ranked as the most important assessment for cognitive skills with the defuzzification value of 0.813. This is followed by giving problem-task in form of project for students to develop products in group through Wikis, discussion forum (engaging in debate and argumentation with the defuzzification value of 0.78.

Table 5.7
The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Attitude)

No	Module Content (Attitude)	Triangular Fuzzy Number: Threshold value (d)	Triangular Fuzzy Number: Percentage of Expert Consensus (%)	Defuzzification Value: m_1	Defuzzification Value: m_2	Defuzzification Value: m_3	Defuzzification Value: Fuzzy Score (A)	Result: Expert Consensus	Result: Ranking
	Developing suitable attitude (affective domain) can be done by:								
1.	give students self-report survey to measure their current attitude as well to gain their attention and to recall prior knowledge by using stories or video Collaborative Tools: *(e.g. YouTube, blog, vblog)*	0.172	93.8%	0.788	0.788	0.788	0.788	ACCEPTED	Not Applicable
2.	instructors can develop attitude among students by showing an appealing and credible role model through video or animation Collaborative Tools*: (e.g. YouTube, Pawtoon, Animoto)*	0.217	75.0%	0.738	0.738	0.738	0.738	ACCEPTED	
3.	students producing content in form of video podcasts, video, blog discussion forum) Collaborative Tools: *(e.g. video development tools, vodcast vlog, weblog discussion forum*	0.193	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	

Table 5.7 (continue)

No	Module Content (Attitude)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
4.	allowing students to design and develop product as well share the product online. Collaborative Tools*:(e.g. video development tools, vodcast vlog, weblog)*	0.167	93.8%	0.813	0.813	0.813	0.813	ACCEPTED	
Resources for developing suitable attitude are:									
5.	videos	0.191	87.5%	0.800	0.800	0.800	0.800	ACCEPTED	1
6.	infographic posters	0.267	25.0%	0.700	0.700	0.700	0.700	REJECTED	-
7.	story (text based/web story or blogs)	0.210	81.3%	0.763	0.763	0.763	0.763	ACCEPTED	2
8.	music	0.191	37.5%	0.700	0.700	0.700	0.700	REJECTED	-
9.	film	0.215	81.3%	0.775	0.775	0.775	0.613	REJECTED	-
Assessing attitude among students can be done by:									
10.	asking students to share and debate among peers on content produced from podcasts, video and blog	0.172	93.8%	0.750	0.750	0.750	0.750	ACCEPTED	2
11.	asking students to produce an e-portfolio as a self-reflection	0.158	93.8%	0.825	0.825	0.825	0.825	ACCEPTED	1

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*$\leq$ 0.2
Percentages of expert consensus $\geq$ 75%
Defuzzification Process: Fuzzy score (A) $\geq$ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (attitude) for the collaborative TPACK module according to the experts' consensus is shown in Table 5.7. All the instructional strategies from item 1 to item 4 for developing attitude were accepted by the experts. No ranking was required for First Principles of Instruction since the phases were arranged accordingly from activation, demonstration, application, and integration.

The resources in developing attitude shows that, the videos were ranked the most important resources with the defuzzification value of 0.800. This followed by story (text based/web story or blogs) with the defuzzification value of 0.763. The experts rejected infographic posters, music and film.

Students producing e-portfolio as self-reflection was ranked as the most important assessment for developing attitude with the defuzzification value of 0.825. This is followed by asking students to share and debate among peers on content produced from podcasts, video and blog with the defuzzification value of the defuzzification value of 0.750

Table 5.8
The Experts' View on the Collaborative TPACK Module Content Based on the FDM (Motor Skills)

No	Module Content (Motor Skills)	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
	Teaching motor skills (able to carry out steps of a motor performance, or procedure, in proper order) can be done by:								
1.	giving students video to gain their attention and quiz to recall prior knowledge. Collaborative Tools: *(e.g. YouTube, Kahoot, Quizlet)*	0.200	81.3%	0.725	0.725	0.725	0.725	ACCEPTED	Not Applicable
2.	instructors present the content by showing videos in form of (2D, 3D, or 360º) Collaborative Tools: *(e.g. YouTube, Virtual Reality)*	0.210	81.3%	0.725	0.725	0.725	0.763	ACCEPTED	
3.	students practice the skills repeatedly through simulation, animation/graphic Collaborative Tools: *(e.g. Virtual Reality, video development tools)*	0.215	81.3%	0.775	0.775	0.775	0.775	ACCEPTED	
4.	allowing students to apply motor skills to personal contexts by giving complex problem task and share material produced online Collaborative Tools: *(e.g. Virtual Reality, vodcast vlog, weblog)*	0.191	87.5%	0.800	0.800	0.800	0.800	ACCEPTED	

Table 5.8 (continue)

No	Module Content (Motor Skills)	Triangular Fuzzy Number: Threshold value (d)	Triangular Fuzzy Number: Percentage of Expert Consensus (%)	Defuzzification Value: m1	Defuzzification Value: m2	Defuzzification Value: m3	Defuzzification Value: Fuzzy Score (A)	Result: Expert Consensus	Result: Ranking
Resources for teaching motor skills are:									
5.	videos	0.191	87.5%	0.775	0.775	0.775	0.775	ACCEPTED	2
6.	animation/graphics	0.193	87.5%	0.788	0.788	0.788	0.788	ACCEPTED	1
7.	infographics posters	0.229	31.3%	0.700	0.700	0.700	0.700	REJECTED	-
Assessing motor skills among students can be done by:									
8.	ask students to apply motor skills to personal contexts by giving complex problem task and share material produced online in video blog or weblog	0.286	81.3%	0.713	0.713	0.713	0.713	ACCEPTED	2
9.	provide simulations of tasks whereby students need to do and check their performance in virtual worlds (procedures they have to do first, second, etc.)	0.234	81.3%	0.725	0.725	0.725	0.725	ACCEPTED	1

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*$\leq$ 0.2
Percentages of expert consensus $\geq$ 75%
Defuzzification Process: Fuzzy score (A) $\geq$ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module content (motor skills) for the collaborative TPACK module, according to the experts' consensus is shown in Table 5.8. The instructional strategies for teaching motor skills shows that, item 1 to item 4 were accepted by the experts. No ranking was required for First Principles of Instruction since the phases were arranged accordingly from activation, demonstration, application, and integration.

The resources used in teaching motor skills shows that, animation/graphics was ranked the most important resources with the defuzzification value of 0.788. This is followed by videos with the defuzzification value of 0.775. The experts rejected infographics posters.

Providing simulations of tasks whereby, students need to do and check their performances in virtual worlds (procedures they have to do first, second, etc.) was ranked as the most important assessment for teaching motor skills with the defuzzification value of 0.25 followed by ask students to apply motor skills to personal contexts by giving complex problem-task and share material produced online in video blog or weblog with the defuzzification value of 0.713

Table 5.9
The Experts' View on the Collaborative TPACK Module Assessment Based on the FDM

No	Module Assessment	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
	In the CPD programme in this module, it is suggested the problem/task will be given to the instructors to:								
1.	design and develop lesson plan with the subject they are currently been teaching by selecting content areas covers the Gagne's Taxonomy of Learning and use collaborative tools to teach the topic. Instructional strategies should cover the first principles of instruction. Lesson plan will be evaluated by a rubric and a checklist.	0.150	100%	0.813	0.813	0.813	0.813	ACCEPTED	2
2.	provide a portfolio reflecting on their TPACK	0.115	100%	0.850	0.850	0.850	0.850	ACCEPTED	1
3.	record their own teaching and learning that reflect TPACK	0.229	87.5%	0.750	0.750	0.750	0.750	ACCEPTED	4
4.	participate in forum/seminar/colloquium presenting discovery, reflection, and evidence-based to effective teaching and student learning upon completion of the CPD	0.153	100%	0.800	0.800	0.800	0.800	ACCEPTED	3

Note: Condition to be met: Triangular Fuzzy Number:
Threshold value *(d)*≤ 0.2
Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module assessment for the collaborative TPACK module according to the experts' consensus is shown in Table 5.9. Provide a portfolio reflecting on their TPACK was ranked the most important problem/task to be given to the instructors with the defuzzification value of 0.850. This is followed by design and develop a lesson plan with the defuzzification value of 0.813.

Next is participating in forum/seminar/colloquium presenting discovery, reflection, and evidence-based effective teaching and student learning upon completion of the CPD with the defuzzification value of 0.800 and lowest ranked assessment was recorded instructors' own teaching and learning that reflect the TPACK with the defuzzification value of 0.750.

Table 5.10
The Experts' View on the Collaborative TPACK Module Delivery Based on the FDM

No	Module Delivery	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
Skill Level: This module should offer to instructors with:									
1.	basic level (no knowledge and skill in TPACK)	0.229	87.5%	0.750	0.750	0.750	0.750	ACCEPTED	1
2.	intermediate level (participants already have prior knowledge on TPACK and able to explain usage of TPACK in teaching and learning in general context)	0.215	75.0%	0.713	0.713	0.713	0.713	ACCEPTED	3
3.	advance level (participants already have prior knowledge on TPACK and able to design and develop own TPACK based on specific content area)	0.200	81.3%	0.725	0.725	0.725	0.725	ACCEPTED	2
4.	combination of basic, intermediate, and advanced level	0.462	31.3%	0.431	0.431	0.431	0.431	REJECTED	-
Medium of Instruction: The CPD programme for this module, should be conducted as:									
5.	online e-CPD (via LMS)	0.401	50.0%	0.463	0.463	0.463	0.463	REJECTED	-
6.	blended mode (combination of online and face to face. for e.g.: 30 % face to face and 70% online) (via LMS)	0.286	75.0%	0.750	0.750	0.750	0.750	ACCEPTED	1

Table 5.10 (continue)

No	Module Delivery	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
7.	fully face to face	0.506	18.8%	0.450	0.450	0.450	0.450	REJECTED	-
The content of the module (theory and assessment) in the CPD programme should be delivered in such a way that:									
8.	the theory on TPACK, collaborative learning, taxonomy of learning and assessment should be delivered via online to the instructors	0.229	31.3%	0.700	0.700	0.700	0.700	REJECTED	-
9.	the theory on TPACK, collaborative learning, taxonomy of learning and assessment should be delivered via face to face with the instructors	0.217	81.3%	0.738	0.738	0.738	0.738	ACCEPTED	1
The content (technology: collaborative tools) of the module in the CPD programme should be segmented as followings:									
10.	each type of collaborative tools should be taught specially in details (for e.g. what is Wikis, advantages, ways of using Wikis in teaching and learning and get started with Wikis.	0.394	50.0%	0.594	0.594	0.594	0.594	REJECTED	-
11.	each type of collaborative tools should be explored by the instructors by their own.	0.344	50.0%	0.575	0.575	0.575	0.575	REJECTED	-
12.	each type of collaborative tools should be taught based on specific taxonomy of learning	0.215	75.0%	0.713	0.713	0.713	0.713	ACCEPTED	1

Table 5.10 (continue)

No	Module Delivery	Triangular Fuzzy Number		Defuzzification Value				Result	
		Threshold value (d)	Percentage of Expert Consensus (%)	m_1	m_2	m_3	Fuzzy Score (A)	Expert Consensus	Ranking
The pedagogy elements of the module in the CPD programme should be segmented as followings:									
13.	Pedagogical knowledge (PK): Knowledge of teaching methods should be taught separately.	0.442	37.5%	0.488	0.488	0.488	0.488	REJECTED	-
14.	Pedagogical content knowledge (PCK): Subject-specific pedagogical knowledge addressing effective ways of teaching within the discipline or topic area should be taught separately.	0.487	31.3%	0.450	0.450	0.450	0.450	REJECTED	-
15.	Technological pedagogical knowledge (TPK): Knowing how collaborative tools can be used for educational purposes should be taught separately.	0.439	31.3%	0.538	0.538	0.538	0.538	REJECTED	-
16.	All PK, PCK and TPK can be taught as integrative intersection on how collaborative tools can be used for pedagogical purposes to help students learn specific content area	0.191	87.50%	0.800	0.800	0.800	0.800	ACCEPTED	1

Note: Condition to be met: Triangular Fuzzy Number: Threshold value *(d)*≤ 0.2, Percentages of expert consensus ≥ 75%
Defuzzification Process: Fuzzy score (A) ≥ a-cut value of 0.5

The threshold value (d), the percentages of expert consensus, defuzzification value and ranks for each item in the module delivery for the collaborative TPACK module. according to the experts' consensus is shown in Table 5.10. The CPD programme for this module, should be conducted as a basic level, which was ranked higher with the defuzzification value of 0.750. This is followed by advanced and intermediate level with the defuzzification value of 0.725 and 0.713 respectively. The experts rejected a CPD programme, that combined different levels of basic, intermediate, and advanced. The CPD module should be delivered via blended mode, that means the combination of online and face to face was ranked higher with the defuzzification value of 0.750. The experts rejected a CPD programme to be conducted fully online or face—face.

The experts accepted that, delivery of the assessment that consist of lesson plan, portfolio, forum/seminar/colloquium presenting discovery, reflection, and evidence-based effective teaching and student learning should be conducted via face to face with the instructors with the defuzzification value of 0.738. The experts rejected content delivery, that consisted of theoretical component of TPACK, collaborative learning or taxonomy of learning to be delivered via online to the instructors. Next is the content delivery that consists of technology part (collaborative tools) of this module shows that, the experts accepted that, each type of the collaborative tools should be taught based on specific taxonomy of learning with the defuzzification value of 0.713. The experts rejected item that says, each type of collaborative tools should be taught specially in details or explored by the instructors by their own. Finally, the pedagogy part of this module shows that, All PK, PCK and TPK should be taught as integrative intersection on how collaborative tools could be used for pedagogical purposes to help students to learn specific content areas was accepted, by the experts with the defuzzification value of .0800. The experts rejected the element of pedagogical knowledge and pedagogical content knowledge to be taught separately.

Summary of Fuzzy Delphi Method (FDM) Findings.

In order to design and develop the collaborative TPACK module, the overall result of the FDM was selected based on the experts' consensus on the elements. FDM was applied to selecting the elements such as, learning outcomes, content (collaborative tools and Taxonomy of learning), assessment based on the real-world problem and delivery required in the design of the collaborative TPACK module, for the CPD among higher education setting. In addition, the ranking of the selected elements and sub-elements were identified to guide the collaborative TPACK module development. The findings of the FDM as illustrated in Table 5.11 to 5.20

Table 5.11
Summary of Learning Outcomes to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Element	Findings	Rational
Learning Outcomes	1. design and develop lesson plans by integrating appropriate pedagogy and collaborative learning tools based on Gagne's Taxonomy of Learning. (100%) 2. apply suitable collaborative learning tools to teach a specified content area (93.8%) 3. apply suitable collaborative learning tools to teach content area based on Gagne's Taxonomy of Learning (87.5%)	TPACK Framework

From the results, it shows that, in Table 5.11, three learning outcomes would be incorporated in the module, where upon completion of the Collaborative TPACK module the instructors would be able to design and develop lesson plans, by integrating appropriate pedagogy and collaborative learning tools based on Gagne's Taxonomy of

Learning. Next, they were able to apply suitable collaborative learning tools to teach a specified content area and finally, the instructors were able to apply suitable collaborative learning tools to teach content area based on Gagne's Taxonomy of Learning.

Table 5.12
Summary of content (Collaborative Tools) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
Collaborative Tools	Main Collaborative Tools 1. discussion forum (100%) 2. Wikis (100%) 3. Instant Messaging (87.5%) 4. Blog (100%) 5. Podcasts (93.8%) Other tools that support collaborative learning 1. Survey Tools (100%) 2. Students Response system (93.8%) 3. Interactive walls (93.8%) 4. YouTube (93.8%) 5. Microblogs (87.5%) 6. Mind mapping (93.8%) 7. Infographic posters (100%) 8. video development tools for animation/non-animation (93.8%) 9. Virtual Reality (93.8%)	TPACK (Technology Knowledge)

From the findings in Table 5.12, it can be seen that, collaborative learning tools such as discussion forum, Wikis and Instant Messaging are included in the module. These tools are selected because, almost all LMS have embedded and offer essential collaborative tools such as wikis, text messaging/chat and discussion forum to organize and control learners' joint activities, where instructors in higher education institution perform specific instructional tasks, related to learner learning activities using the LMS as a platform (Schoonenboom, 2014).

In addition to that, podcast and blog are also included in the module because in the higher education, the integration of podcasts in the online learning environment has become more common (Caladine, 2008; Copley, 2007) and it may be delivered via LMS or uploaded to the iTunes University, that serves as the podcasting-hosting site (Bolliger, Supanakorn, & Boggs, 2010). On the other hand, blog also an interactive tool for teaching, and that requires minimum effort to create and maintain as to promote collaborative learning since there are no advanced programming skills required for learners to create blogs, by using multimedia elements (Papastergiou et al., 2011).

Previous study by He and Yang (2016) shows that, some collaborative learning tools, such as, Wikis is necessary to be integrated with other collaborate tools, to have positive effect on the collaborative outcome. Therefore, other teaching tools and application include survey tools, student response system, interactive wall, YouTube, microblog, mind mapping, infographic posters, video development tools, and virtual reality are included in the module. Although, virtual reality provides the opportunity to the students to learn topics that is difficult to demonstrate with traditional method, but the high financial cost of the VR system is one of the vital drawbacks, that causes limited application of VR in education (Christou, 2010).

Table 5.13
Summary of Content (Taxonomy of Learning) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
Taxonomy of Learning	1. Instructors should be trained to teach their students intellectual skills (classifying things, applying rules and principles, and solving problems) (100%) 2. Instructors should be trained to teach their students cognitive strategies (developing the thinking and learning skills) (93.8%) 3. Instructors should be trained to develop suitable attitudes among students (affective domain) (93.8%) 4. Instructors should be trained to teach their students motor skills (psychomotor domain) (100%) 5. Instructors should be trained to teach their students verbal information (labels, facts, information. bodies of knowledge) (100%)	TPACK (Content Knowledge)

As Table 5.13 shows, all five taxonomy of learning would be integrated in the module however, more emphasis was given to intellectual skills, cognitive skills, attitude, and motor skills because, all these four skills are needed to develop students higher order thinking skills which is important for 21st century learning for students, not only acquire the knowledge and skills, but also been able to apply them to new situations. Less emphasis is given to verbal information. It is not surprised that, intellectual skills, cognitive skill, attitude, and motor skills are ranked higher than verbal information because learning in higher education should move towards higher level thinking, that allow students to apply problem solving skills and knowledge construction, rather than learning facts and concepts as content (Dewitt et al., 2015; Ronen & Pasher, 2011). Subsequent tables show the taxonomy of learning, which comprise of instructional design based on First Principles of Instruction, resources and evaluation, that instructors could implement, while teaching certain domain of learning. All this will be included in the CPD module.

Table 5.14
Summary of Content (Intellectual Skill) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
First Principles of Instruction	giving students video and graphic diagram to gain their attention and to recall prior knowledge. Collaborative Tools: (e.g. *YouTube, Screencast, Mind Maps) (*93.8%)	Activation
	showing interactive slides, video, existing blogs and podcast to present the content Collaborative Tools: (*e.g. Prezi, Screencast, YouTube, Blogger) (*87.5%)	Demonstration
	student apply new knowledge by participating in an online discussion forum, chat Collaborative Tools: *(e.g. LMS discussion forum/chat/WhatsApp, Facebook) (*87.5%)	Application
	students know 'how to do' by applying intellectual skills into personal contexts by developing content/product Collaborative Tools: *(e.g. Wikis, video development tools, infographic tool-Canva) (*93.8%)	Integration
Other Resource Tools	1. videos *(*93.8%) 2. interactive slides (visual, text, audio) *(*93.8%) 3. animation/graphics *(*93.8%) 4. quiz (75%)	TPACK (Technology Knowledge)
Assessment	1. give problem/task for students to develop content in form of video, infographic posters, interactive slides (100%) 2. give problem/task for students to design products based on principles (87.5)	Problem-Based Task

Finding from Table 5.14 presents that, all four phases of Merrill's' Principle of Instruction are included in the module for teaching intellectual skills. Teaching resources such as video were included, because, teaching procedural knowledge begins with knowing the connection with declarative knowledge using video as teaching medium (Hong, Pi, & Yang, 2016). Also, through video, students are able to exercise and perform the skills learned via practise which is the key important in learning procedural knowledge (Anderson, 2005; Hong et al., 2016). Besides that, other tools such as interactive slides, animation/graphics and quizzes are included in the module.

As reported on the experts' consensus, assessment such as, developing content in form of video, infographic posters, interactive slides and design products, based on principles are incorporated in module because, learning in higher education should not just based on knowledge transmission but for students to have higher level thinking to solve problem, to practice, build and relate the learned knowledge and skills (Dewitt et al., 2015).

Table 5.15
Summary of Content (Cognitive Strategies) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	**Findings**	**Rational**
First Principles of Instruction	asking questions in form of pre-assessment to gain their attention and to recall prior knowledge to make sure students have mastered prerequisite skills Collaborative Tools: *(e.g. Kahoot, Poll Everywhere, Socrative, blog-reflective writing) (*87.5%)	Activation

Table 5.15 (continue)

Elements	Findings	Rational
	restructuring new knowledge through discussion forum, video, interactive slides) Collaborative Tools: *(e.g. discussion forum, YouTube, Screencast)* Scaffolding by providing support to the students when using cognitive strategy (e.g. Instant Messaging: LMS chat, WhatsApp) (93.8%)	Demonstration
First Principles of Instruction	student apply new knowledge by making a mind maps, concept mapping, associate new information with the existing one through paraphrasing, summarizing, note-taking, and questions and answers. Collaborative Tools: (*e.g. Coogle, iMindMap, discussion forum) (*87.5%)	Application
	students engaged in a complex problem solving so that students can design products Collaborative Tools: (*e.g. Wikis, video development tools, infographic tool-Canva, Wiki, discussion forum)* (93.8%)	Integration
Other Resource Tools	1. diagram/concept mapping (93.8%) 2. animation/graphics (93.8%)	TPACK (Technology Knowledge)
Assessment	1. giving cognitively challenging problems to solve so that students need to design products based on analysis of existing situations using animation/graphics and infographic posters to show their own progress and to increases students sense of ownership (100%) 2. giving problem -task in form of project for students develop products in group through Wikis, discussion forum (engaging in debate and argumentation (93.8%)	Problem-Based Task

As Table 5.15 above illustrates, all four phases of Merrill's' Principle of Instruction are included in the module. Teaching resources such as diagram/concept mapping and animation/graphics included in the module because, cognitive strategies assist the learner in remembering what was learned, by constructing an image to words, underlines key sentences and the use of self-questioning to check own understanding, organizing material in an meaningful order, by concept mapping, advance organizer for outlining information (Gagné, 1985; Gredler, 2009).

Assessment such as, giving cognitively challenging problems to solve, so that, students need to design products, based on analysis of existing situations using animation/graphics and infographic posters. A possible explanation for this is that, designing infographic posters is a hands-on problem-based task, that promote deep learning among students to encourage them to be active and independent learners, to take control over their own learning (Tanner & Chapman, 2012). Besides that, through presentation of the infographic posters, students can practise and do their presentations in multiple time and that allows for repetitions task, that has positives effect on students learning (Bygate, 1996). Moreover, cognitive strategies enable the learners to manage their thinking, by identifying the appropriate time the intellectual skills and verbal information can be integrated into the learning process (Gagne, 1984).

Besides that, assessment by giving problem-task in form of project for students to develop products in group, through Wikis, discussion forum to engage them in the debate and argumentation are incorporated in the module. This finding may be explained, by the fact that Wiki based activities significantly able to promote learner achieving higher levels of learning through applying, analysing, synthesising and evaluating the shared knowledge (Altanopoulou et al., 2015; Nichols, 2010; Stafford et al., 2014).

On the other hand, discussion forum activity facilitates collaborative knowledge construction, because, its promote reflective and critical thinking where students can share, learn build knowledge collectively form their peers, thus promotes promote higher-order thinking skills such as, reflective and critical thinking (Gašević et al., 2015; Hew & Cheung, 2013; Kent et al., 2016; Özçinar, 2015)

Table 5.16

Summary of Content (Attitude) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
First Principles of Instruction	give students self-report survey to measure their current attitude as well to gain their attention and to recall prior knowledge by using stories or video Collaborative Tools: *(e.g. YouTube, blog, vblog) (*93.8%)	Activation
	instructors can develop attitude among students by showing an appealing and credible role model through video or animation Collaborative Tools*: (e.g. YouTube, Pawtoon, Animoto)* (75%)	Demonstration
	students producing content in form of video podcasts, video, blog discussion forum) Collaborative Tools: *(e.g. video development tools, vodcast vlog, weblog discussion forum) (87.5%)*	Application
	allowing students to design and develop product as well share the product online. Collaborative Tools*:(e.g. video development tools, vodcast vlog, weblog)* (93.8%)	Integration
Other Resource Tools	1. videos (87.5%) 2. story (text based/web story or blogs) (81.3%)	TPACK (Technology Knowledge)
Assessment	1. asking students to produce an e-portfolio as a self-reflection (93.8%) 2. asking students to share and debate among peers on content produced from video podcasts, video and blog (93.8%)	Problem-Based Task

According to finding presents in Table 5.16, all four phases of Merrill's' Principle of Instruction are included in the module. Teaching resources such as, videos because, past research showed that, video as a medium to develop students' attitude to value individual differences and to increase students' interest in subject taught, since video is a powerful agent to display people's emotion through the audio-visual (Snelson & Elison-Bowers, 2009). Subsequently, most effective ways of changing the learner's attitude are through human model/modeling (Bandura, 1969; Gagne 1971) which could be demonstrated through the use of video. Beside video, learning resources such, web, text-based and blog story are included in the module.

Based on experts' consensus, assessment in a form of e-portfolio as self-reflection and students sharing imbedded in the module because past research showed that, e-portfolio motivates the students throughout their learning to reflect on their learning processes and behaviours (Slepcevic-Zach & Stock, 2018).

Assessment in a form of debating among peers on content produced from podcasts, video, and blog are type of assessment that is needed to developing attitude among students. There are possible explanation for this result because, through blogging activities students are able to socialize, interact, debate and discuss and express themselves with their peers (Alsamadani, 2017). Not only that, producing content in a form of blog promotes higher order thinking skills, by questioning peer's write up critically and syntheses the message from different perspectives (Zawilinski, 2009).

Table 5.17
Summary of Content (Motor Skill) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Element	Findings	Rational
First Principles of Instruction	giving students video to gain their attention and quiz to recall prior knowledge. Collaborative Tools: *(e.g. YouTube, Kahoot, Quizlet)* (81.3%)	Activation
	instructors present the content by showing videos in form of (2D, 3D, or 360º) Collaborative Tools: *(e.g. YouTube, Virtual Reality)* (81.3%)	Demonstration
	students practice the skills repeatedly through simulation, animation/graphic Collaborative Tools: *(e.g. Virtual Reality, video development tools)* (81.3%)	Application
	allowing students to apply motor skills to personal contexts by giving complex problem task and share material produced online Collaborative Tools: *(e.g. Virtual Reality, vodcast vlog, weblog)* (87.5%)	Integration
Other Resource Tools	1. animation/graphics (87.5%) 2. videos (87.5%)	TPACK (Technology Knowledge)
Assessment	1. provide simulations of tasks students need to do and check their performance in virtual worlds (procedures they have to do first, second, etc.) (81.3%) 2. ask students to apply motor skills to personal contexts by giving complex problem task and share material produced online in video blog or weblog (81.3%)	Problem-Based Task

From the finding in Table 5.17, all four phases of Merrill's' Principle of Instruction are included in the module. Teaching resources such as, animation/graphics and video are also incorporated in the module because, according to past study, motor skills were demonstrated through formal lecture, lab session, textbooks, teacher-instruction and live demonstration. This is achievable , with rapid growth of technology that has promoted the use of video and multimedia to support traditional learning and create a cognitive representation to help students to learn better (Ferronato & Hruby, 2011; R. Smith, Cavanaugh, & Allen Moore, 2011).

Moreover, the use of interactive video and instructional media support the learning of motor skills, among students while more time was invested by the lectures for modelling, students' practice and feedback instead of listening to traditional lecture (Salyers, 2007). In addition, assessment in a form of simulations of tasks in the virtual worlds is embodied in the module. This is because, some authors have found out that, simulation based practice and training was very important for novice students in term of boosting their confident levels to perform newly learned skills, in a supportive environment (Işık & Kaya, 2014; Karadag, Caliskan, Korkut, Baykara, & Ozturk, 2012).

Due to that, students in simulation group perform, better in demonstrating the skills learned than the control group (Al-Kadi & Donnon, 2013; Işık & Kaya, 2014; Karadag et al., 2012). Other assessment suggested by the experts was to apply motor skills to personal contexts in a video blog or weblog.

Table 5.18

Summary of content (Verbal Knowledge) to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
First Principles of Instruction	giving students online test/quizzes to gain their attention and to recall prior knowledge. Collaborative Tools: *(e.g. Quizlet, EDPuzzle, Kahoot, Poll Everywhere)* (87.5%)	Activation
	showing video and interactive slides to present the content. Collaborative Tools *(e.g. YouTube Prezi, Screencast, Ed Puzzle)* (93.8%)	Demonstration
	lecturer design exercises to elicit student's performance in order for students to practise the new skill through online test/quizzes in form of multiple choices Collaborative Tools: (*e.g. Quizlet, EDPuzzle, Kahoot, Poll Everywhere)* (93.8%)	Application
	students able to rehearsal, elaboration, and organize verbal knowledge. Collaborative Tools: (*e.g. Peerwise)* (87.5%)	Integration
Other Resource Tools	1. videos (93.8%) 2. quiz (100%) 3. polls (100%) 4. interactive slides (visual, text, audio) (93.8%)	TPACK (Technology Knowledge)
Assessment	1. give test with open-ended questions, short answers, matching answers, labelling diagrams (87.50%) 2. give quiz based on level (basic to advance) in form of summative assessment (81.3%) 3. create platform for students to ask each other questions from what they have learnt (81.3%)	Problem-Based Task

As Table 5.18 presents, all four phases of Merrill's' Principle of Instruction are included in the module. Teaching resources such as, videos is incorporated because video is powerful teaching toolkit, that are able to present knowledge through visual and audio, where learning declarative knowledge (understanding and remembering) could be done easily, with lower cognitive skills via video (Hong et al., 2016). Other tools included in the module such as, quizzes, polls and interactive slides (visual, text, audio).

Based on expert consensus, assessment in a form of test with open-ended questions, short answers, matching answers and labelling diagrams, quizzes from basic to advance level and questioning session with peer were included in the module. The possible explanation for this result, because, assessment through multiple-choice questions (MCQs) quizzes or test for declarative knowledge is a tool, not just to measure students' knowledge gain through recall of facts, definitions, terminologies, concepts, but to promote surface learning, understanding concept and strategies (Abu-Zaid & Khan, 2013).

Table 5.19
Summary of assessment to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
Assessment for the Instructors	1. provide a portfolio reflecting on instructors' TPACK (100%)	Transformative Model Phase 5: (Transfer of knowledge and the retention of expertise)

Table 5.19 (continue)

Elements	Findings	Rational
Assessment for the Instructors	2. design and develop lesson plan with the subject they are currently been teaching by selecting content areas covers the Gagne's Taxonomy of Learning and use collaborative tools to teach the topic. Instructional strategies should cover the first principles of instruction. Lesson plan will be evaluated by a rubric and a checklist (100%)	Transformative Model Phase 2: (Application)
	3. record instructors' own teaching and learning that reflect TPACK (87.5%)	Transformative Model Phase 5: (Transfer of knowledge and the retention of expertise)

Table 5.19 shows different type of assessment agreed by the experts. In that case, assessment such as designing a portfolio reflecting on instructors' TPACK incorporated in the module. This suggestion further supports the idea that, digital portfolio could be used to assess educators understanding and ability to use and teach with technology (Greenhalgh, Rosenberg, Keenan, & Koehler, 2015).

Then, reflection could be an effective strategy to help educator in sharing of practical experiences implementing TPACK in real classroom setting, through collecting of artefacts that showcase their learning and developments (L. Lu, 2014).

Besides the e-portfolio, assessment in from of developing a lesson plan was also included in the module, as one of the tasks for the instructors. These results agreed with the findings of other studies that, lesson plans were one of the ways of assessing authentic activities to evidence educators' TPACK (J. Harris et al., 2010). Recording own teaching and learning would be conducted as a lesson observation to assess instructors' ability to demonstrate teaching with TPACK as previous research indicated that, classroom observation as one of the important methods to evaluate instructors' potential to apply TPACK in their lessons (Kwangsawad, 2016).

Participating in forum/seminar/colloquium presenting discovery, reflection, and evidence-based effective teaching and student learning were excluded from the module due to lack of resources such as time, money, and manpower.

Table 5.20
Summary of Delivery to be included in the collaborative TPACK module for CPD programme based on experts' consensus

Elements	Findings	Rational
Skill Level	basic level (less knowledge and skills in TPACK) (87.5%)	-
Medium of Instruction	blended mode (combination of online and face to face. for e.g.: 30 % face to face and 70% online via LMS) (75%)	Transformative Model
Content Delivery (Theory and Assessment)	the theory on TPACK, collaborative learning, taxonomy of learning and assessment should be delivered via face to face with the instructors (81.3%)	
Pedagogy (Teaching about Collaborative Tools)	each type of collaborative tools should be taught based on specific taxonomy of learning (75%)	TPACK Framework
Pedagogy (Teaching about pedagogy, content, and technology)	All PK, PCK and TPK can be taught as integrative intersection on how collaborative tools can be used for pedagogical purposes to help students learn specific content area (87.5%)	

Based on Table 5.20 above, the module offers to train the instructors from the basic level of knowledge and skills in TPACK, due to the results obtained from the pilot test that was conducted among thirty-four instructors. From the knowledge test on collaborative tool and domains of learning, it shows that, the instructor's ability to identify/select collaborative tools to teach the knowledge/skills needed improvement.

At the same time, the instructor's ability to use tools for purpose of collaboration is below expectation.

The medium of instruction of this CPD would be blended learning conducted in University LMS whereby, the all the theory and in class assessment would be carried out face to face in the training room. However online assessment such as reflection, portfolio and survey were conducted online. In the module, the elements of TPACK which consisted of technology (collaborative learning tools) would be demonstrated, based on a specific taxonomy of learning outcome.

Pedagogy aspect of the module such as PK, PCK and TPCK would be included in the module as integrative intersection on incorporating collaborative learning tools into appropriate pedagogy to help students to learn specific content area. This finding might be explained by the facts that, there is need to effectively integrate technology into instruction, the instructors need to have a good understanding of how technology could be incorporated together with pedagogy and content knowledge (Hughes, 2005; Margerum-Leys & Marx, 2002; Niess, 2005; Zhao, 2003).

Development of The Module

The collaborative TPACK module development took into account, the input from the FDM and the information that was gathered from experts' reviews. The development of the collaborative module was be discussed according to the following;

i. collaborative TPACK module for CPD
ii. evaluation of the Collaborative TPACK module
iii. development of the platforms for Collaborative TPACK module delivery
iv. development of Collaborative TPACK module resources
v. development of Collaborative TPACK module assessment

Collaborative TPACK module for CPD

After taking consideration of the findings from the panel of experts in the FDM, the module that was developed consisted of a cover page, module's aim, learning outcome, module structure, module outline and the CPD schedules. Besides that, CPD phases, delivery mode, assessment criteria, module material and resources such as, power point slides, diagrams are included. In addition, the CPD plan for all the three sessions consists of lesson overview and duration were also incorporated.

Furthermore, all the assessment and evaluation in a form of surveys and test were also included in the module. Rubric and checklist for the lesson observation, as well as, the lesson plan was integrated into the Collaborative TPACK module.

Evaluation of the Collaborative TPACK module

Once the module was developed, four experts evaluated it and the experts validated the module by using a checklist listing the present elements in the Transformative Model for CPD and Merrill's First Principles (*see Appendix U).* 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 Jamaluddin Ahmad (2005).

The module was reviewed by the four experts from the area of Instructional Design, Educational Technology and Continuing Professional Education and Teacher Education. The experts evaluated the designed module and provided suggestions and opinions during the meeting session. Overall based on the checklist, all the experts agreed that, module was incorporated with elements that formed the Transformative Model for CPD and Merrill's First Principles.

In addition, all the experts also agreed that, the module meet the expectation from the aspect of target population, successful implementation, duration planned, and purpose of the module to help to develop instructors TPACK. From the learning outcomes part, experts agreed that, the module were clearly defined, relevant and challenging to the target audience for CPD purpose. They also agreed that, the module covered topics, that are relevant, organized and easy to follow. The module content was also accurate, up-to-date and reflective of the current best practice of teaching with TPACK.

Besides that, experts agreed that, the assessment methods were appropriate to the learning outcome of the module and clear directions were given for each task, that the instructors were expected to do. For the module delivery, all the experts agreed that, the blended learning method, that was used in the module could support the learning outcome and activities in both face to face and online. At the same time, the experts agreed that, the supportive information provided in the module such as, journal article, sample of lesson plans, videos and diagrams were useful for the instructor's learning.

When the experts evaluated the task-centred learning, all the experts agreed that, the CPD plan clearly described the activities performed for the Phase 2 which was the demonstration/modelling and the Phase 5 which was transfer of knowledge and the retention of expertise. The experts agreed that, the task that was given to the instructors was based on the real-world problem, covered the whole teaching with TPACK that allowed them to be able to demonstrate TPACK in their own teaching and learning.

They also agreed that, the task such as reflection journal, designing a lesson plan, e-portfolio, knowledge test and TPACK self-assessment support the development of TPACK among the instructors. The experts indicated their consents on the task-centred learning for the Phase 1 which was the comprehension phase. Two experts suggested that, the CPD plan should include suitable activities to measure the instructors' knowledge and understanding in the comprehension phase. According to Expert 1, "*I think, suitable activities for comprehension phase with suitable technology need to be included in the CPD plan*". As stated by Expert 2, "*after understanding the concepts and the theoretical part, how do we measure the participants understanding? I think it's good to have activities in this phase".*

They felt that, comprehension stage was not the only phase of understanding the general concepts of TPACK and its definitions, benefits, and possible application, but, also a phase to measure the instructor's ability to understand those concepts via appropriate activities. Next, one expert was concerned about the coaching and feedback elements in the Phase 3, Application was not mention in detail, on how the coaching and feedback should be carried out in the CPD plan. As mention by Expert 1, "*I suggest to include more details on coaching and feedback process in the CPD plan for a clear guideline especially for Application phase".*

Three experts suggested to have reflection activities after each CPD session besides having a survey at the end of the module. Based on Expert 3 and 4, *"Although there is Phase 4, reflection, it is also essential to add some reflection question after each end of each CPD session*". In the opinion of Expert 2, "*reflection question is like debrief questions which the most important ones to ask after a lesson, in this example to be asked after each CPD session".* The experts felt that, the reflection would help the instructors to self-examine their learning after each session.

Based on the open-ended questions at the end of the checklist, the panel of experts indicated their comments on the Collaborative TPACK module. All the experts provided their views and comments on the strengths, weaknesses, and areas for improvement. According to the Expert 1, "*A good module consisting of both online and offline activities covered by the Collaborative TPACK module".* Expert 2 said, *"The continuous and progressive feedback and reflection activities is the strength of this module".*

Experts 3 also indicated that, *"This module has a high reliability of study and the information contained in this module is sufficient"*. Finally, Expert 4 said that, "*The module covers everything, holistic from the aspect of content, application, reflection and the follow-up. Great transformative approach".* Furthermore, the experts also suggested some improvements such as:

1) include conceptual definition of 'instructors' and 'trainer' in the module (as a footnote probably).
2) Change the 'lesson plan' to 'CPD plan' since the term is more suitable for this study
3) include activities column with a detail description in the CPD plan
4) remove the principles stated in the CPD plan since its already integrated in the lesson overview
5) include 'resources/tools column in the CPD plan
6) reconstruct 'self-reflection questions' based on (C. Campbell & Deed, 2009)
7) adopt teacher/lecturer six professional life phase by (Christopher Day & Gu, 2010) in all surveys for demographic question on the 'teaching experience(s)'

After editing the module based on the panel of experts' feedback, the Collaborative TPACK module was developed in the institutional platform, LMS.

Development of the platform for delivering the Collaborative TPACK module. Based on the experts' consensus, the institutional LMS could be used, to deliver the module in the CPD. Hence, in this study the institutional LMS was selected as a medium to deliver the module, since, this Moodle was based on open-source was readily available at no cost for the instructors to use in the university.

Besides that, LMS is also available on mobile and tablet which runs on Android and iOS so that, the instructors could access the Collaborative TPACK module resources and media content anywhere, anytime. Before accessing the module in LMS, instructors need to log into institutional LSM. Once instructors logged in to the LMS, there is a preview of the information page of the Collaborative TPACK module (*see Appendix V)* In the preview page, instructors were given brief introduction to the purpose and learning outcome of the Collaborative TPACK module. In addition, principle researcher name, supervisors name, sponsorship and ethical approval information were included.

In the Collaborative TPACK module, there are components of "Before the CPD" session, "During the CPD" session and "After the CPD" session. Therefore, in the current study, instructional, material and resources were designed to be organized systematically into folders on the LMS, according to the three lessons planned (*see Appendix W)*. "Before the CPD" session, the instructors were given a survey of Pre-Test on their prior Knowledge of the Collaborative Learning and the CL tools, as well as, the TPACK self-assessment. "During the CPD" session, the CPD plans were divided into Pedagogies and Instructional Strategy Module and Collaborative TPACK Module.

Each CPD plan consisted of instructional material and resources used, during delivery of Collaborative TPACK module. "After the CPD" session was divided into module reflection and follow-up. The module reflection consisted of survey of Post-Test on Knowledge of Collaborative Learning and CL tools, TPACK self-assessment and Instructors Perception on Technical and Pedagogical Usability of the module.

The Collaborative TPACK Module Follow-up section contains guidelines for instructors to design an e-portfolio with TPACK in their teaching and learning. Figure 5.1 shows the summary of before, during and after component of the Collaborative TPACK module development in the LMS platform.

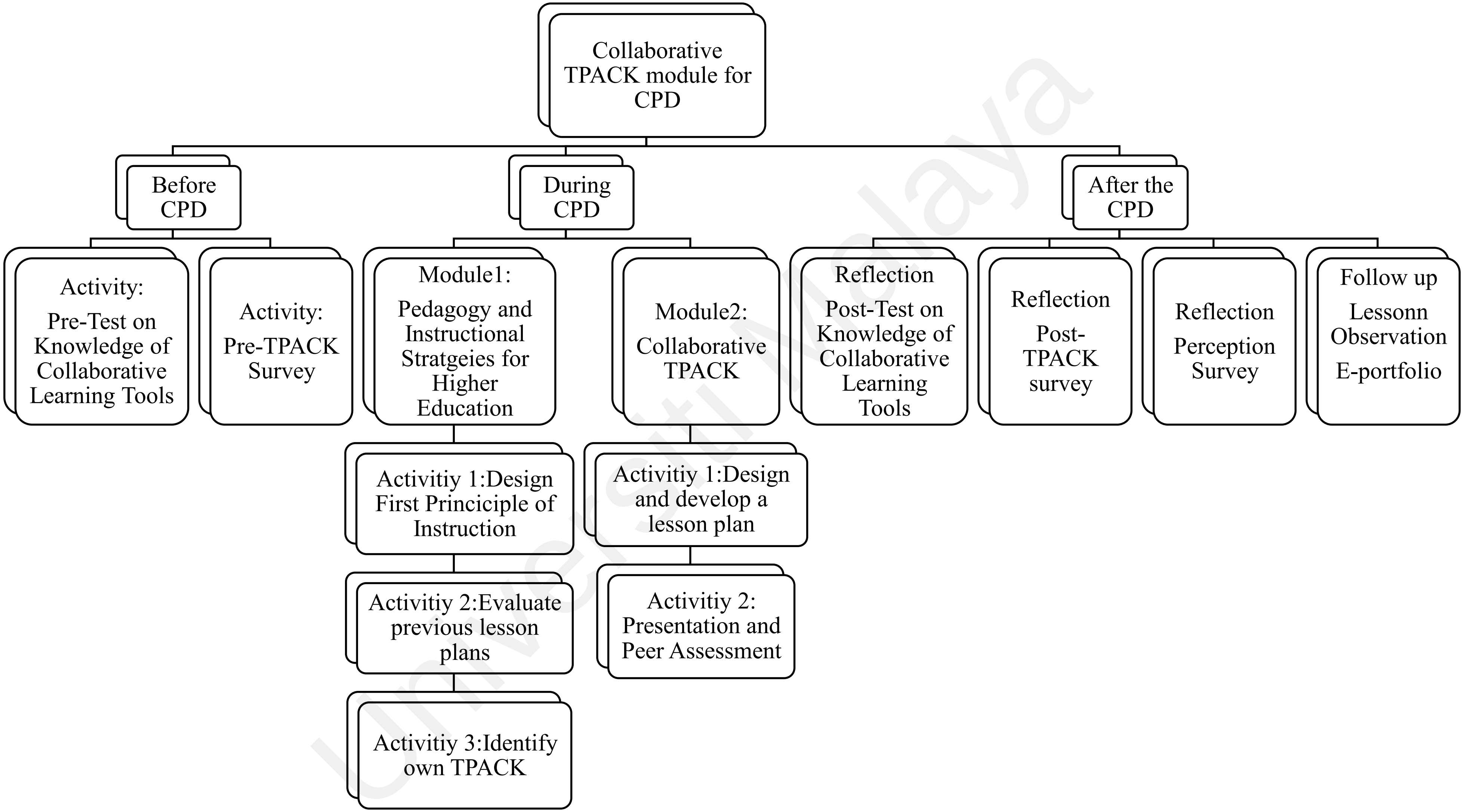

Figure 5.1 Summary of before, during and after component of the Collaborative TPACK module developed in the LMS platform

Development of Collaborative TPACK module resources page

The module resource page was designed so that, instructors could access the link to read the materials shared on a webpage that was designed using Adobe Spark (*see Appendix X).* The resource page contains diagrams on the different type of collaborative learning tools and its usage, which was developed based on literature.

To support the instructors teaching with TPACK, matrix of First Principles of Instruction was designed based on different taxonomy of learning of verbal knowledge, intellectual skills, cognitive strategic, attitude and motor skills. These matrixes were developed based on the experts' opinion and consensus.

Besides that, videos were created using Window Movie Maker to demonstrate the usage of different type of collaborative learning tools such as, Wikis, Podcasts, Discussion Forum, Blog, Padlet, Augmented Reality and many more. Table 5.21 presents the summary of the type of resources and CPD material developed for the module.

Table 5.21
Summary of the type of resources and CPD material developed for the module

Developed Resources/Materials	Application Used	Phase Used	Module
Interactive Slides	Nearpod	Comprehension and Modeling	All modules
Presentation Slides	Ms Power Point	Comprehension and Modeling	All modules
Animation Video on Pedagogy	PowToon	Comprehension	Pedagogy and Instructional Strategies for Higher Education
Video on Collaborative vs Cooperative	YouTube	Modeling	Pedagogy and Instructional Strategies for Higher Education
Collaborative TPACK resource page	Adobe Spark	Modeling	All modules

Table 5.21 (continue)

Developed Resources/Materials	Application Used	Phase Used	Module
Interactive Quiz	Socrative	Comprehension	Pedagogy and Instructional Strategies for Higher Education
Collaborative Diagram	Lucid chart	Application	Pedagogy and Instructional Strategies for Higher Education
TPACK idea	Padlet	Application	Pedagogy and Instructional Strategies for Higher Education
Reflection Activity	Padlet	Reflection	All modules
Poll Activity	Poll Everywhere	Comprehension	TPACK
TPACK video	YouTube	Comprehension	TPACK
Interactive Quiz	Kahoot	Comprehension	TPACK
Lesson Plan Activity	Wiki	Application	TPACK

Development of Collaborative TPACK module assessment

In the Collaborative TPACK module, instructors were given an entry level Pre-Test to determine their prior Knowledge of Collaborative Learning and CL tools as well as Pre-Survey on TPACK self-assessment through Google Form. This was to obtain the instructors' awareness and knowledge pertaining to collaborative learning, CL tools and their own TPACK before the module implementation.

A score would be generated to represent the pre-test and TPACK self-assessment. During the module implementation, the instructors were given a problem-based task to design a lesson plan in a group on a specific unit of their choices upon, by developing a Wiki page in the LMS. After the development of the lesson plan, each group presented their works for peer assessment and trainers' feedback.

Groups that obtained higher scored, based on peer evaluation were given token of appreciated to acknowledge their inputs. After the end of module implementation, instructors were given Post-Test on Knowledge of Collaborative Learning and CL tools and Post-Survey on TPACK self-assessment to determine instructors' knowledge and skills after attending the Collaborative TPACK module CPD.

A score would be generated to represent the post-test and post-survey on TPACK self-assessment to compare the scores before and after the module implementation. As part of follow up session, instructors were assess based on lesson plan designed for the respective class using a rubric. Besides that, instructors also evaluated during the class observation to determine their abilities to apply the knowledge and skills on TPACK, First Principles of Instruction and collaborative learning tools in their teaching and learning sessions. Scores are awarded for lesson observation based on a rubric. Table 5.22 presents the summary of the type of assessment developed for the module

Table 5.22
Summary of the type of assessment developed for the module

Developed Assessment	**Application Used**	**Phase Used**
Pre-Test on Knowledge of Collaborative Learning and CL tools	Google Form	Before the module implementation
Pre-Survey of TPACK	Google Form	Before the module implementation
Peer Assessment	Poll Everywhere	Application
Post-Test on Knowledge of Collaborative Learning and CL tools	Google Form	Reflection
Post-Survey of TPACK	Google Form	Reflection
Lesson Plan	-	Knowledge retention and Transfer (Follow-up)
Lesson Observation	-	Knowledge retention and Transfer (Follow-up)

Conclusion

This chapter reported on the design and development phase of the Collaborative TPACK module for CPD in higher education. The Fuzzy Delphi Method (FDM) which adopted was for the design phase, where sixteen experts obtained consensus on the design elements of the module. Based on the consensus, the most preferred content (instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery were ranked for the development of the module. The module was developed, based on the First Principles of Instruction (Merrill, 2013) and the Transformative Model. The developed module was evaluated by the panel of experts before the module was made available on the institutional learning platform, LMS. Next, chapter discussed the implementation and evaluation phase of the Collaborative TPACK module for CPD in higher education.

CHAPTER 6

IMPLEMENTATION AND EVALUATION

Introduction

This is the final phase of the study that discusses the research findings from the evaluation of the Collaborative TPACK module. The objectives of this phase are to i) assess the effectiveness of Collaborative TPACK module in developing instructors TPACK ii) assess the effectiveness of Collaborative TPACK module in developing instructors TPACK for different domains of learning and iii) explore instructors 'perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD. In this study, quasi- experimental design which focuses one group of instructors was applied. In this chapter, the implementation and evaluation of Collaborative TPACK module was reported based on

i. Collaborative TPACK module implementation
ii. effectiveness of the Collaborative TPACK module in developing instructors' TPACK
iii. effectiveness of the Collaborative TPACK module in developing instructors' TPACK for different taxonomy of learning
iv. evaluation of perception on the technical and pedagogical usability pertaining to Collaborative TPACK module for CPD

Collaborative TPACK Module Implementation

After the Collaborative TPACK module was evaluated and modified accordingly based on the panel of expert's opinion and suggestion, the module was implemented among thirty-four instructors from various faculties who voluntary joined the CPD. The CPD sessions were conducted by a trainer and an assistant trainer. The implementation of the CPD was conducted in two cohorts. First cohort of CPD is implemented from 21st till 23th November 2018 and the second cohort was from 3rd till 5th December 2018 at a public university in Klang Valley. The process of the Collaborative TPACK module implementation is shown in Table 6.1

Table 6.1
Implementation Phase of Collaborative TPACK Module

Implementation Phase	Duration
Welcoming Distribution of Informed Consent Form Pre-Test on Knowledge of Collaborative Learning and CT Tools Pre-TPACK	30 minutes
Intervention (Collaborative TPACK Module)	15 hours face to face splits into 3 sessions
Post-Test on Knowledge of Collaborative Learning and CT Tools Post-TPACK Perception Survey	1 week (online)
Follow up Lesson Planning Lesson Observation E-portfolio	1 month

Effectiveness of the Collaborative TPACK Module in Developing Instructors TPACK

In order to answer the first research question, to assess the effectiveness of the Collaborative TPACK module in developing the instructors TPACK, it was necessary to investigate whether the instructors have developed the TPACK skills after undergoing the CPD with Collaborative TPACK module. Hence, data were analysed from the pre-TPACK survey and post-TPACK score. This was because previous research shows that, measurement gained from the instructors TPACK through self-assessment survey was as important as self-reflection about individual knowledge and could increase the confidence in TPACK than their actual gains in practice. Hence, self-reported data should be triangulated with different sources to investigate the effectiveness of the module in developing instructors' TPACK and the complex nature of the TPACK framework with several constructs that suggested that, self-reported itself was insufficient to measure the instructors' TPACK (Ansyari, 2015; Harris et al., 2010; Kwangsawad, 2016).

Therefore, the self-reported TPACK survey was triangulated with the lesson plan score; lesson observation score and post-lesson observation interview. Besides that, findings from the post lesson observation interview also offered an effective way to capture the thick and rich description about the phenomena. To answer the research question, a null hypothesis was formulated based on research question as following:

H_0: There is no significant difference between the pre-TPACK survey and post-TPACK score due to the implementation of the Collaborative TPACK module.

Since the nature of this study is quasi experimental hence the focus of the study was the Pre-TPACK survey and the Post-TPACK survey of the one group instructors. To determine, if a parametric or a nonparametric test was to be used to identify if there was a significant difference between the Pre-TPACK survey and Post-TPACK survey, a normality test was done.

Normality Test for Pre and Post-TPACK Survey Scores

In statistic test, assessment of the normality of data is necessary and vital based on the assumption that the data follows a normal distribution (Ghasemi & Zahediasl, 2012). Normality could be done, based on two main methods of using visual or graphical method and numerical method. Data that presented visually for checking the normality were the frequency distribution (histogram), stem-and-leaf plot, boxplot, P-P plot (prob- ability-probability plot), and Q-Q plot (quantile-quantile plot) (Field, 2009). Meanwhile, the numerical tests were additional to the visual assessment of normality such as symmetry (skewness) and pointiness (kurtosis) and other statistical test for the assessment of normality were Kolmogorov-Smirnov (K-S) test and Shapiro-Wilk test (Öztuna, Elhan, & Tüccar, 2006). After conducting the normality test, the *p*-value for pre-test (0.004) and post-test (0.043) was smaller than 0.05, hence data was not normally distributed as presented in Table 6.2.

Table 6.2
Test of Normality for Pre and Post TPACK

Test	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pre-test	.207	34	.001	.896	34	.004
Post-test	.129	34	.164	.935	34	.043

Wilcoxon Matched-pairs Signed Ranks Test

When data is not normally distributed and then the assumption has been violated, thus the non-parametric alternative test is Wilcoxon matched-pairs signed ranks test as presented in Table 6.3 and 6.4 below.

Table 6.3
Wilcoxon matched pairs signed ranks test

	post - pre
Z	-5.089[b]
Asymp. Sig. (2-tailed)	.000

Table 6.4
Median of the Pre-TPACK and Post-TPACK

				Percentiles		
	N	**Mean**	**Std. Deviation**	**25th**	**50th (Median)**	**75th**
Pre-test	34	4.95	1.05	4.60	5.34	5.73
Post-test	34	6.27	.50	5.99	6.18	6.64

By examining the results in Table 6.3 and Table 6.4, a Wilcoxon matched-pairs signed rank test was conducted to determine whether there was a significant increase in the score of the pre-TPACK survey and post-TPACK survey due to the implementation of the Collaborative TPACK module. The Wilcoxon matched-pairs signed rank test indicated the median Post-TPACK survey score (*Md*=6.18), were statistically higher than the median Pre-TPACK survey score (*Md*=5.34), $z = -5.089$, $p < .001$, and the increase was large ($r = -.87$).

Therefore, the null hypothesis is rejected. Based on this result, it could be concluded that, a Wilcoxon matched-pairs signed rank test showed that, 15 hours, 3 sessions of Collaborative TPACK module did elicit a statistically significant change in TPACK development among instructors. This shows that, Collaborative TPACK module effectively developed instructors' TPACK from the transformative experience gained from the module implementation.

Lesson Plan Scores

The Collaborative TPACK module seems to effectively develops instructors' TPACK which was also evident from the score of lesson plan designed by the instructors. Lesson plan was scored based on a rubric to determine the use of collaborative learning tools (technology knowledge) compatible with the content taught (content knowledge) and the instructional strategies (pedagogical knowledge) as presented in Table 6.5

Table 6.5
Instructors 'Score based on Lesson Plan Rubric

Criteria	Instructors' Score (%)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Learning Outcome(s) & Collaborative Tool(s) Content based technology use **(TCK)**	33.3	33.3	33.3	33.3	25.0	25.0	25.0
Instructional Strategies & Collaborative Tool(s) Using collaborative tool(s) in teaching/learning **(TPK)**	33.3	25.0	25.0	33.3	25.0	25.0	25.0
Collaborative Tool(s) Compatibility with content & instructional strategies **(TPACK)**	33.3	33.3	33.3	33.3	33.3	33.3	25.0
TOTAL SCORE	100	92	92	100	83.3	83.3	75

According to Table 6.5, four instructors were able to select collaborative learning tools that were strongly aligned with course learning outcome, but other three instructors were only able to choose collaborative learning tools in their teaching, that just aligned with the course learning outcome in the first criteria. In the second criteria, only two instructors were able to determine collaborative learning tools, that optimally supports the teaching and learning process. However, about five of the instructors were able to select collaborative tools that basically supports the pedagogy and students learning.

In the third criteria, six instructors were able to choose collaborative learning tools which were ideal with the content taught and the instructional strategies. Even though, one instructor was able to choose appropriate collaborative learning tools, but the selection was not exemplary, based on content taught and the pedagogical strategies. Therefore, it could be concluded that, overall seven instructors were able to apply the TPACK framework, that emerges from an interaction of technology, pedagogy and content knowledge when they are able to determine collaborative learning tools that is compatible with subject taught and the instructional strategies.

Lesson Observation Scores

The Collaborative TPACK module seems to effectively develops instructors' TPACK which was also evident from the lesson observation that was scored based on a checklist to determine the application of the First Principles of Instruction phases in teaching and learning as presented in Table 6.6

Table 6.6
Instructors 'Score based on Lesson Observation Rubric

Principle of Instruction	**Instructors' Score (%)** ***n*=7**
Problem-Centred	
Does the lessons show learners the task they would be able to do or the problem they would be able to solve as a result of completing a lesson or unit?	100
Activation	
Does the lesson direct learners to recall, relate, describe, or apply knowledge from relevant past experience that could be used as a foundation for new knowledge?	100
If learners already know some of the content, are they given an opportunity to demonstrate their previously acquired knowledge or skill?	100
Demonstration	
Does the lesson demonstrate [show examples] of what is to be learned rather than merely tell information about what is to be learned?	100
Are the demonstrations (examples) consistent with the content being taught?	100
Is media relevant to the content and used to enhance learning?	100

Table 6.6 (continue)

Principle of Instruction	**Instructors' Score (%)** ***n*=7**
Application	
Do students have an opportunity to practice and apply their newly acquired knowledge or skill?	100
Does the lesson require learners to use new knowledge or skill to solve a varied sequence of problems	100
Do learners receive corrective feedback on their performance?	100
Integration	
Does the lesson provide an opportunity for learners to publicly demonstrate their new knowledge or skill?	71.4
Does the lesson provide an opportunity for learners to reflect on, discuss, and defend their new knowledge or skill?	100

Based on Table 6.6, there are four phases in the First Principles of Instruction; activation, demonstration, application, and integration. In each phase, the detail description of principle of instruction were observed to determine the application of the First Principles of Instruction phases in teaching and learning of the seven instructors. For problem-centred, all seven instructors (100%) were able to demonstrate either the relevant problem or task, that the students were able to perform, upon completing particular lesson or course. In the activation phase, all seven instructors (100%) were able to activate students' prior knowledge about the subject to prepare them to learn.

During the activation phase, students were able to recall and relate the past experience as well as, to demonstrate their previously acquired knowledge with the use of variety collaborative learning tools such as Kahoot, Padlet, video and QR Code and software such as, Blendspace. Following that, in the demonstration phase, all seven instructors (100%) were able to provide various examples in a form of diagram, newspaper clipping on the topic being taught and the examples were accordant with the lesson. Instructors also demonstrated new knowledge and skills to the students by using variety collaborative learning tools such as, podcast, Microsoft Sway blog and presentation as well as, video to show the students how to perform the real-world problem or task.

Subsequently, in application phase, all the seven instructors (100%) were able to provide opportunity for the students to practice the skills and knowledge in solving the given problem or task by producing infographics, participating in peer assessments, online quizzes and interactive presentation. After successful complication of the task, the students were given feedback on their achievements either on the same day of the lesson or on the following week. One of the instructors used survey tool such as Poll, everywhere for peer assessment on the task they had completed. Another instructor used students' response system such as, Socrative and Kahoot to provide instant feedback on the students' performance. Besides that, there was instructors who provided feedback by commenting and discussing the answers based on student's work posted on the Padlet wall, so, interactive wall Padlet was used as a medium of brainstorming and immediate feedback on students' activities.

Instructors design the learning task by incorporating activities by using collaborative learning tools such as, Kahoot, Padlet, Socrative and computing software such as, MATLAB. Thereafter, in the final phase, integration, only 71.4% (*n*=4) instructors were able to create opportunity for the students to publicly integrate the new learned knowledge and skills. Most of the integration happened in a form of oral and multimedia presentation whereby, after extensive research, students were able to present their solutions to the given problem. Students also used collaborative learning tools such as, Padlet and Kahoot as part of their reflections and discussions on new learned knowledge and skills. One of the instructors also encouraged the students to produce material in a form of infographic posters to be shared, during the class presentation. All the activities carried out in all four phases were recorded in an e-portfolio (*see Appendix T).*

Post Lesson Observation Interview

The Collaborative TPACK module seems to be effectively developed instructors' TPACK also supported, by the post lesson observation interview which was conducted with the instructors after the teaching and learning. All the seven instructors acknowledge that, after undergoing the transformative process of Collaborative TPACK module, their TPACK had developed significantly in term of **building confidence to integrate TPACK in teaching**; **create awareness and opportunity to practice TPACK**; and **build knowledge and skill to teach effectively.** Quotations with pseudonym from the transcripts were presented to highlight needs that were important to instructors.

Building confidence to integrate TPACK in teaching. From the interview data, it shows that, instructor agreed that, their confidence level in incorporating technology in subject area increased after the implementation of the Collaborative TPACK module.

> *The module has also built my confidence level from below 50% to above 50% now. I wasn't sure how the flip-classroom will work when I decided to develop the Podcast and allow the students to watch before coming to class. Previously, I deliver the lecture in the classroom but like today, we had more time to focus on the activities which the students need more of my assistance. I feel it's more flexible and more relaxed since I have the chance to do more activities together with my students rather than I just deliver the lecture and them just listening* [Dr.1:248-253]

Before from not knowing TPACK and now I get to know about TPACK, I feel more confidence using it. I also plan, probably use other technology platforms that is suitable to be used in my class [Dr.4:151-154]

Create awareness and an opportunity to practice TPACK. The interview data also shows that, the Collaborative TPACK module provided an opportunity for the instructors not only to learn the concept of TPACK, but also to incorporate the application part, that allows them to work collaboratively on various task especially designing the lesson plan in respective subject areas.

The module has developed my TPACK skills, increase awareness and also the desire wanted to apply in my teaching and learning………The Collaborative TPACK module gave me the opportunity to learn the concept, practice during the session as also apply it in our own teaching and learning session. As a lecturer, I find out that the module is very good, and I learned new things because I believe teaching should go beyond talk and chalk [Dr.2:229-232]

Yea, I strongly agree about that especially the practical part where we were given a task to prepare the teaching plan in groups, so we able to we apply what we have learned throughout the CPD. Besides that, we presented the lesson plan and the trainer provided us instant feedback and opinion on our work which has a good impact and gave me motivation to apply in my teaching and learning [Dr.5:267-273].

Build knowledge and skill to teach effectively with TPACK. Collaborative TPACK module has transform instructors from not-knowing to knowing TPACK. Hence the module had built instructors knowledge and skills to apply TPACK with appropriate instructional strategies to promote effective learning experiences for their students.

Before attending the Collaborative TPACK module CPD, I don't know about TPACK. This is because I was not taught to teach, and my teachings are based on my understanding of how my lecturer used to teach me during my undergraduate times, so I presented my teaching in the similar way. However, after learning from the *module, I able to learn and apply different ways to deliver and conduct my lesson. The module indeed very useful* [Dr.1:98-103].

Yes, the module has developed my TPACK from the technological aspect and pedagogy when planning the lesson. This is because I never been taught to plan lesson hence most of my teachings are based on my past experiences and how comfortable I feel. However, like everyone else I was using PowerPoint and that's it. However, after attending the Collaborative TPACK module CPD, I know that there are instructional strategies to design successful teaching plan that will benefit myself as well as students learning which I am using at the moment in my class [Dr.4:187-194]

As a result, data from the pre and post-test; lesson plan and lesson observation scores; and the interview excerpt shows that, the Collaborative TPACK module significantly developed instructors TPACK by applying the knowledge and skills they had acquired during the module implementation in to their teaching and learning. The module has not only created awareness and knowledge among the instructors, but also allow the instructors to be advance and expert in practising TPACK in their respective subject area. Next section attempts to answer the second research question.

Effectiveness of the Collaborative TPACK Module in Developing Instructors' TPACK for Different Taxonomy of Learning

In order to assess the effectiveness of the Collaborative TPACK module in developing the instructors TPACK for different taxonomy of learning, it is necessary to investigate whether the instructors have acquired sufficient knowledge and skills in collaborative learning and CL tools for different taxonomy of learning after undertaking the CPD with Collaborative TPACK module. Hence, data were analysed from the pre-test and post-test score on Knowledge of Collaborative Learning Tools. Besides that, findings from the lesson observation were also used for triangulation purpose. To answer the research question, a null hypothesis was formulated based on research question as following:

H_0: There is no significant difference between the pre-test and the post-test on Knowledge of Collaborative Learning and CL Tools in teaching different taxonomy of learning scores due to the implementation of the Collaborative TPACK module

To determine if a parametric or a nonparametric test was to be used to identify if there was a significant difference between the pre-test and post-test on Knowledge of Collaborative Learning Tools, a normality test was carried out.

Normality Test on the Pre and Post-Test Scores on Knowledge of Collaborative Learning Tools

Based on the normality result, Table 6.7 show the skewness value for pre-test is -0.091 (*SE*= 0.403) and kurtosis is -0.1467 (*SE*=0.788). Meanwhile post-test is -0.04 (*SE*= 0.403) and kurtosis is -0.097 (*SE*=0.788). Skewness and kurtosis values are within the range of +/-2(*SE*) are consider normal. Hence, applying this rule, normality is evidence.

Table 6.7
Skewness and Kurtosis for Pre and Post Test

	Statistic		**Std. Error**
	Mean	11.2059	0.84733
Pre-test	Skewness	0.494	0.403
	Kurtosis	-0.642	0.788
	Mean	24.0294	1.18328
Post-test	Skewness	0.363	0.403
	Kurtosis	-0.691	0.788

Since there were thirty-four participants in this study, Shapiro-Wilk normality test was used and these test was recommended for a sample size of less than 50 and exhibited more statistical power with small sample size (Elliott & Woodward, 2007). Based on the Shapiro-Walk table, *p*- value for pre-test (0.145) and post-test is (0.264) which much larger than 0.05 hence, the null hypothesis that the pre and post-test that were normally distributed should be accepted at the 5% level. Therefore, the pre and post-test are normally distributed as shown in Table 6.8

Table 6.8
Test of Normality for Pre and Post Test on Knowledge of Collaborative Learning and CL Tool

Test	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pre-test	.171	34	.113	.935	34	.145
Post-test	.111	34	.200	.961	34	.264

The analysis shows in Table 6.8 show the result for testing normality of data using Shapiro-Wilk value. Based on the finding, the sig value for Shapiro-Wilk is (0.145) for the pre-test and (0.264) for post-test and sig. value of more than 0.05 indicated normality. Since the sig value for both pre and post-test were greater than α=0.05, so the data was normally distributed. Next, to identify the significant in mean differences, comparison of the two tests and the paired t-test was conducted.

Paired Sample t-test for Knowledge of Collaborative Learning and CL Tool

According to Table 6.9, the paired sample t-test result shows the different scores in instructors' knowledge in collaborative learning and CL tool in teaching different domain of learning before and after implementation of Collaborative TPACK module.

Table 6.9

Paired Sample t-test for Knowledge of Collaborative Learning and CL Tool

	Paired Differences					
	Mean	**N**	**Std. Deviation (SD)**	**t**	**df**	**Sig. (2-tailed)**
Pre-test	11.20	34	4.94	-12.818	33	.000
Post-test	24.02	34	6.89			

*p<0.05

The null hypothesis stated that, there is no significant difference between the pre-test and the post-test pertaining to Knowledge of Collaborative Learning and CL Tools in teaching different taxonomy of learning due to implementation of the Collaborative TPACK module. However, the *t*-test analysis showed there is a statistically significant difference in the pre-test score (*M*=11.20, *SD*=4.94) and post-test score (*M*=24.02, *SD*=6.89) with *t* (33) =12.813, *p*=0.000. Therefore, the null hypothesis is rejected.

Thus, it could be concluded that, instructor gained more knowledge pertaining to collaborative learning and CL tools for different taxonomy of learning after the implementation of the Collaborative TPACK module. This indicates that, Collaborative TPACK module effectively develop instructors' TPACK for different taxonomy of learning from the transformative experience gained from the module implementation.

Lesson Observation Findings

The Collaborative TPACK module effectively develop instructors' TPACK for different taxonomy of learning which was also evident from the lesson observation which was recorded in an e-portfolio. Based on the lesson observation, instructors were able to develop their TPACK for teaching intellectual skills, cognitive strategies, develop attitude, motor skills and verbal knowledge. This section discussed in detail on instructors' TPACK for different taxonomy of learning as presented in Table 6.10. However, no motor skills were demonstrated in any of these disciples.

Table 6.10
Instructors' TPACK for different taxonomy of learning

Instructors	Discipline	Taxonomy of Learning				
		Intellectual Skill	**Cognitive Strategies**	**Attitude**	**Motor Skills**	**Verbal Information**
Dr.1	Engineering	Kahoot	Podcast, Padlet	-	-	-
Dr.2	Education	-	Podcast, Padlet	-	-	LMS Quizzes
Dr.3	Medical	Kahoot	Padlet, Poll Everywhere	Video	-	-
Dr.4	Sciences	Kahoot	Padlet	Diagram/ Poster	-	-
Dr.5	Computer Science	Microsoft Sway	Poll Everywhere	-	-	-
Dr.6	China Studies	Socrative	Padlet	Video	-	-
Dr.7	Language & Linguistic	-	-	-	-	Kahoot

Intellectual skills. According to Gagné (1985), intellectual skills are also known as procedural knowledge on how to do things. Almost all the instructors lesson involved teaching different levels of learning either discrimination, concept, rule, and problem-solving. Kahoot is the game-based learning application which was implemented to measure students' ability to understand certain meaning, distinguish concept, objects or identifying certain concepts. One of the instructors [Dr.6] also integrated student response system, Socrative which was also similar to Kahoot to certain extent to measure students' ability to discriminate and define concepts on certain topic. Besides that, Microsoft Sway was one of the instructors [Dr.5] choices to teach rules by presenting the topic in a form of presentation. All collaborative learning tools used to conduct the activities are recoded in an e-portfolio (*see Appendix T*).

Cognitive strategies. Cognitive Strategies also part of intellectual skills for the purpose of learning and thinking. Learning strategies could be summarized, note taking, discussion session through questioning and sharing of answers, organization of information in a form of mapping or outline (Gagné, 1985). Almost all the instructors integrated Padlet for collaboration among students whereby they could reflect, share links and pictures pertaining to the lesson. Therefore, Padlet was used for collaborative learning in the format of a debate to get new ideas also for students to share their solutions and findings on topic learned.

Besides Padlet, podcast also integrated by two instructors [Dr.1] and [Dr.2] in their lessons. Students were provided with the podcast before the lesson so that, they were able to view and organize given information in a form of outline or mapping which included the information they need further clarification. During the face to face session, instructors have more time clarifying students' misconception and conduct more practical activities, as well as, providing facilitation to the students, when needed. All collaborative learning tools used to conduct the activities were recorded in an e-portfolio (*see Appendix T)*

In addition to Padlet and podcasting, two instructors [Dr.3] and [Dr.5] integrated Poll everywhere, as a tool for peer assessment to encourage students to learn deeply by building their own understanding on certain topics, rather than having factual knowledge. Through peer assessment students were able to judge the performances of their peers and gain some insight into their own knowledge and skills gap in comparison to their peers.

Attitude. Attitude basically focuses on developing student' emotion, feeling, choice, attitude, value and willingness that, students should possess at the end of lesson (Krathwohl et al., 1964). Only three instructors [Dr.3], [Dr.4] and [Dr.6] incorporated lesson that developed attitude to benefits the students as learning in this area is as important as learning in other learning domains. The instructors used video as a medium, to develop students' attitude to value individual differences and to increase students' interest in subject taught since video is a powerful agent to display people emotion through the audio-visual (Snelson & Elison-Bowers, 2009). In addition to video, one of the instructor also provided and opportunity for the students to develop their attitude through development of diagram and posters using appropriate software such as, Lucidchart and Canva as part of their assessments as research found that, posters were able to attract human attention and effective medium for knowledge transformation (Rowe & Ilic, 2009). All collaborative learning tools used to conduct the activities were recorded in an e-portfolio (*see Appendix T).*

Verbal information. Verbal information is also known as declarative knowledge, to assist students to connect new information which they already known with new knowledge to ensure learning more significant and distinctive (R. Gagné, 1985). One of the instructors [Dr.2] used quizzes to declare or state what the students have learned. Another instructor [Dr.7] also integrated Kahoot also used in the beginning of the lesson to activate students' prior knowledge before new knowledge or skills are presented to students. At the same time, Kahoot also used as part of assessment in the end of the lesson to identify, if students were able to recall basic information before participating in practical activities. (Rowe & Ilic, 2009). All collaborative learning tools used to conduct the activities were recorded in an e-portfolio (*see Appendix T).*

As a result, data from the pre and post-test on Knowledge of Collaborative Learning and CL Tool; and lesson observation reported in an e-portfolio shows that, the Collaborative TPACK module significantly developed instructors TPACK for different taxonomy of learning when instructors were able to plan and execute the lesson accordingly based on the taxonomy learning outcome. Instructors also plan their teaching by using appropriate technology tools and pedagogy to encourage students to apply and integrate the new knowledge and skills they had acquired in the real-world problem. The findings show that, instructors had identified at least more than one taxonomy learning outcome in their lessons to create holistic learning objectives. Unfortunately, no motor skills demonstrated in any subject areas. Next section attempts to answer the third research question.

Evaluation of Perception on the Technical and Pedagogical Usability of Collaborative TPACK module for CPD

In order to explore instructors' perception on the technical and pedagogical usability pertaining to Collaborative TPACK module, a survey questionnaire was administered to the instructors at the end of the CPD session. This data also would support the open-ended questionnaire on their experiences using the Collaborative TPACK module.

Instructors' demographic profile. Based on Table 6.11, it shows the demographic details of the thirty-four instructors who had completed the perception survey after the intervention of the Collaborative TPACK module.

Table 6.11
Instructors' Demographic Profile

Demographics		Frequency	Percentage (100%)
Gender	female	20	58.8
	male	14	41.2
Age	35-44	18	52.9
	25-34	15	44.1
	45-54	1	2.9
Faculty	Medicine	17	50.0
	Engineering	5	14.7
	Dentistry	3	8.8
	Education	2	5.9

Table 6.11 (continue)

Demographics		Frequency	Percentage (100%)
	Science	2	5.9
	Asia Europe Institute	1	2.9
	Computer Science and Information Technology	1	2.9
	Cultural centre	1	2.9
	Economics and Administration	1	2.9
	Language and Linguistics	1	2.9
Teaching Experience	0-3 years	20	58.8
	4-7 years	7	20.6
	8-15 years	5	14.7
	16-23 years	2	5.9
Teaching Level	Both post/undergraduate	24	70.6
	Undergraduate	8	23.5
	Postgraduate	2	5.9

The respondents comprised 58.8% of female and 41.2% of male. 52.9% of the instructors were age between 35-44 and instructors were age between 25-34 are 44.1%. Only one instructor was from the age group of 45-54. Half of the instructors (50%) were from the Faculty of Medicine followed by Faculty of Engineering (14.7%). 8.8% of the instructors that used the module were from the Faculty of Dentistry and 5.9% from the Faculty of Education and Sciences. Minority (2.9%) of instructors underwent the Collaborative TPACK module CPD were from the Asia Europe Institute, Faculty of Computer Science and Information Technology, Cultural Centre, Economics and Administration and Language and Linguistics.

About 58.8 % of the instructors have minimum of 3 years of teaching experiences. Instructors with 4-7 years of teaching experience were 20.6% followed by 8-15 years (14.7%) of teaching experiences. Only 5.9% of the instructors used the module have about 16-23 years of teaching experiences. About 70.6% of the instructors were teaching both the undergraduate and postgraduate level followed by

23.5% teaching only the undergraduate level. Only 5.9% of them were teaching the postgraduate students.

Instructors' perception of the Collaborative TPACK module usefulness, the ease of use, satisfaction and pedagogical usability. From these sections onwards, Table 6.12 till 6.15 present the results on instructors' perception on the technical and pedagogical usability of the Collaborative TPACK module.

Table 6.12
Instructors' perception of the Collaborative TPACK module usefulness

	Frequency of use (%)						
Scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Items	**Strongly Disagree**	**Disagree**	**Slightly Disagree**	**Neither agree nor disagree**	**Slightly Agree**	**Agree**	**Strongly Agree**
This module helps me to be more effective in teaching with collaborative learning tools	-	-	-	-	5.9 (2)	50.0 (17)	44.1 (15)
This module helps me to be more innovative in teaching with collaborative learning tools	-	-	-	-	-	55.9 (19)	44.1 (15)
This module is useful for me to teach with collaborative learning tools	-	-	-	2.9 (1)	5.9 (2)	44.1 (15)	47.1 (16)
This module meets my needs as a lecturer	-	-	-	2.9 (1)	11.8 (4)	47.1 (16)	38.2 (13)
This module helps me to be more effective in learning TPACK	-	-	-	-	8.8 (3)	52.9 (18)	38.2 (13)

Table 6.12 (continue)

Scale Items	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither agree nor disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
	Frequency of use (%)						
This module is useful for me to learn about TPACK	-	-	-	-	2.9 (1)	50.0 (17)	47.1 (16)
This module makes TPACK training easy for me					17.6 (6)	47.1 (16)	35.3 (12)
This module covers everything I would expect to know about TPACK	-	-	-	2.9 (1)	17.6 (6)	47.1 (16)	32.4 (11)

Instructors' perception on the Collaborative TPACK module usefulness. About 50% of them agreed and 44.1% strongly agree that, the module assisted them to be more effective in teaching with collaborative learning tools. Almost half of the instructors (55.9%) agree and 44.1% strongly agree that, they became more innovative in teaching with collaborative learning tools after the implementation of the module. In response to the question '*This module is useful for me to teach with collaborative learning tools',* a range of responses was elicited.

Majority about 47.1% instructors strongly agree, 44.1% agree and 5.9% slightly agree that, the module was useful since they learn how to teach with collaborative learning tools. However, only 2.9% instructor was being neutral with the module usefulness for teaching with collaborative learning tools. 47.1% of the instructors strongly agree and 38.2 % agree that, the Collaborative TPACK module met their needs as a lecturer. However, a minority of the instructors (11.8%) indicated that, they slightly agree with the statement and 2.9% instructor was being neutral with the statement.

Besides that, 52.9% agree and 38.2 strongly agree that, the module helps them to more effective in learning TPACK. Only 8.8 % instructors neither agree nor disagree that, the module is effective in learning about TPACK. Instructors were asked to indicate whether the module was useful for learning TPACK, 50% indicated that, they were agree and 47.1% strongly agree with the usefulness of the module for learning about TPACK. Only 2.9% instructor was being neutral with the statement.

Next, in response to the questions "*This module makes TPACK training easy for me"* 47.1% lecturers agreed that, the learning TPACK was possible through the implementation of Collaborative TPACK module. For the last item of module usefulness section, the overall response for the questions was good when 47.1%

instructors agree, and 32.4 % instructors strongly agreed that, the module covered everything they would expect to know about TPACK. A minority of participants (2.9%) indicated neither agree nor disagree toward the statements.

Table 6.13

Instructors' perception on the ease of use of the Collaborative TPACK module

Scale Items	Frequency of use (%) 1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither agree nor disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
This module is easy to be implemented among the lecturer	-	-	-	5.9 (2)	17.6 (6)	38.2 (13)	38.2 (13)
This module is accessible from different browsers (e.g. Google Chrome, Safari, Firefox etc) and devices (PC, laptop, smartphone etc)	-	-	-	-	11.8 (4)	44.1 (15)	44.1 (15)
This module requires the fewest steps possible to accomplish the TPACK training	-	-	-	14.7 (5)	17.6 (6)	50.0 (17)	17.6 (6)
This module is consistent with my interests.	-	-	-	8.8 (3)	17.6 (6)	38.2 (13)	35.3 (12)
This module is suitable to be used by experienced and novice lecturers.	-	-	-	8.8 (3)	14.7 (5)	47.1 (16)	29.4 (10)
This module was successfully implemented during the training	-	-	-	-	14.7 (5)	41.2 (14)	44.1 (15)

Instructors' perception on the ease of use of the Collaborative TPACK module. This section of the questionnaire required instructors to give information on their perceptions on the ease of use of the Collaborative TPACK module, as presented in Table 6.13. The instructors were asked to indicate whether the module was easy to be implemented among the instructors, hence, 38.2% of the respondents agree and strongly agree on the statement. About 17.6% instructors expressed slightly agreement that, the Collaborative TPACK module was easy to be implemented. A small number of instructors (5.9%) neither agree nor disagree with the statement.

In response to the questions '*This module is accessible from different browsers',* the majority of those who responded to this item agree (44.1%) and strongly agree (44.1%) that, the module could be accessed via different browsers and devices. Among the thirty-four instructors who responded to this question, four (11.8%) indicate slightly agreement on this item.

When the instructors were asked, if the module requires the fewest steps possible to accomplish the TPACK CPD, the majority agree (50.0%) on the statement. Some participants (17.6%) strongly agree and slightly agree that, only fewest steps needed to achieve the TPACK CPD. Only small number (14.7%) neither agree not disagree with the statement. About 38.2% agree and 35.3% strongly agree that, the Collaborative TPACK module was accordant with their interests. Just 17.6% of instructors expressed slightly agreement on the items. A minority of instructors (8.8%) being neutral towards the items.

In response to the questions '*This module is suitable to be used by experienced and novice instructors*, a range of response was elicited. About 47.1% agree and 29.4% strongly agree that, the experienced and novice instructors could develop TPACK through this module. Some instructors (17.7%) expressed slightly agreement on the item. Only three (8.8%) of instructors indicated neither agree nor disagree to the item. For the last item in ease at use section, the overall response to the question was very positives, whereby 44.1% strongly agree and 41.2% agree that, the Collaborative TPACK module was implemented successfully during the CPD. Other response to this question indicates that 14.7% instructors slightly agree with the statement.

Table 6.14
Instructors' perception on the satisfaction of the Collaborative TPACK module

Scale Items	Frequency of use (%) 1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither agree nor disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
This module has been designed for my purpose	-	-	-	8.8 (3)	14.7 (5)	47.1 (16)	29.4 (10)
I would recommend to my colleague to undergo this training (with this module)	-	-	-	2.9 (1)	2.9 (1)	64.7 (22)	29.4 (10)
This module is fun to learn (e.g. content, activities, assessment)	-	-	-	-	5.9 (2)	52.9 (18)	41.2 (14)
This module works the way I want it to work	-	-	-	5.9 (2)	17.6 (6)	50.0 (17)	26.5 (9)
This module is engaging	-	-	-	-	2.9 (1)	58.8 (20)	38.2 (13)
This module is what I need for future references	-	-	-	-	2.9 (1)	58.8 (20)	38.2 (13)

Instructors' perception on the satisfaction of the Collaborative TPACK module. This section of the questionnaire required instructors to give information on their perceptions on the satisfaction of the Collaborative TPACK module as presented in Table 6.14. Instructors were asked to indicate whether the module had been designed for their purposes. In response to this question, arrange of responses was elicited. About 47.1% agree and 29.4% strongly agree that, the Collaborative TPACK module was designed based on instructors' need. A minority of participants (14.7%) indicated slightly agreement and 8.8% neither agree nor degree with the item. Next, about 64.7% instructors agree and 29.4% strongly agree that, they would recommend the Collaborative TPACK module to their colleagues. Among 34 instructors who responded to this question, one (2.9%) slightly agree with the item. One individual (2.9%) neither agree nor disagree with the statement.

In response to question *'This module is fun to learn'*, most of those surveyed indicated that, the module content, activities and the assessment were fun to learn (52.9%). About 41.2 % also strongly agree that, the Collaborative TPACK module fun to learn. A small number (5.9%) neither agree nor disagree with the item. About 50% agree and 26.5% strongly agree that, the module works the way they wanted. Only 17.6% instructors slightly agree with the statement. This followed by 5.9% instructors neither agree nor disagree with the item. The total number of 58.8% agree and 38.3% strongly agree that the Collaborative TPACK module was engaged during the CPD session.

Other responses to this question included slightly agree (2.9%). In response to the last item in the module satisfaction section, the majority indicated that, the they needed Collaborative TPACK module for future references (58.8%) and 38.2% said they were strongly agreed that, the module was what they needed. One individual (2.9%) neither agree nor disagree with the statement.

Table 6.15
Instructors' perception on the pedagogical usability of the Collaborative TPACK module

Scale Items	Frequency of use (%) 1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither agree nor disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
This module has been divided into sections that allows me to learn in pre-defined order and respond to the assessment	-	-	-	-	11.8 (4)	55.9 (19)	32.4 (11)
This module allows me to participate in collaborative learning with my colleagues (Definition: collaborate using e.g. Wiki, Kahoot, Coggle)	-	-	-	-	2.9 (1)	61.8 (21)	35.3 (12)
This module covers the skills that I need to teach with collaborative learning tools	-	-	-	-	11.8 (4)	55.9 (19)	32.4 (11)
This module covers the skills and knowledge that I need to teach with collaborative learning tools in the future.	-	-	-	-	11.8 (4)	50.0 (17)	38.2 (13)
This module offers activities for me to practise with collaborative learning tools	-	-	-	-	-	64.7 (22)	35.3 (12)
The module engaged me to learn the topics deeply as I can.	-	-	-	-	8.8 (3)	52.9 (18)	38.2 (13)

Table 6.15 (continue)

Scale Items	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither agree nor disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
	Frequency of use (%)						
This module contains topics that interest me	-	-	-	5.9 (2)	14.7 (5)	52.9 (18)	26.5 (9)
This module presents information in a format that is easy to learn.	-	-	-	-	14.7 (5)	44.1 (15)	41.2 (14)
This module presents the new material in a sequence that suits me.	-	-	-	-	14.7 (5)	41.2 (12)	44.1 (15)
This module makes it quick and easy to learn a new topic or recap an earlier topic on TPACK.	-	-	-	2.9 (1)	17.6 (6)	44.1 (15)	35.3 (12)

Instructors' perception on the pedagogical usability of the Collaborative TPACK module. This section of the questionnaire required instructors to give information on their perceptions on the pedagogical usability of the Collaborative TPACK module as presented in Table 6.15. There were 55.9% instructors agree and 32.4% instructors strongly agree that, the Collaborative TPACK module was divided into sections, that allows them to learn in pre-defined order and respond to the assessment. Only 11.8% of instructors slightly agree with the statement. Responded were asked to indicate, whether the module allows them to participate in collaborative learning with their colleagues. About 61.8% agree and 35.3% strongly agree with the statement. A minority of instructors (2.9%) slightly agree that, they were able to learn collaborative with each other during the implementation of the module. 55.9% instructors agree and 32.4% strongly agree that, the module covered the skills they needed to teach with collaborative learning tools. Only four (11.8%) of the instructors slightly agree with the statement.

In response to the questions, *'This module covers the skills and knowledge that I need to teach with collaborative learning tools in the future'*, 50% of the instructors agree with the items. Followed by 38.2% strongly agree that, the module comprises of skills and knowledge to teach with collaborative learning tools in the future. Only small number or respondents indicated slightly agree (11.8%) with the item. Next, the overall response to the question *'This module offers activities for me to practise with collaborative learning tools'* was very positive whereby, 64.7% instructors agree and 35.3% strongly agree that, hands-on practise with collaborative learning tools were offered in the module

About 52.9% instructors agree that, the module engaged them to learn all the topics in-depth as they could. 38.2% of those surveyed strongly agree with the statement. A minority of participants (8.8%) slightly agree with the statement. Instructors were asked, if the module contains topics that interest them, arrange of responses was elicited. Majority (52.9%) was very positive that, the topics covered in the Collaborative TPACK module interest them. 26.5% strongly agree and only 14.7% slightly agree with the item. 5.9% of respondents neither agree nor disagree with the item.

When the participants of the CPD was asked if '*the module presents information in a format that is easy to learn'.* The overall response to this question was very positive. 44.1% instructors agree and 41.2% strongly agree that, the module offer information in a simple way to learn. Some participants (14.7%) slightly agree with the statement. There were 41.2% instructors agree and 44.1% strongly agree that, the Collaborative TPACK module presented the new material in a sequence that suits them. A minority of 14.7% instructors slightly agree with the statement. In response to the last questions in the pedagogical usability of the module, most of those surveyed agree (44.1%) and (35.3%) strongly agree that, the module makes it quick and easy to learn a new topic or recap an earlier topic on TPACK. Of the 34 participants who responded to this question, six (17.6%) slightly agree with the statements. One individual (2.9%) neither agree nor disagree with the statement.

Open-ended question. Based on the open-ended question, instructors were asked to indicate 'what did you like **BEST** about the Collaborative TPACK module'? The overall response to this question was very positives. Instructors responses were categories to **trainer, module content, module activities, module delivery** and **general satisfaction.**

Trainer. According to the responses in the open-ended question, the instructors acknowledge that, the trainer was knowledgeable about the topics covered in the Collaborative TPACK module. '*The trainer shows us different way of teaching with instructional strategies.* Other responses to this question included that, the trainer encourage active participation among the instructors as well as with the trainer *'The trainer is very pleasant and willing to interact with the learner (instructors)'* and '*The best I like about the module is the interaction of the trainer with her audience (instructors) during the CPD session'.*

Module content. Some instructors expressed their believes that, they like the topic covered, since, the topics were relevant with their needs. '*All the topics covered in the module are good for my teaching and learning'.* Other response to this question included '*Topic such as understanding of different pedagogy, important of pedagogy, collaborative and cooperative concepts are the best liked in the module'.* In addition, instructors also indicated that, '*Best about the module is the exposure to different technologies for example collaborative learning tools and software for teaching and engaging students learning'.*

Module activities. A variety of perceptive were expressed by the instructors whereby, there were sufficient opportunity for interactive participation during the practical session of the module implementation. Some instructors expressed their believes that, '*The practical session conducted during the module implementation is very useful for my teaching approach'.* Other responses to this question included '*The sessions are very interactive with lots of hands-on activities, discussion, question and answer session'.* Moreover, instructors also indicated that, *'The best about the module is the collaborative group task activities in designing the lesson plans and Merrill's First Principles of Instruction activities.'* One instructor commented that *'Listening to* *everyone opinion and sharing on the activities and presentation'* is one of the best things about the Collaborative TPACK module activity. Another instructor believes that, '*The module allows us to apply TPACK in the lesson plan activities'.*

Module delivery. Additionally, instructors also indicated that, the learning outcome of the module were clearly defined. '*The objectives of the Collaborative TPACK mode were clearly explained, content and material provided are good as well as the realistic examples given throughout session. The module is designed in a good structure'.* Besides that, the instructors also acknowledged that '*The module is clear and easy to follow'* and *'The module is easy to be understood'*.

General satisfaction. Overall, instructors responded that, they were satisfied with the Collaborative TPACK module. **'***The Collaborative TPACK module consisted of productive session'.* Other response to this question included *'I am able to apply TPACK and Gagne's Taxonomy of Learning to create a teaching plan after attending the Collaborative TPACK module'*.

Post Lesson Observation Interview

Apart from the open-ended question, during the post lesson observation interview conducted with the instructors, they were asked 'what **DIFFICULTIES** were you facing during the implementation of Collaborative TPACK in their teaching and learning sessions'? Instructors responses were categorized to **availability of time; limited technical skills; and nature of classes and topic taught.** Quotations with pseudonym from the transcripts were presented to highlight needs that were important to instructors.

Availability of time. A common view among the instructors was the time constraint, as the major challenges for them to plan, design and execute their teaching and learning plans with appropriative technology tools and pedagogy.

> *The difficulty is to find time to design the lesson. Of course, the first time when I looked at the podcasting, a lot of things can be done to better students learning. The time I spend apart from teaching and learning, I still have to focus on research, student supervision, and a lot of other admin works, so it's like I really have to allocate time for planning my lesson appropriately [Dr. 1:221-222/228-230]*

> *So, the only obstacle I face was taking time off to learn new things, for instance if there's a new technology that will be useful to me and I need to learn about it. If I have the time, then I won't mind going for it [Dr. 2:67-69]*

> *Yes, another thing I feel is that it also takes time to prepare the materials, additional time is needed, and you also need to explore more tools [Dr.5:113-114]*

Limited technical skills. Other two instructors alluded to the notion of the lack of technical skills, when designing their lessons with some collaborative learning tools.

> *So, for students to be able to watch the podcast, there are setting to be done. At first, I didn't get it right. I must figure out to make the link available for. viewing So that was the issues I faced in the beginning. However later I able to tackle the issue so it's also a learning process for me [Dr.1:223-225]*

> *Yes, I did the Padlet and Kahoot myself, but the Poll Everywhere was a bit technical, like how to run it and how to get the report out. I was having some technical difficulty however with your help I able to figure it out [Dr.3:153-154]*

Nature of classes and topic taught. Two instructors indicated their difficulties of applying all phases of First Principles of Instruction in certain lesson, due to the nature of classes whereby, an hour of tutorial class would not allow Dr. 5 to apply all phases in a single class. She was hoping to have both lecturer and tutorial under her supervision soon. Dr. 6 also acknowledge that, he was facing with difficulties to apply the principle when teaching certain topic because he believes by continues practice and application in his lesson he would overcome it.

> *When come to applying the Merrill's Principle, some lesson its quite easy to apply but when come to some topics in my field I feel I need to do more thinking to apply technology in all four phases. I believe I still have to practise more in my lesson since am still learning [Dr .6:68-69]*

> *Yes, besides the time constraint, the nature of the classes which this semester am conducting only the tutorial classes. If it is a lecture it would be easier for me to use more technology tools in all four phases [Dr .5:108-109]*

Referring to the findings from the survey, open ended question, the post lesson observation interview, the results revealed that, the instructors were very positives with the Collaborative TPACK module from the aspect of technical and pedagogical usability. They also acknowledged that, the module effectively helped them to apply TPACK and First Principles of Instruction in their respective subject area. However, instructors also expressed some challenges such as, time constrain; limited technical skills; and nature of classes and topic taught while integrating collaborative TPACK in their teaching and learning activities.

Conclusion

This chapter reported the findings for the implementation and evaluation phase of the Collaborative TPACK module for CPD in higher education. The findings revealed that, the module effectively developed instructors TPACK by applying the knowledge and skills they had acquired during the module implementation in to their teaching and learning activities. Besides that, the module also effectively developed instructors' TPACK for different taxonomy for teaching intellectual skills, cognitive strategies, develop attitude and verbal knowledge. In addition to that, module was found usable for both technical and pedagogical aspects. The next chapter 7, therefore, moves on to discuss the overall findings of the study which comprises of discussion of the findings of the study, the theoretical and practical implications; limitations of the study and recommendation for further research.

CHAPTER 7

DISCUSSION AND FINDINGS

Introduction

This chapter emphasized the summary of the process undertaken in the development of the Collaborative TPACK module by discussing in detail, the summary of the study from three phases, the need analysis; design and development of the module phase; the implementation and evaluation of the module phase. The discussion of the result related to the literature and implications of this study from the aspect of the theory and practice were discussed. Followed by the limitation of the study, suggestions for further research and finally the conclusion.

Summary of the Study

A developmental research approach, using the phases of analysis, design and development, and evaluation, was employed for the module. The first phase was the need analysis phase, where data were collected via semi-structured interview among seven instructors, two Head of Training Units and a trainer. The interview was used to capture instructors' technology skill regarding the use of collaborative learning tools, instructors' perspective regarding the use of Collaborative Learning (CL) and collaborative learning tools (CT) and form of tools that instructors' access to the institution's Learning Management System (LMS). Besides the interview, document analysis consisted of previous TPACK course evaluation and instructor's LMS activity were also gathered, to evaluate the training effectiveness and its downfall. The purpose of these phases was to discover the instructors' technology skills, perspective on CL and its tools, as well as, the tools they utilized in the institutional LMS.

The second phase was the design and the development of the Collaborative TPACK module. The FDM method was employed to gather data, regarding the module design which involved sixteen experts. The purpose of this phase was to design and develop the Collaborative TPACK module based on the views of a panel of experts. The FDM findings from the elements of the learning objective, content (instructional strategies, resources/media, evaluation), assessment (real-world problems), and delivery were reported. Based on the experts' consensus, the elements that should be included in the collaborative TPACK module for CPD were identified.

After the development of the module, four experts reviewed the module by providing suggestion and comments for improvement, by using a checklist listing the presents elements in the Transformative Model for CPD and Merrill's First Principles. 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 Jamaluddin Ahmad (2005). After editing the module based on the panel of experts' feedback, the Collaborative TPACK module looked ready for implementation.

The last phase of the DDR method was the evaluation phase, where the Collaborative TPACK module was implemented among thirty-four instructors from various faculties who voluntarily joined the CPD. The CPD sessions were conducted by a trainer and an assistant trainer. The implementation of the CPD was conducted in two cohorts. The purpose of this phase was to assess the effectiveness of the collaborative TPACK module for CPD in developing instructors TPACK and TPACK for different domains of learning. In addition, instructors' perception of the technical and pedagogical usability, pertaining to the collaborative TPACK module for CPD were identified. The study employed one group pre-test and post-test design quasi-experimental study that, was designed to assess the effectiveness of the Collaborative

TPACK module in developing instructors' TPACK, as well as, TPACK for different domains of learning. Besides that, a perception survey was used to explore the instructors 'perception on the technical and pedagogical usability pertaining to collaborative TPACK module which was administered, among thirty-four instructors who participated in the module implementation.

Besides the pre-test, post-test and the survey instrument, findings were also obtained from the continues assessment, and follow-up session conducted among seven voluntary instructors. Following this, lesson planning and classroom observations were carried out to assess instructors' abilities to demonstrate TPACK and appropriate instructional strategies in their respective subject areas. A semi-structured post observation interview was also conducted to support the qualitative findings which was focused on TPACK integration in the real teaching and learning. In order to show the best practices with TPACK, instructors with the assistance of the researcher produced an e-portfolio, that contained individual lesson plans, artefacts (evidence of students works/assignment) and personal reflection on Collaborative TPACK module in developing their own TPACK practices.

Discussion of Research Findings

The summary of the findings in this section was divided into three sections. The first section presented the discussion and the findings of the need analysis phase. The second section described the discussion and findings of the design and development phase of the Collaborative TPACK module and the third section illustrated the discussion and findings of the Collaborative TPACK module effectiveness, as well as, the technical and pedagogical usability.

Discussion of the Need Analysis Phase

Based on the research questions, the analysis was to discover instructors' technology skill on the use of collaborative learning tools in the institution's LMS; instructors' current perspective regarding the use of Collaborative Learning (CL) and CL tools in the LMS; and form of tools that instructors' access in the institution's LMS. The findings of phase one offered some insights on the need for online collaborative TPACK module for CPD among instructors in higher education. In the need analysis phase, findings from the interview and document analysis could be summarized based on the followings;

Basic knowledge pertaining to the usage of technology in education. First, the finding shows that instructors have basic knowledge pertaining to the use of technology but, they have very little knowledge of the collaborative tools and its usage in the teaching and learning session. Even though, CL tools have shown to be useful for learning (Dewitt et al., 2015) however, instructors were more comfortable using technology that is simple and easy such as Microsoft PowerPoint, downloading and uploading materials and video in LMS, because, learning new tools were quite challenging for them. This was supported by a previous study where instructors were required to familiarize themselves with the new learning environment, technology tools which were eventually added to the complexity faced (Rienties et al., 2013a). Therefore, in the design of the Collaborative TPACK module needed to include different type of application activities, to provide the opportunity for the instructors to learn and practise with various CL tools with guidance to increase their confident levels and feel less challenging, before implementing it in daily teaching and learning activities.

Limited knowledge of collaborative learning tools and its usage. Besides that, instructors have certain TK, but having just TK does not guarantee that, the instructors could implement technologies into their teaching practices, because, teaching and learning processes in the twenty-first century require the instructor to move from designing lesson with technology for information transmission and drill-and-practice to restructure learning activities, that enable students to be involved in critical thinking, problem-solving, communication, collaboration and knowledge construction through social learning environment ((Koh, Chai, Benjamin, & Hong, 2015; Learning Partnership for 21st Century, 2016). So, the instructor needs to be technologically and pedagogically competent by having the knowledge and skills, to identify suitable tools to teach different content areas rather than just having knowledge on a variety of technologies used in learning environments. Hence, in the design phase the theoretical and practical application component of TPACK needed to be included so that, instructors could apply appropriate pedagogical approach and content knowledge to teach in an effective way besides having TK. Besides that, the module needs to include practical application of designing a lesson plan so that, instructors will be able to plan instruction to incorporate higher- level technology instruction in the form of CL tools such as, wikis, blog, podcast, instant messaging, and discussion forum, to enhance students learning, through knowledge building, engaging and motivating learners in the learning activity.

Lack of knowledge on CL concepts and implementation in the teaching process. Instructors are lacking knowledge of the CL meaning, and usage, even though, the instructors used Facebook and screencast to deliver a lecture, they were still lacking the knowledge to incorporate those technologies with an appropriate task, that could promote collaborative learning among students. As highlighted in the past literatures that, collaborative learning is known for its task-specific collaborations with goals and work-oriented activities (Cheung & Vogel, 2013; Dewitt et al., 2015) hence, instructors should understand the nature of CL to identify how collaborative learning activities could be carried out effectively through its tools. Therefore, in the designing of the module, First Principles of Instruction will be included to train the instructors to plan a more engaging, effective and efficient lesson. Through different phases of application, demonstration, application and integration, instructors will be able to identify suitable CL tools to promote learning.

Misconception about CL. In addition to that, instructors were also having a misconception about collaborative learning to cooperative learning. Some of the instructors believed that, when students were divided into a small group and working together on a given task, is called collaborative learning. Based on the instructors who claimed to have practiced collaborative learning, the activities given to students were structured such as, lecturers explain the assignment, datelines, submission and group presentation for assessment. At the same time, each student was assigned a specific role, to work on a separate task. Lecturers usually supply all the information for students to read or sometimes provide them with some links to search for information.

Past research identifies the differences and commonalities between collaborative and cooperative learning based on different ideas of the role, purpose, and individual participants in the activity (Lethinen et al, 1999). So, in the designing of the module, the concept of collaborative learning and co-operative learning were included, to expose the instructors to the similarities and the differences of both concepts in order for them to upgrade their knowledge and be aware of the educational potential on collaborative learning and co-operative learning.

Tools for communication. Discussion forum and chat were the only form of collaborative tools in the LMS that instructors could access. These tools were used for the purpose of thought sharing and ideas among students, making announcements, welcoming and introduction session for a new semester. This is also supported by past studies that, the discussion forum was a widely used tool in many educational learning platforms (Chan & Chan, 2011; Yang, Sinha, & Adamson, 2013) since the discussion forum allows the learners to engage in dialogue with peers or instructors at their conveniences, without temporal or geographic restrictions (Hew & Cheung, 2013; Özçinar, 2015; Zion, Adler, & Mevarech, 2015). Similar to chat or sometimes known as Instant Messaging (IM) also is being used widely in the online discussion (Branon & Essex, 2001; Hou & Wu, 2011) due to its nature of instant information sharing and feedback.

Therefore, in designing the module, various CL tools would be included that, not limited to discussion forum and chat since other CL tools such, a wikis, blog and podcast are able to enhance students learning, through knowledge building, engaging and motivating learners in the learning activities.

Non- collaborative tools. Even though, almost all LMS has CL tools that are not just limited to a discussion forum and chat, instructors are using LMS mainly as a repository of materials and information (Ariffin et al., 2015; Zainuddin et al., 2016); sharing teaching resources (Becker & Jokivirta, 2007; Malikowski, Thompson, & Theis, 2007); group formation and publishing exams grades (Chawdhry, Paullet, & Benjamin, 2011; Wilson, 2007). Hence, LMS would be useful in creating fun and engaging educational activities for learners, if instructors employ LMS beyond updating or uploading a learning materials to more collaborative activities such as, creating online content with Wiki, blog, or podcast that can contribute towards shared knowledge, resources, communication and networking between instructors and students as well as students with peers (Al-Busaidi & Al-Shihi, 2010; Lonn et al., 2011; Zainuddin et al., 2016; Zanjani et al., 2017)

This atmosphere could be achieved, through the integration of CL tools into students' learning activities. Hence, in designing the Collaborative TPACK module, activities that incorporate using LMS tools would be included to expose the instructors to use the tools beyond the general usage and integrate them into their instructions to promote students learning.

Lack of training specifically done on CL and CL tools. From the findings, there was no training programme that specifically focused on developing instructors' skills and knowledge in collaborative learning and tools, based on the taxonomy of learning. The previous TPACK training module was based on the general context of TPACK in higher education. The past researches, TPACK module were based on the specific subjects like Mathematics, Science, Geography, and English was designed by identifying the instructional objectives/goals, followed by determining pedagogical and technology approach, without concern on theories of how people learn (Spector, 2016). Therefore, in the design phase, there is need to integrate collaborative learning and CL tools so that, instructors would be able to identify the right TCK with TPK to build instructors TPACK.

Need for different teaching strategies with technology. The instructors wanted training that allows them to learn different CL tools with examples and demonstrations from the trainer, as well as, adapting it into their teaching practices. This would enable instructors to construct more holistic lessons by using all the domains in constructing learning tasks. This diversity in learning helps students to acquire greater experience in using different learning styles and learning modalities. Teaching in an effective way by using TPACK is not just about how well instructors could teach with technology (Jen et al., 2016) but also, design the instructional strategies that are linked to the type of skill or task instructors that students wish to learn (Spector, 2016). Hence, in designing the Collaborative TPACK module, it is important to incorporate Gagne Taxonomy of Learning Outcome so that, the instructors would be able to differentiate in detail, the specific learning outcome they are setting, since, there is no particular size (learning domains) that fits all instructional tasks (Jen et al., 2016).

Need for continuous assessment. Next, the current TPACK module assessment is only focusing on group task, such as, a group presentation at the end of training. There is a need for continuous assessment as it is important for instructors, trainer, as well as the management of training provider, since, continuous assessment is an ongoing inquiry into, what and how the instructors are practicing their good teaching with technology. At the same time, CPD in developing instructors TPACK should not just end immediately after the training, but continuous assessment by following up is important for instructors to reflect on what was learnt and its application. Based on the past literatures, one constraint of this training was the follow-up limitation, therefore, a training that is supported by follow -up coaching session, one to one with participants would significantly increase the training effectiveness (Abbott, Stening, Atkins and Grant, 2006; Olivero, Bane, & Kopelman, 1997). Hence, the module design includes the continues activities, in a form of real classroom practices, that would allow instructors to sustain the integration of CL tools in teaching and learning.

The findings from phase one provided a greater understanding of the need for module development among instructors, as well as, to determine the design of the Collaborative TPACK module in the phase two.

Discussion of the Design and Development Phase Findings

The information and findings from the need analysis were used to guide the design and development phase. The objective of the second phase was to design and develop the collaborative TPACK module for CPD in higher education. In this phase, through the FDM the researcher obtained the views and consensus of panel experts from the aspect of learning objective, content (instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery to be included in the Collaborative TPACK module for CPD. As the first step, a critically review of literature was conducted to gather information, regarding TPACK, collaborative tools, taxonomy of learning and First Principles of Instruction. The information gathered then transformed into a semi-structured interview protocol, for a face to face interview with the experts. From the interview findings, the FDM questionnaire was designed and administrated among sixteen experts, who determined the learning outcome, content, assessment, and delivery elements of the module and provide their views and consensus.

From the FDM results, experts reached consensus to incorporate three learning outcomes for the module. Upon the completion of the Collaborative TPACK module, the instructors would be able to design and develop lesson plans by integrating appropriate pedagogy and collaborative learning tools based on Gagne's Taxonomy of Learning. The tool would apply suitable collaborative learning tools to teach a specified content area and ability to apply suitable collaborative learning tools to teach content area, based on Gagne's Taxonomy of Learning. This means the module is designed, based on TCK and TPCK concepts in the TPACK framework and five learning domains of outcome.

As for the content, CL tools, such as, discussion forum, Wikis and Instant Messaging were included in the module, since, experts reached high consensus on these three tools. These tools were selected because, almost all LMS have embedded and offered essential collaborative tools such as, wikis, text messaging/chat and discussion forum to organize and control learners' joint activities, where instructors in higher education institution perform specific instructional tasks related to learner learning activities by using the LMS as a platform (Schoonenboom, 2014).

In addition to discussion forum, Wikis and Instant Messaging experts also indicated consensus to include podcast and blog in the module, because, in the higher education, the integration of podcasts in the online learning environment has become more common (Caladine, 2008; Copley, 2007) and it may be delivered via LMS or uploadeded to the University iTunes, that serves as the podcasting-hosting site (Bolliger, Supanakorn, & Boggs, 2010). On the other hand, blog is also an interactive tool for teaching and that requires minimum effort to create, maintain and promote collaborative learning, since, there are no advanced programming skills required for learners to create blogs using multimedia elements (Papastergiou, Gerodimos, & Antoniou, 2011).

The previous study by He and Yang (2016) shows that, some CL tools such as, Wikis is necessary to be integrated with other collaborative tools for a positive effect on the collaborative outcome. Therefore, based on consensus reached among the experts other teaching tools and applications including survey tools, student response system, interactive wall, YouTube, microblog, mind mapping, infographic posters and video development tools were included in the module.

Even though, virtual reality (VR) agreed by the experts to be included in the module, but it was based on low consensus compared to other tools. This is because, based on previous study, although virtual reality provides the opportunity to the students to learn topics that are difficult to demonstrate in the traditional method. The high financial cost of setting up VR system is one of the drawbacks that limited the application of VR in the education (Christou, 2010). However, in this module VR was included to expose the instructors to the educational potential of VR in providing immersing learning experiences.

From the aspect of the content, experts reached consensus to all five taxonomy of learning to be integrated into the module. However, more emphasis was given to the intellectual skills, cognitive skills, attitude, and motor skills, because, all these four skills were needed to develop students higher order thinking skills, which are important for the 21st century learning that, students do not only acquire the knowledge and skills, but also would be able to apply them to a new situation. Less emphasis was given to the verbal information. It was not surprising that, intellectual skills, cognitive skill, attitude, and motor skills were ranked higher, than verbal information, because, learning in higher education should move towards higher level thinking, that allows students to apply problem-solving skills and knowledge construction rather than, learning facts and concepts as content (Dewitt, Alias, & Siraj, 2015; Ronen & Pasher, 2011).

Then, from the aspect of assessment, the experts reached higher consensus to include e-portfolio, as one of the assessments that reflects on the instructors' TPACK into the module. This suggestion further supports the idea that, a digital portfolio could be used to assess educators' understanding and ability to use and teach with technology (Greenhalgh, Rosenberg, Keenan, & Koehler, 2015). The reflection could be an effective strategy, to help the educator in sharing of practical experiences in implementing TPACK in the real classroom setting through the collection of artefacts, that showcase their learning and developments (Lu, 2014). Hence, in this module, e-portfolio task activity was included as part of continuous assessment.

Besides the e-portfolio, experts also reached consensus to include assessment, while developing a lesson plan in the module, as one of the tasks for the instructors. This is in agreement with the findings of other studies that, lesson plans are one of the ways of assessing the authentic activities to evidence educators' TPACK (Harris, Grandgenett, & Hofer, 2010). Therefore, developing a lesson plan was included as part of the assessment in the Collaborative TPACK module. In addition to lesson plan activity, experts also reached agreement to activity of recording own teaching and learning. However, in this study, recording own teaching and learning is conducted, as a lesson observation to assess instructors' abilities to demonstrate teaching with TPACK, previous researches indicate that, classroom observation is one of the important methods to evaluate instructors' potential to apply TPACK in their lessons (Kwangsawad, 2016).

In addition to the aspect of module delivery, the experts indicated higher consensus that, the Collaborative TPACK module should offered to the instructors with the basic level of knowledge and skills in TPACK, because of the results obtained from the pilot test that was conducted between thirty-three instructors. From the knowledge test on the collaborative tool and domains of learning, it shows that, the instructor's ability to identify/select collaborative tools to teach the knowledge/skills needed improvement. At the same time, the instructor's ability to use tools for the purpose of collaboration is below expectation.

Experts arrived at consensus that, the module should adopt blended learning as the medium of instruction which could be conducted in the University LMS. Nevertheless, experts reached higher consensus that, all the theories and in-class assessment to be carried out face to face in the training room, but online assessment such as reflection, portfolio and survey to be conducted online.

In addition, experts reached consensus that, in the module, the elements of TPACK which consist of technology (collaborative learning tools) to be demonstrated based five learning domains of outcome. They also agreed that, the pedagogy aspect of the module such as PK, PCK, and TPCK be included in the module, as an integrative intersection on incorporating collaborative learning tools into appropriate pedagogy to help students learn the specific content areas. This finding may be explained by the facts that, to effectively integrate technology into instruction, the instructors need to have a good understanding of how technology could be incorporated together with the pedagogy and content knowledge (Hughes, 2005; Margerum-Leys & Marx, 2002; Niess, 2005; Zhao, 2003)

Therefore, a consensus obtained from the panel of experts, through the FDM was prominent to develop the learning outcome, content, assessment, and delivery of the Collaborative TPACK module.

Discussion of the Implementation and Evaluation Phase Findings

The Collaborative TPACK module was implemented among thirty-four instructors from a higher education institution. The objectives of this phase were to assess the effectiveness of the Collaborative TPACK module in developing instructors TPACK; assess the effectiveness of the Collaborative TPACK module in developing instructors TPACK for different domains of learning and to explore instructors' perceptions of the technical and pedagogical usability, regarding the Collaborative TPACK module for CPD. In this phase, one group pre-test and post-test quasi experimental design was implemented.

In the evaluation phase, findings from the pre and post TPACK survey; pre-test and post-test score on Knowledge of Collaborative Learning Tools; lesson plan score; lesson observation score, post-lesson observation interview an e-portfolio finding could be summarized based on the followings;

The Collaborative TPACK module effectively develops instructors' TPACK. Findings shows that, there is increase in score of the pre-TPACK and post TPACK due to the implementation of Collaborative TPACK module. This shows that, the Collaborative TPACK module effectively develop instructors' TPACK, from the transformative experience gained to the module implementation. Instructors were also able to apply the TPACK framework, that emerges from an interaction of technology, pedagogy, and content knowledge, when they were able to determine collaborative learning tools that are compatible with the subject taught and the instructional strategies, that can be evident from the lesson planning.

This is because, the true meaning proposed by the TPACK model is the three knowledge; CK, PK, and TK and they are not independent, but should interact with each other (Cabero & Barroso, 2016). At the same time, technology is not separated from content and pedagogy (Janssen & Lazonder, 2015; Mouasher & Lodge, 2016).

The Collaborative TPACK module effectively develops instructors' TPACK, which is also evident from the lesson observation that, the instructors were able to demonstrate the application of the First Principles of the Instruction phases in teaching and learning, after participating in the Collaborative TPACK module implementation. However, this result has not been previously reported in past studies.

Previous studies indicated that, despite a comprehensive training provided to elevate instructors TPACK, instructors were still unable to enhance their pedagogical practices. This is because, their believes on the best teaching approach is mismatched with what was being exposed in the training. This mean, a minimal impact was found in the actual teaching practice (Charalambous & Karagiorgi, 2002; Deni et al., 2013; McCarney, 2004). However, in this study, the Transformative Model that was incorporated in the module allows the instructors to experience innovative teaching practises and implement what they had been learning and practicing during the CPD into real teaching and learning. Therefore, Collaborative TPACK is not only effective in developing instructor's knowledge in TPACK, but also, their skills in planning and delivering their lessons with appropriate technology and pedagogy underpinned the Merrill's First Principles of Instruction.

Instructors also acknowledged that, after undergoing the transformative process of the Collaborative TPACK module, their TPACKs have developed significantly, in term of building confidence to integrate TPACK in teaching. This finding supports the idea of integrating technology in a meaningful way into teaching begins, when someone acquired the knowledge and technical skills of using certain technology, having technology knowledge is the underlying basis to develop confidence in TPK and TCK (Graham et al., 2009). Similar to Ward and Parr (2010) study, where instructors see the advantages of using technology in their teaching and learning, it is most likely to drive their confidence to facilitate students learning.

Besides that, instructors also realized that, the module creates awareness and opportunity for them not only to learn the concept of TPACK, but also, to practice it. The application activities allow the instructors to work collaboratively on various tasks especially, designing the lesson plan in their respective subject areas. This finding shows that, the Collaborative TPACK module was designed to expose the instructors with real-world task throughout the CPD.

This is because, past study indicates that, in Malaysia higher education, professional development is a replica of traditional behaviourist models, based on didactic and transmission-oriented approaches whereby, the training module is mainly spreading teaching skills and knowledge, and no room for inquiry or reflection on instructors actual teaching approaches (Deni et al., 2013). Hence, this CPD module seems to expose the instructors to the transformative model of CPD that's allow instructors to apply, reflect and continuous learning through real teaching and learning practices.

Moreover, instructors also indicated that, the Collaborative TPACK module built their knowledge and skills to teach effectively with TPACK, when the module has transformed instructors from not-knowing to knowing TPACK. Hence, the module had built instructors knowledge and skills to apply TPACK with appropriate instructional strategies to promote effective learning experiences for their students, because, previous studies found out that, the instructional design of CPD activities was likely to be ineffective if it is not being designed conscientiously, it would impact instructors' knowledge, skills, and attitudes (Guskey, 2000; Merrill, 2013).

Effectiveness of the Collaborative TPACK module in developing the instructors TPACK for different domains of learning. The findings form the pre-test and post-test score on Knowledge of Collaborative Learning Tools shows that, after the implementation of the Collaborative TPACK module, instructors were able to identify appropriate CL tools to teach different domains of learning outcome. They were also able to identify how to use the tools for the purpose of collaboration, as the Collaborative TPACK module has effectively developed instructors' TPACK for a different taxonomy of learning which is also evident from the lesson's observation, that was recorded in an e-portfolio. According to the previous study, fewer studies focused on analysing the event of authentic teaching using TPACK framework, since classroom observation provides an opportunity for rich analysis in the form of videos and artefacts (Patahuddin, Lowrie, & Dalgarno, 2016; Polly & Brantley-Dias, 2009).

Instructors were able to develop their TPACK for teaching intellectual skills, cognitive strategies, develop attitude, motor skills and verbal knowledge. However, motor skills were not demonstrated in any of their lessons. These findings further support the past studies which, indicated that, teaching in an effective way using TPACK was not just about how well instructors could teach with a technology (Jen et al., 2016) but also, design the instructional strategies that are linked to the type of skill or task instructors wish students to learn (Spector, 2016) since there is no particular size (learning domains) fit all instructional tasks (Jen et al., 2016).

Instructors' perception on the technical and pedagogical usability pertaining to Collaborative TPACK module. The findings from the survey, as well as, post-lesson observation interview shows that, all the instructors either agree or strongly agree that the, Collaborative TPACK module was useful and easy to use. They also either agree or strongly agree that, they were satisfied with the module from the aspect of content, activities, and assessment. In addition, the survey also shows the Collaborative TPACK module is technically and pedagogically usable.

Instructors indicated that, the best part of the Collaborative TPACK module was the trainer who is knowledgeable about the topics covered in the Collaborative TPACK module, and encouraged active participation among the instructors, as well as, with the trainer. The finding of the current study, with previous studies suggested that, to support learning processes, trainers are required to apply instructional design by taking into account adult learner characteristics, such as experience, motivation, physiological barriers, and memory (Ilie, 2014) to guide them in the tools and system development. This view was supported by DeWitt (2010) that, a trainer needed to develop both instructional and learning environments where instructors (trainee) and colleagues together with the trainer would interact with the learning material and create a socially supportive environment.

Subsequently, instructors also expressed their believes that, they liked the module content covered, since, the topics were relevant with their needs because, past literature revealed that, instructors found out that, the current CPD programmes were designed with ineffective and irrelevant activities, as the CPD topic rarely address the instructors needs and concerns (Rodrigues et al., 2003).

Besides the topics covered in the module, instructors shared their opinions that, there was sufficient opportunity for interactive participation during the practical session of the module implementation through variety of activities such as, collaborative group task, hands-on activities, discussion, question and answer session and follow up session after the module implementation. These findings further support the idea of previous studies that, one of the training constraints is follow-up , therefore, a training that is supported by a follow-up coaching session, one on one with participants would significantly increase the training effectiveness (Abbott et al., 2006; Olivero et al., 1997).

Additionally, instructors also indicated that, the learning outcome of the Collaborative TPACK module was clearly defined, and the material provided were good with a realistic example, given throughout the session. Besides that, the instructors also acknowledged that, the module was clear and easy to follow. This finding is opposite to Kenny (2002) findings that only a few instructors extended their current knowledge to teach with technology, since most CPD was designed didactically and out of context delivery.

Furthermore, some CPD is lacking conceptual framework guideline which underpinning the planning, designing and implementation process of CPD (Rodrigues et al., 2003) The result was passive and didactic forms of CPD delivery, which was overcome through the implementation of First Principles of Instruction and Transformative Model of CPD, as guiding framework to the design and development of the module. Additionally, the instructors responded that, they were satisfied with the Collaborative TPACK module since, they were able to apply elements of TPACK and Gagne's Taxonomy of Learning to create a teaching plan after attending the Collaborative TPACK module. This is because, planning an appropriate pedagogy with the right educational technologies into instruction is very challenging. Since instructors need to embed this practice daily in teaching and learning and not for certain context or settings (Harris & Hofer, 2009; Rienties et al., 2013b).

The findings also show that, there are several difficulties faced by the instructors during the implementation of the Collaborative TPACK in their teaching and learning sessions. The common view among the instructors was the time constraint, being the major challenges for them to plan, design and execute their teaching and learning plans with appropriate technology tools and pedagogy. This result matches with those observed in the earlier studies that, the instructor's main barrier for lesson planning and technology integration was time constraints (P. A. Ertmer, 2005; Jetnikoff, 2015; Means, 2010). Other challenges are lack of technical skills, when designing their lessons with some collaborative learning tools. This finding confirms that, the lack of technical skills will affect the instructors' ability to incorporate technology into their lessons (Hsu, 2016; Schoonenboom, 2014) and the instructor also indicated the difficulty of applying all phases of First Principles of Instruction in certain lesson. This is as a result of the nature of the classes whereby, an hour of a tutorial class would not be sufficient to apply all phases in a single class.

Research Implications

There are two main implications that formed the aspects of theoretical and practice that were drawn from the discussion of the findings of this study are discussed in this section. Theory implication focused on the findings of the study, based on the theory and models that support the rationale for developing the Collaborative TPACK module. The practical implication is the outcome of the findings that impact the Ministry of Higher Education (MOHE), faculty, instructors and students by providing guidance in developing instructors. This happens with knowledge and skills in TPACK through a transformative approach and create meaningful learning experiences for the students.

Theoretical Implication

Two major theories that were used in this study were instructional design and learning, and the findings of this study are supported by the theories and the models that, underpin this study. The Collaborative TPACK module synthesized from the main theory was used to describe the learning approaches that focused on communication and collaboration is a Social Constructivism Theory (Vygotsky, 1978) and eclectic Instructional design model, First Principles of Instruction (Merrill, 2013) were used to design the learning environment. Besides that, Technological Pedagogical Content Knowledge, TPACK model (Mishra & Koehler, 2006), Taxonomy of Learning Outcome (Gagne,1972) were also referred to, as a guide to develop the module content and Transformative Model of CPD (Jang & Chen, 2010). This was adopted in the implementation phase of the module that emphasize on learning-by-doing approach/ practice-based approach base. This is to ensure that, the module developed is theoretically sound. There has never been a development of a Collaborative TPACK module for CPD with a combination of the above mention theories and models as a guide and reference for module development.

Hence this study contributed to the element of collaboration in the existing TPACK model which known as Collaborative TPACK. Based on previous literature, there was no CPD module developed with combination of TPACK framework. Therefore, this study contributed to design and deliver a CPD programme by incorporating Collaborative TPACK. In addition to the CPD, this study also contributed to the development of TPACK framework with Merrill's First Principles and taxonomy of learning outcome

Besides that, the Transformative Model for CPD by Jang and Chen (2010) consisted of four phases namely; comprehension, demonstration, application and integration. However, in this study, adds to the repertoire of knowledge the important of continues assessment with inclusion of phase five, transfer of knowledge and the retention of expertise.

Hence, other researchers were able to gain some insight from well-established theories and models, as also used in this study as a reference base to design and develop a new module. Figure7.1 shows the integration learning theory, instructional design principle, as well as, the models in all the three phases of this study. In need analysis phase, in order to capture instructors' technology skills in using CL tools and their perceptions towards collaborative learning, TPACK (Mishra & Koehler, 2006) model were used as a base to identify their current teaching practices with technology.

Next, in the second phase, the design and developmental was concentrated on to obtain the consensus of the panel of experts on the elements of (learning outcomes, content, assessment based on real-world problem and delivery). Hence, the TPACK model (Mishra & Koehler, 2006) and Taxonomy of Learning Outcome (Gagne,1972) were referred to developing the learning outcome, as well as, the content for the module. This is followed by the First Principles of Instruction (Merrill, 2013) referred to develop the reference material for the CPD, as well as, the content for the module. Finally, in phase three, implementation and evaluation, the Transformative Model (Jang & Chen, 2010) was adopted, to implement the Collaborative TPACK module based on the five main stages of comprehension, modelling, application, reflection, and transfer of knowledge and the retention of expertise

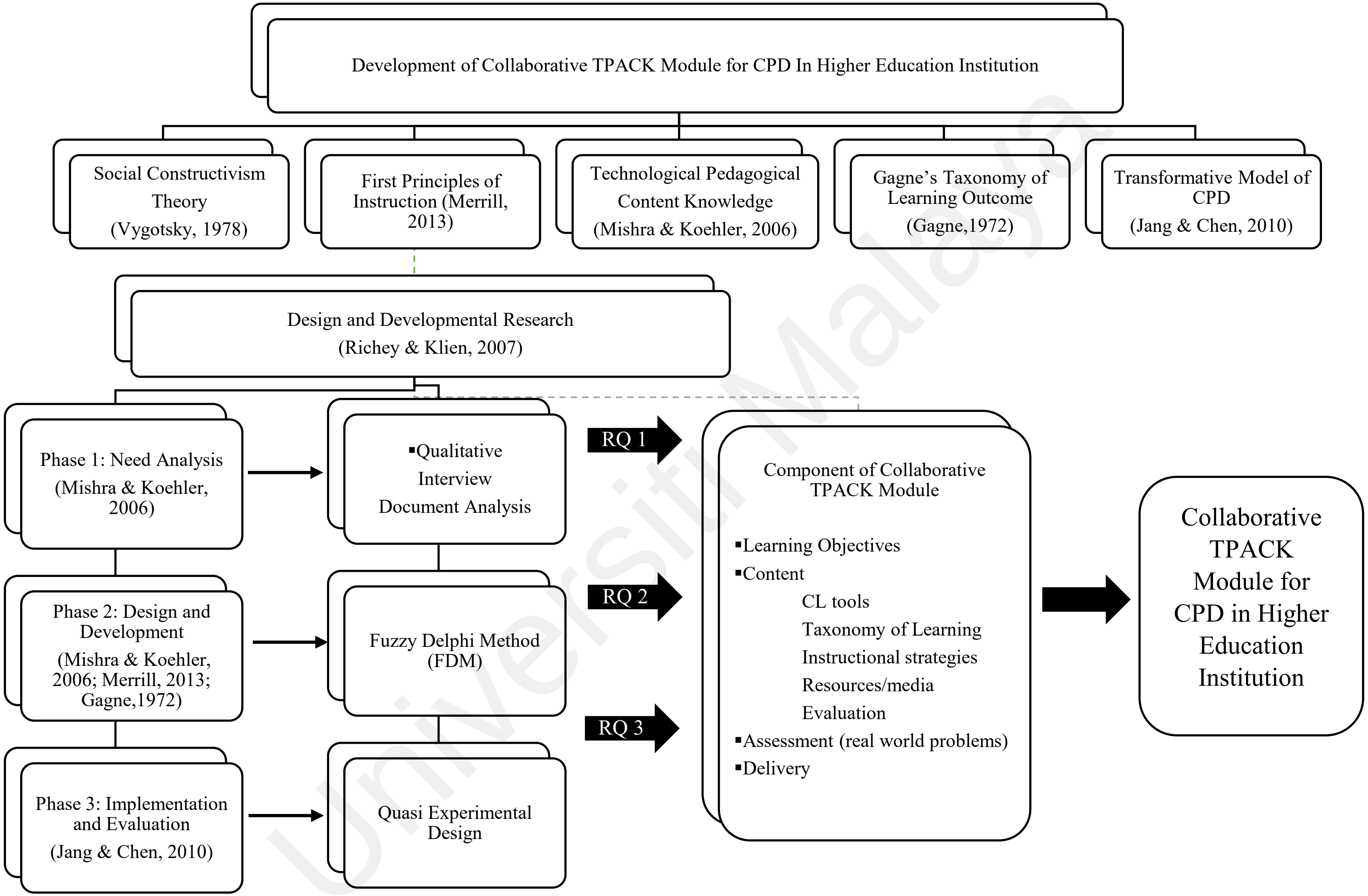

Figure 7.1 Combination of theories and models in the development of Collaborative TPACK

Practical Implication

The findings of this study are important to all specially for Ministry of Higher Education (MOHE), higher education institution, instructors and students. It provides the framework and guidelines on the processes to undertake the development of Collaborative TPACK module for CPD through design and developmental research. The Collaborative TPACK module provided transformative approach, in developing the instructor's knowledge and skills in TPACK and effective way of integrating collaborative tools into specific learning domain to maximize students learning.

Practical Implications for MOHE. This study has the aspirations of the MOHE in mind, in the development of the Collaborative TPACK module. Based on the evaluation phase, the findings show the module capability and strength in developing instructor's knowledge and skills in TPACK. Collaborative TPACK is important towards building the capabilities of the academic community, as stated in the National e-learning Policy that, by 2020, 75% of higher education instructors would need to have knowledge on TPACK, basic skills in e-learning, as well as, to implement blended learning mode in teaching and learning processes (MOHE, 2015). This vision can only be achieved, if instructors have the knowledge and skills that will assist them to employ technological resources in their curricular designs. This is achievable by planning effective teaching and meaningful learning experience for the students.

At the same time, the Malaysian Higher Education Blueprint (2015-2025), MOHE has included Globalized Online Learning, as one of the shifts to transform education in this country. This will enables the access to good quality content and enhanced the teaching quality and learning. This shift has created an opportunity to harness the power of blended learning model to be the main pedagogical approach in the higher educational institution. This allows higher education to shift towards the blended instruction mode for the courses offered via a Learning Management System (LMS). As such, MOHE is making online learning, an integral part of higher education and lifelong learning. This starts with the transformation of undergraduate courses, by using LMS with up to 70% of programmes to use blended learning models. Through Collaborative TPACK, instructors will be able to design their own blended learning teaching and learning plans.

Practical implications for higher education institution. Higher education institution can use the Collaborative TPACK module as part of their CPD or training modules to equip instructors with relevant and significant knowledge and skills of TPACK, which will influence the teaching practice. The Collaborative TPACK module can also be used by *AKEPT* and other higher education academic development centre and training unit. This will be part of staff development programmes in a form in-service workshop, courses, training session and professional development. In addition, higher education institution can benefit from the finding of this study, since this study also identifies possible pitfalls and barriers towards implementing collaborative TPACK, that higher educational institutions should be take into consideration, while planning, executing, and evaluating any technology integration training or CPD.

The Collaborative TPACK module is unique and different from previous training modules, because, in the past professional development developers often designed module without taking into consideration of learning needs of instructors from the different faculties. This module are usually designed in a manner that developer considers as important. However, this study was designed by taking into consideration, the need of instructors and the findings from the evaluation phase shows that, instructors were very positives and confident in implementing TPACK into their teaching and learning, since they have been exposed to the theoretical and practical aspects in the module.

Practical implications for instructors. The Collaborative TPACK module also promote the culture of innovation in the use of technology among the instructors, as the module development consisted of activities being planned based on skills, knowledge, and information on collaborative TPACK. The findings in this study show that, the module offered practical application to the instructors to demonstrate their own TPACK, by selecting suitable CL tools to teach different domains of learning. That means the module enables instructors to plan their lessons by referring to Frist Principle of Instruction, which will encourage students in knowledge building and meaning making instead of absorbing known information.

The findings of this study will also assist instructors to integrate technology into their pedagogical practices. This will assist because, to integrate technology effectively into instruction, the instructors need to have a good understanding of how technology can be incorporated together with pedagogy and content knowledge. As an added value, the Collaborative TPACK module could be implemented and applied across discipline and field of study.

Practical implications for students. Students benefits when their instructors used Collaborative TPACK, so that, the students will be acquiring skill of interacting, applying, evaluating, creating new knowledge and problem solving and will be able to work as a team. This is because collaborative learning is often seen, as very important from educational perspectives, since students need to have collaborative skills before they step into the working environment. At the same time, when instructors integrated Collaborative TPACK in teaching and learning, that means they are moving away from teacher centred and teaching facts and concepts as content towards students focused with discussion, debate, argumentation, and deep understanding. Hence, this can be achieved through social interactions and cognitive process during collaborative learning. Through, the implementation of the Collaborative TPACK module among the instructors, the findings showed that, the instructors were able to design learning task with elements of collaboration. This is to promote knowledge construction among students to create meaning for themselves, rather than just receiving it from the others (Hannafin, Hannafin, & Gabbitas, 2009; Heo, Lim, & Kim, 2010; Jowallah, 2014; Kim & Song, 2005; Suthers, 2006). That means that, students will benefit by becoming learners who are responsible for their learning while using CL tools.

Contribution to the Field of Knowledge

The primary aim of this study was to design and develop Collaborative TPACK module for CPD in higher education institution. So far, most studies on CPD programme for instructors in higher education over the past years has focused on developing pedagogical knowledge, technical knowledge in the specialist subjects, personal development skills, general managerial skills technology knowledge. In this study, researcher has tried to shift the focus to CPD that aware the complex interplay between technology, pedagogy, and content, rather than most CPDs that focus on technology often lack the incorporation of pedagogy and content. The expected contribution from this study is wide and immense in scope.

The finding discovered from the need analysis; design and development; and evaluation phase in this study, have answered the research questions and the following contributions are expected from the study. This study provides a guideline for instructors to teach meaningfully different domain of learning with collaborative learning tools, in terms of teaching resources which is derived from the suggestions of the experts.

The module offered instructors the innovative way of integrating technology and pedagogy into their field of studies, by integrating TPACK model and Taxonomy of Learning Outcome. This is to move away from the didactic teaching approaches in higher education that should go beyond transmission of knowledge and teaching facts and concepts as content (Dewitt et al., 2015).

Through integration of Collaborative TPACK, instructors were able to plan and design lesson that would allow students to acquire the skills of interacting, applying, evaluating, creating new knowledge and problem solving (Martin, 2006; Ronen & Pasher, 2011) that was achieved through social interactions and cognitive processes during collaborative learning in a form of collaborative learning tools, such as, wikis, blog, podcast, instant messaging, and discussion forum. Besides that, the module is valuable for the instructors because, the resources and material that were used in this module consisted of demonstration videos in real classroom setting in local higher education setting.

In addition to that, the module provides the best practices of teaching with collaborative TPACK and First Principles of Instruction with real-world problem that was derived from the follow up session during lesson observation. The Transformative Model for CPD consist of four phases namely; comprehension, modelling, application and reflection that allows the instructors to have control over their learning processes by given instructors the opportunity to experience Collaborative TPACK before implementation in the real teaching process. Besides the four phases, the current study added another phase known as transfer of knowledge and the retention of expertise due to the need for continuous assessment in the CPD.

During the transfer of knowledge and the retention of expertise phase, the instructional material and students' work (artefacts) were collected and recorded in an e-portfolio, that could provide a valuable contribution on how instructors from the various field of studies, demonstrated their interconnected TPACK through reflection to justify the impact of Collaborative TPACK module implementation. At the same time, this study contributes to a specific discipline- TPACK to guide other instructors in future to integrate collaborative TPACK into their teaching processes.

Moreover, the Collaborative TPACK module was able to solve the current problem addressed in the literatures from the aspect of instructors, TPACK and CPD. Literature indicated that, even though, the instructors understand the importance and promise technology hold in shaping their teaching and students learning, many instructors are still facing challenges incorporating technology into their instructions (Wachira & Keengwe, 2011), and being less confident to convince themselves that, technology can improve their classroom instructions (Jimoyiannis, 2010). Nevertheless, after implementation of the Collaborative TPACK module, instructors were more confidence to implement TPACK in their teaching and learning, since, they been exposed to theoretical and practical application of TPACK in respective field. In addition, instructors admitted that, they were not exposed to teach, and their teachings were based on experiences observed from their own instructors.

Besides that, the Collaborative TPACK module was designed and developed, based on consensus achieved from the experts. Therefore, experts suggested the content areas, that covered latest CL tools and taxonomy of learning that focuses on developing higher order thinking skills which contributed to the methodological aspect of this study.

Implementation of the Collaborative TPACK module has transform instructors from not -knowing to know TPACK by building instructors knowledge and skills, to apply TPACK with appropriate instructional strategies to promote effective learning experiences for their students. The module was effective in developing instructors TPACK, because, it was designed and developed by taking into consideration of instructors needs, since past literature revealed that, instructors found out that, the current CPD programmes were designed with ineffective and irrelevant activities, because, the CPD topic rarely addresses the instructors needs and concerns (Rodrigues et al., 2003).

Furthermore, some CPD are lacking conceptual framework guiding underpinning the planning, designing and implementation process of CPD, that resulted into passive and didactic forms of CPD delivery (Rodrigues et al., 2003) was resolved by implementing the module, based on Transformative Model of CPD, that emphasized on learning-by-doing approach and instructors were given opportunity to debrief and reflect on their learning.

Limitation and Suggestion for Future Study

There are several limitations related to the current study, while the first limitation is the duration of the module implementation and the follow up session. The duration of the module implementation in the CPD was very short with only fifteen hours face to face (3 sessions). Besides that, the follow up session conducted with the instructors in the form of lesson observation, was only conducted for short period of time (1 month) to observe their skills in implementing collaborative TPACK in teaching process. According to past studies, it could consume up to six months, in order for an individual to change to new behaviour that fully embrace a new technology tools to become part of his/her life.

This is because of overcoming the novelty effect of using a technology application which can be a major difficulty, since, it may wear off over time (Koch, Luck, Schwarzer, & Draheim, 2018; Prochaska & Diclemente, 1982). Hence, it is recommended to organize the module implementation for period of more than 3 sessions, since the finding of the study showed that, most instructors indicated their opinions that, 3 sessions were very limited to learn in depth about TPACK application. At the same time, the lesson observation should be done at the beginning of the semester to allow instructors to plan their lessons with collaborative TPACK, so that, observation could be done over one semester (14 weeks).

Secondly, the design of current study is one group pre-test and post-test quasi experimental group, without any form of control group in order to obtain the comparison score between the control group and the experimental group. Having control group is important to measure the degree of changes that occurred as a result of the intervention of the Collaborative TPACK module implementation. Therefore, for future studies, it is recommended to employ control group primarily for the purpose of measuring changes resulted from the experimental treatment.

Besides the design of the study, more instructors should be involved. In the current study only thirty-four instructors were available to participate in the module implementation, and seven instructors who partake in the follow up session for lesson observation. Due to that, it is suggested that future study should obtain appropriate sample size, since a large sample size is more representative of the population. Following that, it also suggested that, future study should conduct lesson observation as part of continuous assessment, with all participants of the CPD to ensure they are able to demonstrate the skills and knowledge acquired into practise.

Moreover, this study designed and developed a module for CPD among instructors in higher education institution, specially to develop their knowledge and skills in collaborative TPACK. The result of this study shows the module has effectively developed instructors' skills in teaching meaningfully, with collaborative learning tools over the time. Findings also illustrated the challenges and difficulty faced with the instructions, while implementing collaborative TPACK into their teaching processes. However, it also important to capture the effectiveness of the module, in promoting students learning and their perceptions towards instructors TPACK skills and knowledge. Thus, future studies should also focus on student's perspective, and the impact of the learning derived from TPACK implementation.

This study was limited to a single institution where the finding of this study can only be generalized. To this end, context and population of this study and might affect the transability if this study is generalized on other higher education institutions. However, the finding of this study maybe applicable and pertinent to instructors in higher education institution from various faculties. In future this research might be replicated to design and develop module to develop other skills besides collaborative for 21st century teaching and learning by integrating the theories and models used in this study.

Conclusion

In this study, the Collaborative TPACK module was successfully designed and developed, based on DDR approach. To undertake the study, three phases that consist of need analysis; design and developmental; implementation and evaluation were employed. In the need analysis phase, semi-structured interviews were conducted among seven instructors in higher education institution, two Head of Training Units and a trainer. Document analysis was used to gain insight into instructional activities that took place. Examining trend and pattern that emerged from instructional documents such as previous TPACK course evaluation and instructor's LMS activity.

The need analysis focused on discovering the need for a Collaborative TPACK module for CPD in higher education, from the aspect of instructors' technology skills, collaborative learning (CL) and CL tools. The finding shows that, instructors have a basic knowledge regarding the usage of technology in education and limited knowledge of CL tools and its usage. Instructors also lack knowledge on CL concepts and implementation in the teaching process and misconception about CL. Finally, form of CL tools the instructor's access in LMS were only discussion forum and chat. Besides that, current training programme lacks elements of CL and CL tools, and there is need for different teaching strategies with technology, and continuous assessment in CPD, since instructors found that learning new technology tools could be challenging.

The second phase of DDR was the design and development where FDM was used to collect data, based on the sixteen experts' consensus on the elements that should be included, in the Collaborative TPACK module for CPD. The finding shows that, the elements required in the module consisted of learning objective, content (instructional strategies, resources/media, evaluation), assessment (real world problems) and delivery. A transformative model of CPD was implemented, to develop instructors collaborative TPACK underpinning the social constructivism learning theory and an eclectic instructional design model of First Principles of Instructions, which use the real-world problems and examples. Once the module was developed, four experts validated the module to ensure the validity and modification on module was done accordingly, based on the panel of expert's opinion and suggestion before the implementation.

The third phase of the study was the implementation and evaluation of Collaborative TPACK module. After the module was evaluated and modified accordingly, based on the panel of expert's opinion and suggestion, the module was implemented among thirty-four instructors from various faculties. These instructor's voluntary joined the CPD at a public university in Klang Valley. A pre-test and post-test of one group quasi experimental was used to evaluate the effectiveness of the module in developing instructors TPACK and taxonomy of learning. The data was also analysed from the lesson plan score and lesson observation score, post lesson observation interview and e-portfolio for triangulation. A survey was administrated to explore instructors' perception on the technical and pedagogical usability regarding Collaborative TPACK module. The finding shows that, the Collaborative TPACK module was found to be effective in developing instructor's knowledge and skills in TPACK and to apply TPACK, based on specific domain of learning. After the implementation of the module, the instructors also positive that, the Collaborative TPACK module was technically and pedagogically usable.

Overall, the module offered instructors the theoretical and practical application of collaborative TPACK. During the CPD, activities related to real-world were given to instructors to work collaboratively by producing First Principles of Instruction using online diagram software, Lucidchart *(see Appendix Y).* Then, were they also exposed to assess previous lesson plan, to identify the elements of pedagogy, content and technology used by sharing their opinions and suggestions of improvement via online brainstorming application Padlet (*see Appendix Z).* Instructions also design their own lesson plans on topic they agreed upon by using Wiki *(see Appendix 29)* and shared their outputs through presentation and peer assessment that were carried out by using

Poll Everywhere. Besides that, findings also show that, the module benefited the instructors through the continuous assessment (follow-up session). Instructors expressed their feelings and opinions that, the follow up session in form of lesson observation allowed them to practise TPACK to teach different domain of learning using technology tools. The technical support gained throughout the follow up session increased their motivation and confident level to continue to implement TPACK in their teaching and learning.

Among the difficulty that was faced during the implementation of Collaborative TPACK in their teaching and learning sessions were availability of time; limited technical skills; and nature of classes and topic taught. However, it seems the benefit that was offered by the module was greater than the challenges being faced. Hence, more studies of this nature need to provide training and support for instructors to continue to develop their knowledge and skills in the area of pedagogy, technology and content. This will make them to teach and provide meaningful learning experiences for the students through acquiring skill of interacting, applying, evaluating, creating new knowledge and problem solving, rather than transmission of knowledge by teaching fact and concepts as content.

REFERENCES

Abbott, G. N., Stening, B. W., Atkins, P. W. B., & Grant, A. M. (2006). Coaching expatriate managers for success: Adding value beyond training and mentoring. *Asia Pacific Journal of Human Resources*, *44*(3), 295–317. https://doi.org/10.1177/1038411106069413

Abdekhodaee, A. H., Ross, B., & Chase, A.-M. (2015). Wikis for group work : Encouraging transparency, benchmarking and feedback. *International Society for the Scholarship of Teaching and Learning*, *33*(October 2015), 15–31. Retrieved from https://www.researchgate.net/publication/283616297_Wikis_for_group_work_Encouraging_transparency_benchmarking_and_feedback

Abrams, Z. I. (2003). The effect of synchronous and asynchronous CMC on oral performance in German. *The Modern Language Journal*, *87*(2), 157–167.

Abu-Zaid, A., & Khan, T. A. (2013). Assessing declarative and procedural knowledge using multiple-choice questions. *Medical Education Online*, *18*, 21132. https://doi.org/10.3402/meo.v18i0.21132

Acutance Sdn Bhd. (2013). *Industry Report Malaysia ICT Sector*. *Switzerland Global Enterprise*. Retrieved from http://www.s-ge.com/sites/default/files/private_files/BBK_Malaysia_Industry_Report_ICT_2013.pdf

Adler, M., & Ziglio, E. (1996). *Gazing Into the Oracle: The Delphi Method and Its Application to Social Policy and Public Health*. Jessica Kingsley Publishers. Retrieved from https://books.google.com.my/books?id=jo1Z1JZIrKIC

Adrianson, L. (2001). Gender and computer-mediated communication: Group processes in problem solving. *Computers in Human Behavior*, *17*, 71–94.

Afari, E., Aldridge, M., Fraser, J., & Khine, S. (2013). Students' perceptions of the learning environment and attitudes in game-based mathematics classrooms. *Learning Environment Research*, *16*, 131–150.

Ain, N., Kaur, K., & Waheed, M. (2016). The influence of learning value on learning management system use: An extension of UTAUT2. *Information Development*, *32*(5), 1306–1321. https://doi.org/10.1177/0266666915597546

Akbari, R., & Yazdanmehr, E. (2014). A Critical Analysis of the Selection Criteria of Expert Teachers in ELT. *Theory and Practice in Language Studies*, *4*(8), 1653–1658. https://doi.org/10.4304/tpls.4.8.1653-1658

Akinyemi, A. F., & Rembe, S. (2017). Challenges Encountered by Communities of Practice in Enhancing Continuing Professional Teachers Development in High Schools. *The Anthropologist*, *30*(1), 8–16. https://doi.org/10.1080/09720073.2017.1377890

Al-Busaidi, K., & Al-Shihi, H. (2010). Instructors' Acceptance of Learning Management Systems: A Theoretical Framework. *Communications of the IBIMA*, (January), 1–10. https://doi.org/10.5171/2010.862128

Al-Kadi, A., & Donnon, T. (2013). Using simulation to improve the cognitive and psychomotor skills of novice students in advanced laparoscopic surgery: A meta-analysis. *Medical Teacher*, *35*. https://doi.org/10.3109/0142159X.2013.765549

Al-Qirim, N. (2015). An empirical investigation of smart board innovations in teaching in UAE University. *Education and Information Technologies*, 1–17. https://doi.org/10.1007/s10639-015-9425-1

Alexander, B. (2006). A new way of innovation for teaching and learning. *Educause Review*, *41*(2), 32–44.

Alias, N. (2010). *Pembangunan modul pedagogi berasaskan teknologi dan gaya pembelajaran Felder-Silverman Kurikulum Fizik Sekolah Menengah*. University of Malaya.

Allen Moore, W., & Russell Smith, A. (2012). Effects of video podcasting on psychomotor and cognitive performance, attitudes and study behaviour of student physical therapists. *Innovations in Education and Teaching International*, *49*(4), 401–414. https://doi.org/10.1080/14703297.2012.728876

Almarashdeh, I. A., Sahari, N., Zin, N. A. M., & Alsmadi, M. (2010). The success of learning management system among distance learners in Malaysian universities. *Journal of Theoretical and Applied Information Technology*, *21*(2), 80–91.

Almerich, G., Orellana, N., Rodríguez, J., & García, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers and Education*, *100*, 110–125. https://doi.org/10.1016/j.compedu.2016.05.002

Alrushiedat, N., & Olfman, L. (2013). Aiding Participation and Engagement in a Blended Learning Environment. *Journal of Information Systems Education*, *24*(2), 133–146.

Alsamadani, H. A. (2017). The Effectiveness of Using Online Blogging for Students' Individual and Group Writing. *International Education Studies*, *11*(1), 44. https://doi.org/10.5539/ies.v11n1p44

Altanopoulou, P., Tselios, N., Katsanos, C., Georgoutsou, M., & Panagiotaki, M. (2015). Wiki-Mediated Activities in Higher Education : Evidence-Based Analysis of Learning Effectiveness Across Three Studies. *Educational Technology & Society*, *18*, 511–522.

Amhag, L., & Jakobsson, A. (2009). Collaborative learning as a collective competence when students use the potential of meaning in asynchronous dialogues. *Computers and Education*, *52*(3), 656–667.

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers and Education*, *53*(3), 749–760. https://doi.org/10.1016/j.compedu.2009.04.015

Anderson, J. R. (2005). *Cognitive Psychology and Its Implications*. Worth Publishers. Retrieved from https://books.google.com.my/books?id=9P4p6eAULMoC

Andre, T. (1997). Selected micro-instructional methods. In R. D. Tennyson, F. Scott, N. Seel, & S. Dijkstra (Eds.), *Implication for instructional design* (pp. 243–267). Mahwah, NJ: Lawrence Erlbaum Associates.

Andresen, M. a. (2009). Asynchronous discussion forums: success factors, outcomes, assessments, and\nlimitations. *Educational Technology & Society*, *12*(1), 249–257. https://doi.org/10.1017/CBO9781107415324.004

Andrews, H., & Goodson, A. (1995). A comparative analysis of models of instructional design. In A. Gary (Ed.), *Instructional technology: Past, present, and future* (pp. 161–182). Englewood, CO: Libraries Unlimited.

Angeli, C., & Valanides, N. (2005). Preservice elementary teachers as information and communication technology designers: an instructional systems design model based on an expanded view of pedagogical content knowledge. *Journal of Computer Assisted Learning*, *21*(4), 292–302.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers and Education*, *52*(1), 154–168. https://doi.org/10.1016/j.compedu.2008.07.006

Angeli, C., & Valanides, N. (2013). Technology mapping: An approach for developing technological pedagogical content knowledge. *Journal of Educational Computing Research*, *48*, 199–221. https://doi.org/10.2190/EC.48.2.e

Ansyari, M. F. (2015). Designing and evaluating a professional development programme for basic technology integration in English as a foreign language (EFL) classrooms. *Australasian Journal of Educational Technology*, *31*(6), 699–712. https://doi.org/10.14742/ajet.v0i0.1675

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 71–88. https://doi.org/10.1080/0158791022000009213

Ariffin, N. H. M., Rahman, H. A., Alias, N. A., & Sardi, J. (2015). A survey on factors affecting the utilization of a Learning Management System in a Malaysian higher education. *IC3e 2014 - 2014 IEEE Conference on e-Learning, e-Management and e-Services*, 82–87. https://doi.org/10.1109/IC3e.2014.7081246

Arnseth, H., & Krange, I. (2016). What happens when you push the button? Analyzing the functional dynamics of concept development in computer supported science inquiry. *International Journal of Computer-Supported Collaborative Learning*, *11*(4), 479–502. https://doi.org/10.1007/s11412-016-9244-4

Arslan, S., & Sahin-Kizil, A. (2010). How can the use of blog software facilitate the writing process of English language learners. *Computer Assisted Language Learning*, *23*(3), 183–197.

Ausubel, D. (1963). *The Psychology of Meaningful Verbal Learning*. New York: Grune & Stratton.

Azam, O., & Zainurin, D. (2011). Professional Development among Academic Staff at Selected Malaysian Public Universities: Preliminary Findings of the Impact of the Basic Teaching Methodology Course (BTMC). *International Journal of Business and Social Science*, *2*(11), 125–134.

Bandura, A. (1969). *Principles of behavior modification*. New York: Holt, Rinehart & Winston.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Baran, E. (2016). Investigating faculty technology mentoring as a university-wide professional development model. *Journal of Computing in Higher Education*, *28*(1), 45–71. https://doi.org/10.1007/s12528-015-9104-7

Baran, E., & Uygun, E. (2016). Putting technological, pedagogical, and content knowledge (TPACK) in action: An integrated TPACK-design-based learning (DBL) approach. *Australasian Journal of Educational Technology*, (November). https://doi.org/10.14742/ajet.2551

Baris, M. F. (2015). Future of E-Learning: Perspective of European Teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(3), 421–429. https://doi.org/10.12973/eurasia.2015.1361a

Baron, N. S. (2004). See you online: Gender issues in college student use of instant messaging. *Journal of Language and Social Psychology.*, *23*, 397–423.

Beauvois, H. (1992). Computer-assisted classroom discussion in the foreign language classroom: conversation in slow motion. *Foreign Language Annals*, *25*(5), 455–464.

Becker, R., & Jokivirta, L. (2007). *Online learning in universities: Selected data from the 2006 Observatory Survey.* Redhill: The Observatory on Borderless Higher Education. Retrieved from http://www.obhe.ac.uk/documents/view_details?id=15

Belland, B, R. (2016). *Instructional scaffolding in STEM education: Strategies and efficacy evidence*. (1st ed.). Springer International Publishing. https://doi.org/10.1007/978-3-319-02565-0

Belland, B. R. (2014). Scaffolding: Definition, current debates, and future directions. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (4th ed., pp. 505–518). New York: Springer.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Hillsdale, New Jersey: Lawrence Erlbaum.

Bergh, L., Ros, A., & Beijaard, D. (2015). Teacher learning in the context of a continuing professional development programme: A case study. *Teaching and Teacher Education*, *47*, 142–150. https://doi.org/10.1016/j.tate.2015.01.002

Berliner, D. C. (2001). Expert Teachers : Their Characteristics , Development and Accomplishments, (January 2004), 13–28.

Bernard, R. M., Rubalcava, B. R., & St-Pierre, D. (2000). Collaborative online distance learning: Issues for future practices and research. *Distance Education*, *21*(2), 260–277.

Biasutti, M. (2011). The student experience of a collaborative e-learning university module. *Journal of Computer & Education*, (57), 1865–1875. https://doi.org/10.1016/j.compedu.2011.04.006

Biasutti, M. (2017). A comparative analysis of forums and wikis as tools for online collaborative learning. *Computers and Education*, *111*, 158–171. https://doi.org/10.1016/j.compedu.2017.04.006

Biasutti, M., & El-Deghaidy, H. (2012). Using Wiki in teacher education: Impact on knowledge management processes and student satisfaction. *Computers and Education*, *59*(3), 861–872. https://doi.org/10.1016/j.compedu.2012.04.009

Biasutti, M., & EL-Deghaidy, H. (2015). Interdisciplinary project-based learning: an online wiki experience in teacher education. *Technology, Pedagogy and Education*, *24*(3), 339–355. https://doi.org/10.1080/1475939X.2014.899510

Bilici, S., Guzey, S., & Yamak, H. (2016). Assessing pre-service science teachers' technological pedagogical content knowledge (TPACK) through observations and lesson plans. *Research in Science & Technological Education*, *5143*(April), 1–15. https://doi.org/10.1080/02635143.2016.1144050

Bishop, J., & Elen, J. (2014). Emerging Technologies. In M. Spector, M. Merrill, M. Bishop, & J. Elen (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 673–674). New York, NY.

Bligh, D. (2000). *What's the point in discussion?* Exeter, UK: Intellect BookS.

Blogging Statistics -Worldometers. (2017). *Blog posts written today. http://www.worldometers.info/blogs/.*

Bloom, B. S. (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals*. D. McKay. Retrieved from https://books.google.com.my/books?id=hos6AAAAIAAJ

Bloom, B. S., Engelhart, M. ., Furst, E. ., Hill, W. ., & Krathwohl, D. . (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.

Bolliger, D., Supanakorn, S., & Boggs, C. (2010). Impact of podcasting on student motivation in the online learning environment. *Computers and Education*, *55*(2), 714–722. https://doi.org/10.1016/j.compedu.2010.03.004

Bolliger, U., & Wasilik, O. (2009). Factors influencing faculty satisfaction with online teaching and learning in higher education. *Distance Education*, *30*(1), 103–116.

Bower, M. (2016). Deriving a typology of Web 2.0 learning technologies. *British Journal of Educational Technology*, *47*(4), 763–777. https://doi.org/10.1111/bjet.12344

Boza, Á., & Conde, S. (2015). Training, attitude, use and impact of Web 2.0 in higher education: Scale validation / Formación, actitud, uso e impacto de la Web 2.0 en educación superior: Validación de una escala. *Cultura y Educación*, *27*(2), 372–406. https://doi.org/10.1080/11356405.2015.1034531

Bradford, P., Porciello, M., Balkon, N., & Backus, D. (2007). The blackboard learning system: The be all and end all in educational instruction? *Journal of Educational Technology Systems*, *35*(3), 301–314. https://doi.org/doi:10.2190/X137-X73L-5261-5656

Branon, R. F., & Essex, C. (2001). Synchronous and asynchronous communication tools in distance education: *A Survey of Instructors. TechTrends*, *45*, 36–42.

Bromme, R., Hesse, F. W., & Spada, H. (2005). Barriers, biases and opportunities of communication and cooperation with computers: Introduction and overview. In R. Bromme, F. W. Hesse, & H. Spada (Eds.), *Barriers and biases in computer-mediated knowledge communication.* (Vol. 5, pp. 1–14). New York, NY.

Brown, H., & Green, D. (2016). *The Essentials of Instructional Design: Connecting Fundamental Principles with Process and Practice, Third Edition*. Routledge. Retrieved from https://books.google.com.my/books?id=K6EOrgEACAAJ

Brown, S., Edmonds, S., & Lee, B. (2002). *Continuing Professional Development: LEA and School Support for Teachers*. Slough, Berkshire.

Browne, T., Hewitt, R., Jenkins, M., & Walker, R. (2008). *2008 survey of technology enhanced learning for higher education in the UK. Oxford, UK:* Universities and Colleges Information Systems Association.

Bruffee, K. (1993). *Collaborative learning: Higher education, interdependency, and the authority of knowledge.* Baltimore, MD: Johns Hopkins University Press. https://doi.org/doi:10.2307/358879

Bruner, J. (1960). The process of education. Cambridge, MA: Harvard University Press. *Education*, *1*(2), 12–11.

Bruner, J. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.

Brunings, R. H., Schraw, G. J., & Ronning, R. R. (1990). *Cognitive psychology and instruction* (2nd ed.). Englewood Cliffs, NJ: Merrill Prentice Hall.

Bryman, A. (2008). *Social Research Methods*. Oxford University Press. Retrieved from https://books.google.com.my/books?id=O7a2QAAACAAJ

Bull, K, S., Shuler, P., Overton, R., Kimball, S., Boykin, C., & Griffin, J. (1999). Processes for developing scaffolding in a computer mediated learning environment. *The America Council on Rural Special Education (ACRES)*, 241–248.

Burhan-Horasanlı, E., & Ortaçtepe, D. (2016). Reflective practice-oriented online discussions: A study on EFL teachers' reflection-on, in and for-action. *Teaching and Teacher Education*, *59*, 372–382. https://doi.org/10.1016/j.tate.2016.07.002

Bygate, M. (1996). Effects of task repetition:: Appraising the development of second language learners. In J. Willis & D. Willis (Eds.), *Challenge and change in language teaching* (pp. 136–146). Oxford: Heinemann.

Cabero, J., & Barroso, J. (2016). ICT teacher training: A view of the TPACK Model. *Culture and Education*, *28*(3), 633–663. https://doi.org/10.1080/11356405.2016.1203526

Caladine, R. (2008). *Enhancing e-learning with media-rich content and interactions.* Hershey, PA: Information Science Publishing.

Campbell, C., & Deed, C. (2009). Engaging boys through self-reflection using journaling tool. *Australian Educational Computing*, *24*(1), 4–9.

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and Quasi-Experimental Designs for Research*. American Educational Research Association. Retrieved from https://books.google.com.my/books?id=KCTrCgAAQBAJ

Carceller, C., Dawson, S., & Lockyer, L. (2015). Social capital from online discussion forums : Differences between online and blended modes of delivery. *Australasian Journal of Educational Technology*, *31*(2), 150–163. https://doi.org/10.14742/ajet.1448

Carr, C. T., Zube, P., Dickens, E., Hayter, C. A., & Barterian, J. A. (2013). Toward a model of sources of influence in online education. *Cognitive Learning and the Effects of Web 2.0. Communication Education*, *62*(1), 61–85.

Caswell, B., & Bielaczyc, K. (2001). Knowledge Forum: altering the relationship between students and scientific knowledge. *Education, Communication & Information*, *1*(3), 325–358. https://doi.org/10.1080/1463631012011710

Chai, C., & Koh, J. (2017). Changing teachers' TPACK and design beliefs through the Scaffolded TPACK Lesson Design Model (STLDM). *Learning: Research and Practice*, (August), 1–16. https://doi.org/10.1080/23735082.2017.1360506

Chai, C., Koh, J., & Tsai, C. (2013). A Review of Technological Pedagogical Content Knowledge. *Educational Technology and Society*, *16*(2), 31–51. https://doi.org/10.1111/j.1365-2729.2010.00372.x

Chai, C., Ng, E. M. W., Li, W., Hong, H. Y., & Koh, J. H. L. (2013). Validating and modelling technological pedagogical content knowledge framework among asian preservice teachers. *Australasian Journal of Educational Technology*, *29*(1), 41–53. https://doi.org/10.1234/ajet.v29i1.174

Chan, C., & Chan, Y. (2011). Students' views of collaboration and online participation in Knowledge Forum. *Computers and Education*, *57*(1), 1445–1457. https://doi.org/10.1016/j.compedu.2010.09.003

Chan, J., Hew, K., & Cheung, W. (2009). Asynchronous online discussion thread development: Examining growth patterns and peer-facilitation techniques. *Journal of Computer Assisted Learning*, *25*(5), 438–452. https://doi.org/10.1111/j.1365-2729.2009.00321.x

Chang, J., & Chang, S. (2014). Assessing peer support and usability of blogging in hybrid learning environments. *Interactive Learning Environments.*, *22*(1), 3–17. https://doi.org/10.1080/10494820.2011.619889

Chang, Jang, S. J., & Chen, Y. H. (2015). Assessing university students' perceptions of their Physics instructors' TPACK development in two contexts. *British Journal of Educational Technology*, *46*(6), 1236–1249. https://doi.org/10.1111/bjet.12192

Charalambous, K., & Karagiorgi, Y. (2002). Information and Communications Technology in-service training for teachers: Cyprus in perspective. *Journal of Information Technology for Teacher Education*, *11*(2), 197–216.

Chawdhry, A., Paullet, K., & Benjamin, D. (2011). Assessing Blackboard: Improving online instructional delivery. *Information Systems Education Journal*, *9*(4), 20. Retrieved from http://isedj.org/2011- 9/N4/ISEDJv9n4p20.html

Chen, C. (2000). Extensions of the TOPSIS for group decision-making under fuzzy environment. *Fuzzy Sets and Systems*, *114*(1), 1–9. https://doi.org/https://doi.org/10.1016/S0165-0114(97)00377-1

Chen, Y. H., Jang, S. J., & Chen, P. J. (2015). Using wikis and collaborative learning for science teachers' professional development. *Journal of Computer Assisted Learning*, *31*(4), 330–344. https://doi.org/10.1111/jcal.12095

Cheng, C.-H., & Lin, Y. (2002). Evaluating the best main battle tank using fuzzy decision theory with linguistic criteria evaluation. *European Journal of Operational Research*, *142*(1), 174–186. https://doi.org/https://doi.org/10.1016/S0377-2217(01)00280-6

Cheung, R., & Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computers and Education*, *63*(February 2014), 160–175. https://doi.org/10.1016/j.compedu.2012.12.003

Cho, M., & Tobias, S. (2016). Should Instructors Require Discussion in Online Courses ? Effects of Online Discussion on Community of Inquiry , Learner Time , Satisfaction , and Achievement. *International Review of Research in Open and Distance Learning*, *17*(2), 124–140. https://doi.org/10.19173/irrodl.v17i2.2342

Christou, C. (2010). Virtual Reality in Education. In *Affective, Interactive and Cognitive Methods for E-Learning Design: Creating an Optimal Education Experience* (pp. 228–243). https://doi.org/10.4018/978-1-60566-940-3.ch012

Chu, S., Capio, C., Aalst, J., & Cheng, E. (2017). Evaluating the use of a social media tool for collaborative group writing of secondary school students in Hong Kong. *Computers & Education*, *110*, 170–180. https://doi.org/10.1016/j.compedu.2017.03.006

Churchill, D. (2011). Web 2.0 in education: a study of the explorative use of blogs with a postgraduate class. *Innovations in Education and Teaching International*, *48*(2), 149–158. https://doi.org/10.1080/14703297.2011.564009

Clark, J. (2010). The digital imperative: Making the case for a 21st-century pedagogy. *Computers & Composition*, *27*, 27–35. https://doi.org/10.1016/j.compcom.2009.12.004

Clutterbuck, D. (1991). *Everyone Needs a Mentor*. London: Institute of Personnel and Development.

Cochrane, T., & Narayan, V. (2012). Redesigning Professional Development: Reconceptualising Teaching Using Social Learning Technologies. *Research in Learning Technology*, *21*(3), 1–19. https://doi.org/http://dx.doi.org/10.3402/rlt.v21i0.19226

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research*, *64*, 1–35.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research Methods in Education*. Routledge. Retrieved from https://books.google.com.my/books?id=p7oifuW1A6gC

Cole, M. (2009). Using Wiki technology to support student engagement: Lessons from the trenches. *Computers and Education*, *52*(1), 141–146. https://doi.org/10.1016/j.compedu.2008.07.003

Collazos, C. A., Guerrero, L. A., Pino, J. A., & Ochoa, S. F. (2003). Collaborative scenarios to promote positive interdependence among group members. In J. Favela & D. Decouchant (Eds.), *International Conference on Collaboration and Technology, CRIWG 2003: Groupware: .Design, Implementation, and Use* (pp. 356–370). https://doi.org/doi:10.1007/978-3-540-39850- 9_30

Collin, K., Heijden, B., & Lewis, P. (2012). Continuing professional development. *International Journal of Training and Development*, *16*(3), 155–163. https://doi.org/10.1111/j.1468-2419.2012.00410.x

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453–494). Hillsdale, NJ, USA: Lawrence Erlbaum Associates.

Copley, J. (2007). Audio and video podcasts of lectures for campus-based students: production and evaluation of student use. *Innovations in Education and Teaching International*, *44*(4), 387–399. https://doi.org/10.1080/14703290701602805

Cress, U., & Kimmerle, J. (2008). A systemic and cognitive view on collaborative knowledge building with wikis. *International Journal of Computer-Supported Collaborative Learning*, *3*(2), 105–122. https://doi.org/10.1007/s11412-007-9035-z

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications. Retrieved from https://books.google.com.my/books?id=PViMtOnJ1LcC

Creswell, J. W., & Clark, V. L. P. (2011). *Designing and Conducting Mixed Methods Research*. SAGE Publications. Retrieved from https://books.google.com.my/books?id=6tYNo0UpEqkC

Cuhadar, C., & Kuzu, A. (2010). Improving interaction through blogs in a constructivist learning environment. *Turkish Online Journal of Distance Education*, *11*(1), 134–161.

Cui, Y., & Wise, F. (2015). Identifying content-related threads in MOOC discussion forums. In *ACM Conference on Learning@ Scale* (pp. 299–303). Vancouver, BC: ACM.

Dalal, M., Archambault, L., & Shelton, C. (2017). Professional Development for International Teachers: Examining TPACK and Technology Integration Decision Making. *Journal of Research on Technology in Education*, *1523*(July), 1–17. https://doi.org/10.1080/15391523.2017.1314780

Darabi, A., Liang, X., Suryavanshi, R., & Yurekli, H. (2013). Effectiveness of Online Discussion Strategies: A Meta-Analysis. *American Journal of Distance Education*, *27*(4), 228–241. https://doi.org/10.1080/08923647.2013.837651

Davidson, R. (2012). Wiki use that increases communication and collaboration motivation : A reflection several semesters later. *Journal of Learning Design*, *5*(2).

Davis, E. A., & Miyake, N. (2004). Explorations of scaffolding in complex classroom systems. *The Journal of the Learning Sciences*, *13*(3), 265–272.

Day, C. (1999). *Developing Teachers: the challenges of lifelong learning*. London: Falmer Press.

Day, Christopher, & Gu, Q. (2010). The new lives of teachers. *The New Lives of Teachers*, 1–224. https://doi.org/10.4324/9780203847909

de Jong, T., Weinberger, A., Girault, I., Kluge, A., Lazonder, W., Pedaste, M., & Ney, M. (2012). Using scenarios to design complex technology-enhanced learning environments. *Educational Technology Research & Development*, *60*(5), 883–901.

De Wever, B., Keer, H. Van, Schellens, T., & Valcke, M. (2010). Roles as a structuring tool in online discussion groups: The differential impact of different roles on social knowledge construction. *Computers in Human Behavior*, *26*(4), 516–523. https://doi.org/10.1016/j.chb.2009.08.008

De Wever, Van Keer, H., Schellens, T., & Valcke, M. (2009). Structuring asynchronous discussion groups: The impact of role assignment and self-assessment on students' levels of knowledge construction through social negotiation. *Journal of Computer Assisted Learning*, *25*(2), 177–188. https://doi.org/10.1111/j.1365-2729.2008.00292.x

Deni, A., Zainal, Z., & Malakolunthu, S. (2013). Improving teaching in higher education in Malaysia: Issues and challenges. *Journal of Further and Higher Education*, *9486*(April), 1–18. https://doi.org/10.1080/0309877X.2013.831037

Dennen, P. (2008). Cognitive apprenticeship in educational practice: Research on scaffolding, modeling, mentoring, coaching as instructional strategies. In J. Spector, M. Merrill, J. Van Merrienboer, & M. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed., pp. 813–828). Mahwah, NJ: Erlbaum.

Department of Statistics Malaysia. (2016). Department of Statistics Press Release Ict Use and Access By Individuals and Households Survey Report. Retrieved December 23, 2016, from https://www.statistics.gov.my/index.php?r=column/cthemeByCat&cat=395&bul_id=Q3l3WXJFbG1PNjRwcHZQTVlSR1UrQT09&menu_id=amVoWU54UTl0a21NWmdhMjFMMWcyZz09

Dewitt, D., Alias, N., & Siraj, S. (2015). Collaborative learning: Interactive debates using Padlet in a higher education institution. *Turkish Online Journal of Educational Technology*, *2015*, 88–95.

DeWitt, D. (2010). *Development of a collaborative mLearning module on nutrition for form 2 students*. University of Malaya.

DeWitt, D, Alias, N., Siraj, S., & Spector, J. (2017). Wikis for a collaborative problem-solving (CPS) module for secondary school science. *Educational Technology and Society*, *20*(1), 144–155.

DeWitt, D, Siraj, S., & Alias, N. (2014). Collaborative mlearning: A module for learning secondary school science. *Educational Technology and Society*, *17*(1), 89–101.

DeWitt, D., Alias, N., Siraj, S., & Hutagalung, F. (2014). Knowledge Management in Education : Designing instruction for using wikis. In Gaol, Mars, & Saragih (Eds.), International Conference on Management And Technology In Knowledge, Service, Tourism & Hospitality (pp. 45–50). London: Taylor & Francis Group. Retrieved from file:///C:/Users/user/Downloads/9780429227370_googlepreview (1).pdf

DeWitt, Dorothy, Alias, N., Siraj, S., & Zakaria, A. (2014). Interactions in online forums: a case study among first year undergraduate students. *Frontiers in Education (FE)*, *2*(1), 6–13. Retrieved from http://eprints.um.edu.my/9489/

Dick, W., & Carey, L. (1996). *The systematic design of instruction* (4th ed.). New York: Harper Collins College Publishers.

Dick, W., & Carey, M. (1985). *The systematic design of instruction* (2nd ed.). New York: HarperCollins.

Dillenbourg, P. (1999). What do you mean by collaborative learning '? *Collaborative Learning Cognitive and Computational Approaches*, *1*(6), 1–15. https://doi.org/10.1.1.167.4896

Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In H. Spada & P. Reimann (Eds.), *Learning in humans and machines* (pp. 189–211). Oxford: Elsevier Science.

Dippold, D. (2009). Peer feedback through blogs: Student and teacher perceptions in an advanced German class. *ReCALL*, *21*, 18–36.

Doering, A., Veletsianos, G., Scharber, C., & Miller, C. (2009). Using the technological, pedagogical, and content knowledge framework to design online learning environments and professional development. *Journal of Educational Computing Research*, *41*(3), 319–346.

Donnelly, F., & Boniface, S. (2013). Consuming and creating: Early-adopting science teachers' perceptions and use of a wiki to support professional development. *Computers & Education*, *68*, 9–20.

Donnelly, M., & Berge, L. (2006). Podcasting: Co-opting MP3 players for education and training purposes. *Online Journal of Distance Learning Administration*, *9*(3).

Donohoe, H. M., & Needham, R. D. (2009). Moving best practice forward: Delphi characteristics, advantages, potential problems, and solutions. *International Journal of Tourism Research*, *11*(5), 415–437. https://doi.org/10.1002/jtr.709

Driscoll, M. P. (2005). *Psychology of learning for instruction* (3rd ed.). New York: Allyn & Bacon.

Ducate, L., & Lomicka, L. (2008). Adventures in the blogosphere: From blog readers to blog writers. *Computer Assisted Language Learning*, *21*, 9–28.

Dysart, S., & Weckerle, C. (2015). Professional Development in Higher Education : A Model for Meaningful Technology Integration. *Journal of Information Technology Education: Innovations in Practice*, *14*, 255–265. https://doi.org/10.28945/2326

Elissavet, G., & Economides, A. A. (2003). An evaluation instrument for hypermedia courseware. *Educational Technology and Society*, *6*(2), 31–44. https://doi.org/10.1177/1473095211400151

Elliott, A. C., & Woodward, W. A. (2007). *Statistical Analysis Quick Reference Guidebook: With SPSS Examples*. SAGE Publications. Retrieved from https://books.google.com.my/books?id=SOsX0IbNxeIC

Ellis, R. A., Ginns, P., & Piggott, L. (2009). E-learning in higher education: some key aspects and their relationship to approaches to study. *Higher Education Research & Development*, *28*, 303–318. https://doi.org/http://dx.doi.org/10.1080/07294360902839909

Embi, M. A. ., Hamat, A. ., & Sulaiman, A. H. . (2012). The use of learning management systems among Malaysian university lecturers. *International Journal of Learning*, *18*(4), 61–70. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84866527138&partnerID=40&md5=1d40ecbc53c27392e225dc08cd16aaae

Emelyanova, N., & Voronina, E. (2014). Introducing a Learning Management System at a Russian University : Students ' and Teachers ' Perceptions. *The International Review of Research in Open and Distance Learning*, *15*(1), 272–289. https://doi.org/10.19173/irrodl.v15i1.1701

Endedijk, D., Vermunt, D., Verloop, N., & Brekelmans, M. (2012). The nature of student teachers' regulation of learning in teacher education. *British Journal of Educational Psychology*, *82*, 469–491.

Ertmer, A., & Ottenbreit-Leftwich, T. (2010). Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect. *Journal of Research on Technology in Education*, *42*(3), 1539–1523.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–39. https://doi.org/10.1007/BF02504683

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism,constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, *26*(2), 43–71. https://doi.org/10.1002/piq

Evans, C. (2008). The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers and Education*, *50*(2), 491–498. https://doi.org/10.1016/j.compedu.2007.09.016

Ferronato, M., & Hruby, R. J. (2011). The use of videos in teaching psychomotor skills: A look at a new way of teaching osteopathic manipulative treatment to a remote campus. *AAO Journal* (Vol. 21).

Field, A. (2009). *Discovering Statistics Using SPSS*. SAGE Publications. Retrieved from https://books.google.com.my/books?id=a6FLF1YOqtsC

Fırat, E. A., & Koksal, M. S. (2017). The relationship between use of Web 2.0 tools by prospective science teachers and their biotechnology literacy. *Computers in Human Behavior*, *70*, 44–50. https://doi.org/10.1016/j.chb.2016.12.067

Fleck, J. (2012). Blended learning and learning communities: opportunities and challenges. *Journal of Management Development*, *31*(4), 398–411. https://doi.org/10.1108/02621711211219059

Fose, L., & Mehl, M. (2007). Plugging into students' digital DNA: five myths prohibiting proper podcasting pedagogy in the new classroom domain. *MERLOT Journal of Online Learning and Teaching*, *3*(3), 277–287.

Freiermuth, M., & Jarrell, D. (2006). Willingness to communicate: can online chat help? *International Journal of Applied Linguistics*, *16*(2), 189–212.

Freiermuth, R., & Huang, C. (2012). Bringing Japan and Taiwan closer electronically: a look at an intercultural online synchronic chat task and its effect on motivation. *Language Teaching Research*, *16*(1), 61–88.

Fu, Q. K., & Hwang, G. J. (2018). Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016. *Computers and Education*, *119*, 129–143. https://doi.org/10.1016/j.compedu.2018.01.004

Gagne, M. (1970). *Conditions of learning* (2nd ed.). New York, NY: Holt, Rinehart and Winston Inc.

Gagne, M. (1977). *Conditions of Learning* (3rd ed.). New York: Holt, Rinehart and Winston.

Gagné, M. (1972). Domains of learning. *Interchange*, *3*(1), 1–8. https://doi.org/10.1007/BF02145939

Gagné, M. (1984). Learning outcomes and their effects: Useful categories of human performance. *American Psychologist*, *39*(4), 377–385. https://doi.org/10.1037/0003-066X.39.4.377

Gagné, M., & Briggs, J. (1974). *The principles of instructional design*. New York, NY: Holt, Rinehart & Winston.

Gagné, M., & Merrill, D. (1990). Integrative goals for instructional design. *Educational Technology Research and Development*, *38*(1), 23–30.

Gagné, M., Wager, W., Golas, K., & Keller, M. (2005). *Principles of Instructional Design*. Thomson/Wadsworth. Retrieved from https://books.google.com.my/books?id=DxgiAQAAIAAJ

Gagne, R. (1971). *Learning hierarchies*. NJ: Prentice Hall.

Gagné, R. (1985). *The Conditions of Learning and Theory of Instruction* (4th ed.). New York: Holt, Rinehart, and Winston.

Gagne, R., & Driscoll, P. (1988). *Essential of Learning for Instructions* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Garcia, E., Elbeltagi, I., Brown, M., & Dungay, K. (2015). The implications of a connectivist learning blog model and the changing role of teaching and learning. *British Journal of Educational Technology*, *46*(4), 877–894. https://doi.org/10.1111/bjet.12184

Gardner, J. (2010). Applying Merrill's First Principles of Instruction: Practical Methods Based on a Review of the Literature. *Educational Technology Magazine*, *50*(2), 20–25.

Garrison, R. (1992). Critical thinking and self-directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly*, *42*, 136–148.

Gašević, D., Adesope, O., Joksimović, S., & Kovanović, V. (2015). Externally-facilitated regulation scaffolding and role assignment to develop cognitive presence in asynchronous online discussions. *Internet and Higher Education*, *24*, 53–65. https://doi.org/10.1016/j.iheduc.2014.09.006

Gast, I., Schildkamp, K., & Veen, J. T. Van Der. (2017). Team-Based Professional Development Interventions in Higher Education : A Systematic Review. *Review of Educational Research, 87(4), 736–767*

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Goh, D., & Kale, U. (2015). The urban–rural gap: project-based learning with Web 2.0 among West Virginian teachers. *Technology, Pedagogy and Education*, *25*(July 2015), 1–22. https://doi.org/10.1080/1475939X.2015.1051490

Goldschmidt, P., & Phelps, G. (2010). Does teacher professional development affect content and pedagogical knowledge: How much and for how long? *Economics of Education Review*, *29*(3), 432–439. https://doi.org/10.1016/j.econedurev.2009.10.002

Graham, Borup, J., & Smith, N. B. (2012). Using TPACK as a framework to understand teacher candidates' technology integration decisions. *Journal of Computer Assisted Learning*, *Advance on*. https://doi.org/10.1111/j.1365-2729.2011.00472.x

Graham, C. R., Burgoyne, N., Cantrell, P., Smith, L., St. Clair, L., & Harris, R. (2009). Measuring the TPACK Confidence of Inservice Science Teachers. *TechTrends*, *53*(5), 70–79. Retrieved from http://www.springerlink.com/content/0vm166x930163735/

Gredler, M. E. (2009). *Learning and Instruction: Theory Into Practice*. Merrill Pearson. Retrieved from https://books.google.com.my/books?id=JTjFHgAACAAJ

Greenhalgh, S., Rosenberg, J., Keenan, S., & Koehler, M. (2015). An investigation of the use of digital portfolios for understanding educators' technology knowledge. *In Educational Communications and Technology*.

Guerrero, S. (2010). Technological pedagogical content knowledge in the mathematics classroom. *Journal of Digital Learning in Teacher Education*, *26*(4), 132–139.

Guiller, J., Durndell, A., & Ross, A. (2008). Peer interaction and critical thinking: Face-to-face or online discussion? *Learning and Instruction*, *18*, 187–200.

Gunawardena, C., Lowe, C., & Anderson, T. (1997). Analysis of global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, *17*(4), 397–431.

Guskey, R. (2000). Professional development and teacher change. Teachers and Teaching. *Theory and Practice*, *8*, 381–391.

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: case studies of science teachers' development of technology, pedagogy, and content knowledge. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 25–45.

Hadjerrouit, S. (2014). Wiki as a collaborative writing tool in teacher education: Evaluation and suggestions for effective use. *Computers in Human Behavior*, *32*, 301–312. https://doi.org/10.1016/j.chb.2013.07.004

Hamzaoğlu, H., & Koçoğlu, Z. (2016). The application of podcasting as an instructional tool to improve Turkish EFL learners' speaking anxiety. *Educational Media International*, *53*(4), 313–326. https://doi.org/10.1080/09523987.2016.1254889

Hannafin, M., Hannafin, K., & Gabbitas, B. (2009). Re-examining cognition during student-centered, web-based learning. *Educational Technology Research and Development, 57*, 767–785. https://doi.org/doi:10.1007/s11423-009-9117-x

Hansson, H. (2006). Teachers' professional development for the technology-enhanced class- room in the school of tomorrow. *E-Learning*, *3*, 552–564.

Hara, N., Bonk, J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science*, *28*, 115–152.

Harasim, L. (1990). *Online education: perspectives on a new environment.* New York: Praeger Publishers.

Harasim, L. (2000). Shift happens: Online education as a new paradigm in learning. *The Internet and Higher Education*, *3*, 41–61.

Harris, J. B., & Hofer, M. J. (2017). "TPACK Stories": Schools and School Districts Repurposing a Theoretical Construct for Technology-Related Professional Development. *Journal of Research on Technology in Education*, *49*(1–2), 1–15. https://doi.org/10.1080/15391523.2017.1295408

Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment rubric. *Teacher Education and Professional Development Commons*, 3833–3840. Retrieved from http://digitalcommons.unomaha.edu/cgi/viewcontent.cgi?article=1014&context=tedfacproc

Hazari, S., North, A., & Moreland, D. (2009). Investigating pedagogical value of wiki technology. *Journal of Information Systems Education*, *20*(2), 187.

He, W., & Yang, L. (2016). Using wikis in team collaboration: A media capability perspective. *Information and Management*, *53*(7), 846–856. https://doi.org/10.1016/j.im.2016.06.009

Heiberger, G., & Harper, R. (2008). Have you facebooked Astin lately? Using technology to increase student involvement. In I. R. Junco & D. M. Timm (Eds.), *Using emerging technologies to enhance student engagement. New directions for student services issue.* (Vol. 124, pp. 19–35). San Francisco, CA: Jossey-Bass.

Heimbuch, S., & Bodemer, D. (2017). Controversy awareness on evidence-led discussions as guidance for students in wiki-based learning. *Internet and Higher Education*, *33*, 1–14. https://doi.org/10.1016/j.iheduc.2016.12.001

Heinich, R., Molenda, M., Russell, J., & Smaldino, S. (1999). *Instructional media and technologies for learning*. Columbus, Ohio: Prentice-Hall.

Heirdsfield, Walker, S., Tambyah, M., & Beutel, D. (2011). Blackboard as an online learning environment: What do teacher education students and staff think? *Australian Journal of Teacher Education*, *36*(7), 1–16.

Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of ‘useful’ digital technology in university teaching and learning. *Studies in Higher Education*, *42*(8), 1567–1579. https://doi.org/10.1080/03075079.2015.1007946

Heo, H., Lim, K. Y., & Kim, Y. (2010). Exploratory study on the patterns of online interaction and knowledge co-construction in project-based learning. *Computers and Education*, *55*, 1383–1392. https://doi.org/doi:10.1016/j.compedu.2010.06.012

Hew, F., & Cheung, S. (2013). Audio-based versus text-based asynchronous online discussion: *Two Case Studies. Instructional Sciences*, *41*, 365–380. https://doi.org/doi:10.1007/s11251-008-9087-

Hewitt, J. (2001). Beyond threaded discourse. *International Journal of Educational Telecommunications*, *7*(3), 207–221.

Hewitt, J. (2003). How habitual online practices affect the development of asynchronous discussion threads. *Journal of Educational Computing Research*, *28*, 31–45.

Hiltz, S. R. (1994). *The virtual classroom—learning without limits via computer networks.* Greenwhich, CT: Ablex Publishing Corporation.

Hoban, F. (2002). *Teacher Learning for Educational Change*. Buckingham: Open University Press.

Hobbs, R., & Tuzel, S. (2017). Teacher motivations for digital and media literacy: An examination of Turkish educators. *British Journal of Educational Technology*, *48*(1), 7–22. https://doi.org/10.1111/bjet.12326

Honebein, C., & Sink, L. (2012). The practice of eclectic instructional design. *Performance Improvement*, *51*(10), 26–31.

Hong, J., Pi, Z., & Yang, J. (2016). Learning declarative and procedural knowledge via video lectures: cognitive load and learning effectiveness. *Innovations in Education and Teaching International*, *55*(1), 74–81. https://doi.org/10.1080/14703297.2016.1237371

Hou, H., Wang, S., Lin, P., & Chang, K. (2015). Exploring the learner's knowledge construction and cognitive patterns of different asynchronous platforms: comparison of an online discussion forum and Facebook. *Innovations in Education and Teaching International*, *52*(6), 610–620. https://doi.org/10.1080/14703297.2013.847381

Hou, H., & Wu, S. (2011). Analyzing the social knowledge construction behavioral patterns of an online synchronous collaborative discussion instructional activity using an instant messaging tool: A case study. *Computers and Education*, *57*(2), 1459–1468. https://doi.org/10.1016/j.compedu.2011.02.012

Hsu, P. (2016). Examining Current Beliefs, Practices and Barriers About Technology Integration: A Case Study. *TechTrends*, *60*(1), 30–40. https://doi.org/10.1007/s11528-015-0014-3

Hsu, S. (2012). Examining the impact of educational technology courses on preservice teachers' development of TPACK. *Teaching Education*, *23*(2), 195–213.

Hsu, S. (2013). Examining changes of preservice teachers' beliefs about technology integration during student teaching. *Journal of Technology and Teacher Education*, *22*(1), 27–48.

Hsu, Y., Tsai, J., Chang, H., & Liang, C. (2017). Surveying In-Service Teachers ' Beliefs about Game-Based Learning and Perceptions of Technological Pedagogical and Content Knowledge of Games. *Educational Technology & Society*, *20*(1), 134–143.

Hu, Z., & McGrath, I. (2011). Innovation in higher education in China: are teachers ready to integrate ICT in English language teaching? *Technology, Pedagogy and Education*, *20*(1), 41–59. https://doi.org/10.1080/1475939X.2011.554014

Huang, C. (2011). The development of Internet use for communication among undergraduate students: A multilevel analysis. *Asia Pacific Education Review*, *12*(2), 215–226. https://doi.org/10.1007/s12564-010-9127-8

Huang, H. (2015). From web-based readers to voice bloggers: EFL learners' perspectives. *Computer Assisted Language Learning*, *28*(2), 145–170. https://doi.org/10.1080/09588221.2013.803983

Hue, L., & Jalil, H. A. (2013). Attitudes towards ICT Integration into Curriculum and Usage among University Lecturers in Vietnam. *Online Submission*, *6*(2). Retrieved from http://eric.ed.gov/?id=ED544073

Hughes, J. (2005). The role of teacher knowledge and learning experiences in forming technology- integrated pedagogy. *Journal of Technology and Teacher Education*, *13*(2), 277–302.

Huizen, P., Oers, B., & Wubbels, T. (2005). A Vygotskian perspective on teacher education. *Journal of Curriculum Studies*, *37*(3), 267–290. https://doi.org/10.1080/0022027042000328468

Hull, M., & Saxon, F. (2009). Negotiation of meaning and co-construction of knowledge: An experimental analysis of asynchronous online instruction. *Computers & Education*, *52*(3), 624–639.

Hussin, S., Embi, M., & Atan, H. (2011). *e-Learning in Malaysian Higher Education Institutions: Status, Trends, & Challenges*.

Huston, T., & Weaver, L. (2008). Peer coaching: Professional development for experienced faculty. *Innovative Higher Education*, *33*, 5–20.

Hwang, K., & Yang, C. (2008). A synchronous distance discussion procedure with reinforcement mechanism: designed for elementary school students to achieve the attending and responding stages of the affective domain teaching goals within a class period. *Computers & Education*, *51*(4), 1538–1552.

Ifinedo, P. (2017). Examining students' intention to continue using blogs for learning: Perspectives from technology acceptance, motivational, and social-cognitive frameworks. *Computers in Human Behavior*, *72*, 189–199. https://doi.org/10.1016/j.chb.2016.12.049

Ilie, M. D. (2014). An adaption of Gagné's instructional model to increase the teaching effectiveness in the classroom: the impact in Romanian Universities. *Educational Technology Research and Development*, *62*(6), 767–794. https://doi.org/10.1007/s11423-014-9353-6

International Society of Technology in Education (ISTE). (2008). *ISTE Standard for Teachers*.

Isaacs, E., Walendowski, A., & Ranganathan, D. (2002). Hubbub: a sound-enhanced mobile instant messenger that supports awareness and opportunistic interactions. In *Proceedings of CHI 2002* (pp. 179–186). Minneapolis, MN: ACM Press.

Işık, B., & Kaya, H. (2014). The Effect of Simulation Software on Learning of Psychomotor Skills and Anxiety Level in Nursing Education. *Procedia - Social and Behavioral Sciences*, *116*, 3864–3868. https://doi.org/10.1016/j.sbspro.2014.01.856

Jaipal-Jamani, K., & Figg, C. (2015). A Case Study of a TPACK-Based Approach to Teacher Professional Development: Teaching Science With Blogs. *Contemporary Issues in Technology and Teacher Education*, *15*(2), 161–200. Retrieved from https://citejournal.s3.amazonaws.com/wp-content/uploads/2015/03/v15i2Science2.pdf

Jamil, M., Hussin, Z., Noh, N., Sapar, A., & Alias, N. (2013). Application of Fuzzy Delphi Method in Educational Research. In S. Siraj, N. Alias, D. DeWitt, & Z. Hussin (Eds.), *Emergent Trends in Educational Research* (pp. 86–92). Kuala Lumpur, Malaysia: Pearson.

Jang, S.-J., & Chen, K.-C. (2010). From PCK to TPACK: Developing a Transformative Model for Pre-Service Science Teachers. *Journal of Science Education and Technology*, *19*(6), 553–564. https://doi.org/10.1007/s10956-010-9222-y

Jang, S. J. (2010). Integrating the interactive whiteboard and peer coaching to develop the TPACK of secondary science teachers. *Computers & Education*, *55*(4), 1744–1751.

Janssen, N., & Lazonder, A. W. (2015). Implementing Innovative Technologies Through Lesson Plans: What Kind of Support Do Teachers Prefer? *Journal of Science Education and Technology*, *24*(6), 910–920. https://doi.org/10.1007/s10956-015-9573-5

Jen, T. H., Yeh, Y. F., Hsu, Y. S., Wu, H. K., & Chen, K. M. (2016). Science teachers' TPACK-Practical: Standard-setting using an evidence-based approach. *Computers and Education*, *95*(April), 45–62. https://doi.org/10.1016/j.compedu.2015.12.009

Jetnikoff, A. (2015). A Case Study of Teaching English and Multimodality with ICTs: Constraints and Possibilities. *English in Australia (0155-2147)*, *50*(2), 41–51. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=110692596&site=ehost-live

Jimoyiannis, A. (2010). Developing a technological pedagogical content knowledge framework for science education: Implications of a teacher trainers' preparation program. *Proceedings of Informing Science & IT,* 597–607. https://doi.org/Done

Jimoyiannis, A., & Komis, V. (2007). Examining teachers' beliefs about ICT in education: Implications of a teacher preparation programme. *Teacher Development*, *11*(2), 149–173.

Johnson, D., & Johnson, R. (1986). Computer-assisted cooperative learning. *Educational Technology*, *26*(1), 12–18.

Johnson, D., & Johnson, R. (1989). *Cooperation and learning: theory and research.* Edina, MN: Interaction Book Company.

Johnson, D., & Johnson, R. (1999). *Learning together and alone: cooperative, competitive, and individualistic learning* (5th ed.). Boston: Allyn & Bacon.

Johnson, D., & Johnson, R. (2004). *Cooperation and the use of technology*. (D. Jonassen, Ed.) (2nd ed.). Mahwah, NJ: Erlbaum.

Johnson, D., Johnson, R., Stanne, M., & Garibaldi, A. (1990). The impact of group processing on achievement in cooperative groups. *Journal of Social Psychology*, *130*, 507–516.

Johnson, & Johnson, R. (2014). Cooperation and the use of technology. In *Handbook of research on educational communications and technology* (2nd ed., pp. 785–812). Mahwah, NJ: Erlbaum. https://doi.org/10.1017/CBO9781107415324.004

Johnson, R., Johnson, D., & Stanne, M. (1986). Comparison of computer assisted cooperative, competitive, and individualistic learning. *American Educational Research Journal*, *23*, 382–392.

Jonassen, D. (1991). Context is everything. *Educational Technology*, *31*(6), 35–37.

Jonassen, D. (1994). Toward a constructivist design model. *Educational Technology*, *34*(4), 34–37.

Jonassen, D. (1999). Designing constructivist learning environments. In C. Reigeluth (Ed.), *Instructional- design theories and models: A new paradigm of instructional theory (Vol. II)* (pp. 217–239). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. (2004). *Handbook of research on educational communications and technology* (2nd ed.). Mahwah, NJ: Lawrence Earlbaum Associates. Kagan.

Jonassen, H., & Kwon, H. (2001). Communication patterns in computer mediated versus face-to-face group problem solving. *Educational Technology Research and Development*, *49*, 35–51.

Jonassen, H., Lee, B., Yang, C., & Laffey, J. (2005). The collaboration principle in multimedia learning. In R. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 247–270). New York: Cambridge University Press.

Jones, H., & Twiss, B. (1978). *Forecasting Technology for Planning Decisions*. Palgrave Macmillan UK. Retrieved from https://books.google.com.my/books?id=QbaxCwAAQBAJ

Joo, Y. J., Lim, K. Y., & Kim, N. H. (2016). The effects of secondary teachers' technostress on the intention to use technology in South Korea. *Computers & Education*, *95*, 114–122. https://doi.org/10.1016/j.compedu.2015.12.004

Jowallah, R. (2014). An Investigation into the Management of Online Teaching and Learning Spaces : A Case Study Involving Graduate Research Students. *The International Review of Research in Open and Distance Learning*, *15*(4), 186–198.

Judd, T., Kennedy, G., & Cropper, S. (2010). Using wikis for collaborative learning: Assessing collaboration through contribution. *Australasian Journal of Educational Technology*, *26*(3), 341–354. https://doi.org/http://dx.doi.org/10.14742/ajet.1079

Junco, R. (2005). Technology and today's first-year students. In M. L. Upcraft, J. N. Gardner, B. O. Barefoot, & Associates (Eds.), *Meeting challenges and building support: Creating a climate for first-year student success* (pp. 221–238). San Francisco, CA: Jossey-Bass.

Junco, R., & Cotten, S. (2011). Perceived academic effects of instant messaging use. *Computers and Education*, *56*(2), 370–378. https://doi.org/10.1016/j.compedu.2010.08.020

Junco, R., & Mastrodicasa, J. (2007). *Connecting to the Net.Generation: What higher education professionals need to know about today's students.* Washington, D.C.: NASPA.

Kafai, Y., & Resnick, L. M. (1996). *Constructionism in practice. Mahwah, NJ: Lawrence Erlbaum Associates.* Mahwah, NJ: Lawrence Erlbaum Associates.

Kafyulilo, A., Fisser, P., Pieters, J., & Voogt, J. (2015). ICT Use in Science and Mathematics Teacher Education in Tanzania: Developing Technological Pedagogical Content Knowledge. *Australasian Journal of Educational Technology*, *31*(4), 381–399.

Karadag, A., Caliskan, N., Korkut, H., Baykara, Z. G., & Ozturk, D. (2012). The Effect of Simulation Training on the Learning of some Psychomotor Skills by First Year Nursing Students: The Case of Turkey. *Procedia - Social and Behavioral Sciences*, *47*, 781–785. https://doi.org/10.1016/j.sbspro.2012.06.734

Karagiorgi, Y., & Charalambous, K. (2006). ICT in-service training and school practice: In search for the impact. *Journal of Education for Teaching*, *32*, 395–411.

Karpov, V., & Haywood, C. (1998). Two ways to elaborate Vygotsky's concept of mediation: Implications for instruction. *American Psychologist*, *53*(1), 27–36.

Kaye, R. (1992). Learning together apart. *In Collaborative Learning through Computer Conferencing*, 1–24. https://doi.org/doi:10.1007/978-3-642-77684-7_1

Kear, K. (2011). *Online and social networking communities: A best practice guide for educators*. New York, NY: Routledge.

Keen, K. (1992). Competence: what is it and how can it be developed? In J. Lowyck, P. de Potter, & J. Elen (Eds.), *Instructional design: implementation issues* (pp. 111–122). Brussels, Belgium: IBM Education Center.

Keevers, L., Bell, M., Ganesharatnam, S., Sultan, F., & Lim, J. (2014). *Transnational Teaching Teams: Professional development for quality enhancement of learning and teaching*. Sydney, Australia. Retrieved from http://transnationalteachingteams.org/

Kelly, P., & McDiarmid, W. (2002). Decentralisation of Professional Development: teachers' decisions and dilemmas. *Journal of In-Service Education*, *28*, 409–425.

Kennedy, A. (2005). Models of Continuing Professional Development : *Journal of In-Service Education*, *31*(2), 235–250. https://doi.org/10.1080/13674580500200277

Kent, C., Laslo, E., & Rafaeli, S. (2016). Interactivity in online discussions and learning outcomes. *Computers and Education*, *97*, 116–128. https://doi.org/10.1016/j.compedu.2016.03.002

Kern, R., Ware, P., & Warschauer, M. (2008). Network-based language teaching. In N. V. Deusen-Scholl & N. H. Hornberger (Eds.), *Second and foreign language education: Encyclopedia of language and education* (2nd ed., Vol. 4).

Kim, D. (2009). Innovative educational technology in your classroom in a global context. *Essential Teacher*, *6*(1), 37–39.

Kim, D., & Jang, S. (2015). Dialogic practices in using podcasting and blogging as teaching tools for teachers seeking ESOL certificate. *Journal of Educational Computing Research*, *51*(2), 205–232. https://doi.org/10.2190/EC.51.2.d

Kim, H., & Song, J. (2005). The features of peer argumentation in middle school students' scientific inquiry. *Research In Science Education*, *36*(3), 211–233.

Kim, H., & Song, J. (2006). The Features of peer argumentation in middle school students' scientific inquiry. *Research in Science Education*, *36*(3), 211–233.

King, H. (2004). Continuing Professional Development in Higher Education : what do academics do ? Continuing Professional Development in Higher Education : what do academics do ? *Planet*, *13*(1), 26–29.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An Analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*, 75–86.

Kobbe, L., Weinberger, A., Dillenbourg, P., Harrer, A., Hämäläinen, R., & Fischer, F. (2007). Specifying Computer-Supported Collaboration Scripts, *2*, 211–224.

Koch, M., Luck, K., Schwarzer, J., & Draheim, S. (2018). The Novelty Effect in Large Display Deployments – Experiences and Lessons-Learned for Evaluating Prototypes. *Proceedings of 16th European Conference on Computer-Supported Cooperative Work*, 1–18. https://doi.org/10.18420/ecscw2018

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research*, *32*(2), 131–152. https://doi.org/openurl.asp?genre=article&id=doi:10.2190/0EW7-01WB-BKHL-QDYV

Koehler, M, & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.) (Ed.), *Handbook oftechnological pedagogical content knowledge (TPCK) for educator* (pp. 3–29). New York, NY: Routledge.

Koehler, M, & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70. https://doi.org/10.1016/j.compedu.2010.07.009

Koehler, Matthew, Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers and Education*, *49*(3), 740–762. https://doi.org/10.1016/j.compedu.2005.11.012

Koehler, Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The Technological Pedagogical Content Knowledge Framework. *Handbook of Research on Educational Communications and Technology: Fourth Edition*, 347–248. https://doi.org/10.1007/978-1-4614-3185-5

Koh, J., Chai, C., Benjamin, W., & Hong, H. (2015). Technological Pedagogical Content Knowledge (TPACK) and Design Thinking: A Framework to Support ICT Lesson Design for 21st Century Learning. *Asia-Pacific Education Researcher*, *24*(3), 535–543. https://doi.org/10.1007/s40299-015-0237-2

Koh, J., Ching, C., & Chin, T. (2013). Examining practicing teachers' perceptions of technological pedagogical content knowledge (TPACK) pathways: A structural equation modeling approach. *Instructional Science*, *41*(4), 793–809. https://doi.org/10.1007/s11251-012-9249-y

Koh, L., Chai, C. S., & Tay, L. Y. (2014). TPACK-in-Action: Unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers and Education*, *78*, 20–29. https://doi.org/10.1016/j.compedu.2014.04.022

Köhler, A., & Fuchs-Kittowski, F. (2005). Integration of communities into process-oriented structures. *Journal of Universal Computer Science*, *11*(3), 410–425.

Koo, A. C. (2008). Factors affecting teachers' perceived readiness for online collaborative learning: A case study in Malaysia. *Educational Technology & Society*, *11*(1), 266–278.

Koschmann, T. (2003). CSCL, argumentation, and Deweyan inquiry. In B. Andriessen & D. Suthers (Eds.), *Arguing to learn: Confronting cognitions in computer-supported collaborative learning environments* (pp. 261–269). Dordrecht: Kluwer Academic Publishers.

Koschmann, Timothy. (2002). Dewey ' s Contribution to the Foundations of CSCL Research. *Proceedings of CSCL 2002*, (1999), 17–22. https://doi.org/10.3115/1658616.1658618

Koschmann, Timothy, Stahl, G., & Zemel, A. (2007). The Video Analyst ' s Manifesto (or The Implications of Garfinkel ' s Policies for Studying Practice within Design-based Research).

Kosnik, C., Menna, L., Dharamshi, P., Miyata, C., Cleovoulou, Y., & Beck, C. (2015). Four spheres of knowledge required: an international study of the professional development of literacy/English teacher educators. *Journal of Education for Teaching*, *41*(1), 52–77. https://doi.org/10.1080/02607476.2014.992634

Kozan, K., & Richardson, J. (2014). Interrelationships between and among social, teaching, and cognitive presence. *Internet and Higher Education*, *21*, 68–73. https://doi.org/10.1016/j.iheduc.2013.10.007

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to newmethods of training evaluation. *Journal of Applied Psychology*, *78*, 311–328.

Kramarski, B., & Michalsky, T. (2010). Preparing preservice teachers for self-regulated learning in the context of technological pedagogical content knowledge. *Learning and Instruction*, *20*(5), 434–447. https://doi.org/10.1016/j.learninstruc.2009.05.003

Krathwohl, D. ., Bloom, B. S., & Masia, B. . (1964). *Taxonomy of Educational Objectives. The Classification of Educational Goals, Handbook II: Affective Domain*. New York: David McKay Company, Inc.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, *19*(3), 335–353. https://doi.org/10.1016/S0747-5632(02)00057-2

Kuo, Y., Belland, B., & Kuo, Y. (2017). Learning through Blogging : Students ' Perspectives in Collaborative Blog- Enhanced Learning Communities, *Educational Technology & Society, 20(2), 37–50.*

Kwangsawad, T. (2016). Examining EFL Pre-service Teachers ' TPACK through Self-report , Lesson Plans and Actual Practice. *Journal of Education and Learning*, *10*(2), 103–108.

Laal, M., & Laal, M. (2012). Collaborative learning: What is it? *Procedia - Social and Behavioral Sciences*, *31*(2011), 491–495. https://doi.org/10.1016/j.sbspro.2011.12.092

Laat, M., & Lally, V. (2003). Complexity, theory, and praxis: Researching collaborative learning and tutoring processes in a networked learning community. *Instructional Science*, *31*(1), 7–39.

Lambert, J., Gong, Y., & Cuper., P. (2008). “Technology, Transfer and Teaching: The Impact of a Single Technology Course on Preservice Teachers’ Computer Attitudes and Ability.". *Journal of Technology and Teacher Education 16*, *4*, 385–410.

Landsberg, M. (1996). *The Tao of Coaching*. London: Harper Collins.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Leak, K. (2017). New academics, new higher education contexts: a critical perspective on professional development. *Teaching in Higher Education*, *2517*(June), 1–16. https://doi.org/10.1080/13562517.2016.1273215

Learning Partnership for 21st Century. (2016). Framework for 21st Century Learning. Retrieved from www.P21.org

Lee, K., Said, N., & Tan, C. (2016). Exploring the affordances of The Writing Portal (TWP) as an online supplementary writing platform (for the special issue of GLoCALL 2013 and 2014 conference papers). *Computer Assisted Language Learning*, *29*(6), 1116–1135. https://doi.org/10.1080/09588221.2016.1172644

Lee, M, & Tsai, C. (2010). Exploring teachers’ perceived self efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science*, *38*(1), 1–21. https://doi.org/10.1007/sl

Lee, Mark, Miller, C., & Newnham, L. (2009). Podcasting syndication services and university students: Why don’t they subscribe? *Internet and Higher Education*, *12*(1), 53–59. https://doi.org/10.1016/j.iheduc.2008.10.001

Lee, & Markey, A. (2014). A study of learners’ perceptions of online intercultural exchange through Web 2.0 technologies. *ReCALL*, *26*(3), 281–297. https://doi.org/10.1017/S0958344014000111

Leight, J. (2008). Lifting the fog on instructional blogs. *Journal of Physical Education, Recreation & Dance*, *79*(2), 52e55.

Lemke, J. L. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching*, *38*, 296–316.

Leng, C., Siraj, S., Naimie, Z., Abedalaziz, N., DeWitt, D., & Darulsalam, G. (2013). Delphi Technique. In S Siraj, N. Alias, D. DeWitt, & Z. Hussin (Eds.), *Designa and Developmental Research: Emergent Trensds in Educational Research* (pp. 71–84). Pearson Malaysia.

Lenhart, A., Purcell, K., Mith, A., & Zickuhr, K. (2010). *Social media and mobile Internet use among teens and young adults.* Available at: http://www.pewinternet.org/files/old-media/Files/Reports/2010/PIP_Social_Media_and_Young_Adults_Report_Final_with_toplines.pdf.

Lethinen, E., Hakkarainen, K., Lipponen, L., Rahikainen, M., & Muukkonen, H. (1999). Computer sup- ported collaborative learning: a review. *CL-Net Project*. Retrieved from http://www.kas.utu.fi/clnet/clne- treport.html [accessed 17 June 2002]

Leuf, B., & Cunningham, W. (2001). *The Wiki way: quick collaboration on the Web*. Boston: Addison-Wesely.

Li, M., & Zhu, W. (2017). Good or bad collaborative wiki writing: Exploring links between group interactions and writing products. *Journal of Second Language Writing*, *35*, 38–53. https://doi.org/10.1016/j.jslw.2017.01.003

Limayem, M., & Cheung, C. M. K. (2008). Understanding information systems continuance: the case of internet-based learning technologies. *Information & Management*, *45*, 227–232. https://doi.org/http://dx.doi.org/10.1016/j.im.2008.02.005

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. SAGE Publications. Retrieved from https://books.google.com.my/books?id=2oA9aWlNeooC

Lipponen, L., Rahikainen, M., Lallimo, J., & Hakkarainen, K. (2003). Patterns of participation and discourse in elementary students' computer-supported collaborative learning. *Learning and Instruction*, *13*(5), 487–509. https://doi.org/10.1016/S0959-4752(02)00042-7

Littlejohn, A. H. (2002). Improving continuing professional development in the use of ICT. *Journal of Computer Assisted Learning*, *18*(2), 166–174. https://doi.org/10.1046/j.0266-4909.2001.00224.x

Liu, Y., & McCombs, S. (2008). Portable education: learning on the go. In T. T. Kidd & H. Song (Eds.), *Handbook of research on instructional systems and technology* (pp. 216–248). Hershey, PA: Information Science Reference.

Loncar, M., Barrett, N. E., & Liu, G. Z. (2014). Towards the refinement of forum and asynchronous online discussion in educational contexts worldwide: Trends and investigative approaches within a dominant research paradigm. *Computers and Education*, *73*, 93–110. https://doi.org/10.1016/j.compedu.2013.12.007

Lonn, S., Teasley, S. D., & Krumm, A. E. (2011). Who needs to do what where?: Using learning management systems on residential vs. commuter campuses. *Computers and Education*, *56*(3), 642–649. https://doi.org/10.1016/j.compedu.2010.10.006

Lu, J., Lai, M., & Law, N. (2010). Knowledge building in society 2.0: Challenges and opportunities. In M. S. Khine & I. M. Saleh (Eds.), *New science of learning* (pp. 553–567). New York, NY: Springer Science Business Media.

Lu, L. (2014). Cultivating reflective practitioners in technology preparation: Constructing TPACK through reflection. *Education Sciences*, *4*, 13–35. https://doi.org/10.3390/educsci4010013

Lund, A. M. (2001). Measuring usability with the USE questionnaire. *Usability Interface*, *8*(2), 3–6. https://doi.org/10.1177/1078087402250360

Maag, M. (2006). iPod, uPod? An emerging mobile learning tool in nursing education and students'satisfaction. In L. Markauskaite, P. Goodyear, & P. Reimann (Eds.), *23rd Annual ascilite conference: Who's learning? Whose technology* (pp. 483–492). Sydney: Sydney University Press.

Mack, S., & Ratcliffe, M. (2007). *Podcasting bible*. Indianapolis: Wiley Publishing.

MacLennan, N. (2017). *Coaching and Mentoring*. Taylor & Francis. Retrieved from https://books.google.com.my/books?id=YEIrDwAAQBAJ

Mahdizadeh, H., Biemans, H., & Mulder, M. (2008). Determining factors of the use of e-learning environments by university teachers. *Computers & Education*, *51*, 142–154. https://doi.org/http://dx.doi.org/10.1016/j.compedu.2007.04.004

Mak, B., & Coniam, D. (2008). Using wikis to enhance and develop writing skills among secondary school students in Hong Kong. *System*, *36*(3), 437e455.

Malikowski, S. R., Thompson, M. E., & Theis, J. G. (2007). A model for research in to course management systems: Bridge technology & learning theory. *Educational Computing Research*, *36*(2), 149–173.

Marbouti, F. (2012). *Design, implementation and testing of a visual discussion forum to address new post bias*. Simon Fraser University, Vancouver, Canada.

Marbouti, Farshid, & Wise, A. F. (2016). Starburst: a new graphical interface to support purposeful attention to others' posts in online discussions. *Educational Technology Research and Development*, *64*(1), 87–113. https://doi.org/10.1007/s11423-015-9400-y

Margerum-Leys, J., & Marx, R. (2002). Teacher knowledge of educational technology: a study of student teacher/mentor teacher pairs. *Journal of Educational Computing Research*, *26*(4), 427–462.

Marhan, A. (2006). Connectivism: concepts and principles for emerging learning networks. In *The 1st International Conference on Virtual Learning* (pp. 209–216). Bucharest.

Marino, M., Sameshima, P., & Beecher, C. (2009). Enhancing TPACK with Assistive Technology: Promoting Inclusive Practices in Pre-service Teacher Education. *Contemporary Issues in Technology and Teacher Education*, *9*(January), 186–207.

Martin, A. (2006). Literacies for the Digital Age. In A. Martin & D. Madigan (Eds.), *Digital literacies for learning* (pp. 3–25). London: Facet Publishing.

Mayer, E. (2001). *Multimedia Learning*. New York: New York: Cambridge University Press.

Mbatha, B. (2015). A Paradigm Shift: Adoption of Disruptive Learning Innovations in an ODL Environment: The Case of The University of South Africa. *International Review of Research in Open & Distance Learning*, *16*(3), 218–232. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN= 10843 1269 &lang= es&site=ehost-live

McAfee, P. (2006). Enterprise 2.0: the dawn of emergent collaboration. *MIT Sloan Management Review*, *47*(1), 21–28.

McCarney, J. (2004). Effective Models of Staff Development in ICT. *European Journal of Teacher Education*, *27*(1), 61–72.

McDougall, J. (2015). The quest for authenticity: A study of an online discussion forum and the needs of adult learners. *Australian Journal of Adult Learning*, *55*(1), 94–113.

McGarr, O. (2009). A Review of podcasting in higher education: Its Influence on the traditional lecture. *Australasian Journal of Educational Technology*, *25*(3), 309–321.

McSwiggan, L. C., & Campbell, M. (2017). Can podcasts for assessment guidance and feedback promote self-efficacy among undergraduate nursing students? A qualitative study. *Nurse Education Today*, *49*, 115–121. https://doi.org/10.1016/j.nedt.2016.11.021

Means, B. (2010). Technology and Education Change: Focus on Student Learning, *Journal of Research on Technology in Education*, *42*(3), 285–307.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2010). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. *U.S. Department of of Education*. https://doi.org/10.1016/j.chb.2005.10.002

Megginson, D., & Whitaker, V. (2003). *Continuing Professional Development*. Chartered Institute of Personnel and Development. Retrieved from https://books.google.com.my/books?id=a-LG9lZMlWUC

Megginson, D., & Whitaker, V. (2007). Exploring continuing professional development. *Chartered Institute of Personnel and Development*, 3. Retrieved from http://www.i-develop-cld.org.uk/pluginfile.php/307/mod_resource/content/1/9781843981664sc.pdf

Merfert, P. (2016). Report: The 2016 state of digital media in higher education. Retrieved from http://www.ednewsdaily.com/report-2016-state-digital-media-higher-education/

Merhi, M. I. (2015). Factors influencing higher education students to adopt podcast: An empirical study. *Computers and Education*, *83*, 32–43. https://doi.org/10.1016/j.compedu.2014.12.014

Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation*. John Wiley & Sons. Retrieved from https://books.google.com.my/books?id=tvFICrgcuSIC

Merrill, D. (1983). Component display theory. In C. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 279–333). Hillsdale, NJ: Lawrence Erlbaum Associates.

Merrill, D. (2002). First principles of instruction. *Educational Technology Research and Development*, *50*(3), 43–60.

Merrill, D. (2006). Levels of instructional strategy. *Educational Technology*, *46*(4), 5–10.

Merrill, D. (2007). First principles of instruction: a synthesis. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and Issues in Instructional Design and Technology* (2nd ed., pp. 62–71). Upper Saddle River, NJ: Merrill/Prentice Hall.

Merrill, D. (2013). *First Principles of Instruction: Identifying and Designing Effective, Efficient, and Engaging Instruction*. Hoboken, NJ: Pfeiffer (John Wiley & Sons).

Meyer, A. (2003). Face-to-face versus threaded discussions: The role of time and higher- order thinking. *Journal of Asynchronous Learning Networks*, *7*, 55–65.

Middleton, A. (2016). Reconsidering the role of recorded audio as a rich, flexible and engaging learning space. *Research in Learning Technology*, *24*, 1–14. https://doi.org/10.3402/rlt.v24.28035

Millis, B., & Cottell, P. G. (1998). Cooperative learning for higher education faculty. Phoenix: Oryx Press.

Ministry of Higher Education (MOHE). (2014). *e-Learning Guidelines for Malaysian HEIs*. https://doi.org/10.1017/CBO9781107415324.004

Ministry of Higher Education (MOHE). (2015). *Malaysia Education Blueprint 2015-2025 (Higher Education)*. *Ministry of Education Malaysia* (Vol. 2025). https://doi.org/10.5923/j.ijis.20120206.05

Mishra, P., & Koehler, M. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge, *Teachers College Record, 108*(6), 1017–1054.

MOHE. (n.d.). *The University Transformation Programme (UniTP) Orange Book - Strengthening Academic Career Pathways and Leadership*.

Morón-García, S. (2006). What lecturers say helps and hinders their use of a virtual learning environment to support face-to-face teaching. In *Technology supported learning and teaching: a staff perspective* (pp. 15–33). Loughborough University, UK. https://doi.org/10.4018/978-1-59140-962-5.ch002

Morrell, E. (2012). 21st-century literacies, critical media pedagogies, and language arts. *Reading Teacher*, *66*, 300–302. https://doi.org/10.1002/TRTR.01125

Morrison, R., Ross, M., & Kemp, E. (2004). *Designing effective instruction* (4th ed.). New York, NY: John Wiley & Sons Inc.

Mouasher, A., & Lodge, J. M. (2016). The search for pedagogical dynamism - Design patterns and the unselfconscious process. *Educational Technology and Society*, *19*(2), 274–285.

Mullen, P. (2003). Delphi: myths and reality. *Journal of Health Organization and Management*, *17*, 37–52. https://doi.org/10.1108/14777260310469319

Murphy, T., & Paor, C. (2017). Teachers' CPD and sectoral interests: Opportunities for convergence and divergence. *Teaching and Teacher Education*, *66*, 242–249. https://doi.org/10.1016/j.tate.2017.04.018

Mustapha, R., & Darulsalam, G. (2018). *Aplikasi Kaedah Fuzzy Delphi dalam Penyelidikan Sains Sosial*. Kuala Lumpur, Malaysia: Universiti Malaya Press.

Naimie, Z., Leng, C., DeWitt, D., Akma, N., & Mohajer, L. (2013). Interview. In Saedah Siraj, N. Alias, D. DeWitt, & Z. Hussin (Eds.), *Emergent Trends in Educational Research* (pp. 51–59). Kuala Lumpur, Malaysia: Pearson.

Nardi, B. A., Whittaker, S., & Bradner, E. (2000). Interaction and outeraction: instant messaging in action. In *Proceedings of CSCW 2000* (pp. 79–88). Philadelphia, PA: ACM Press.

Naseri, S., & Motallebzadeh, K. (2016). Podcasts: A factor to improve Iranian EFL learner' self-regulation ability and use of technology. *Educational Technology and Society*, *19*(2), 328–339.

Nasirun, N., Noor, S. M., Yusoff, R. Z., & Othman, A. A. (2015). A Comparison Between Web Enhancer Learners and Blended Learners in Flipped Classroom : A Quasi-Experimental Approach, *International Academic Research Journal of Business and Technology, 1*(2), 100–107.

Nastasi, B. K., & Clements, D. H. (1992). Social-cognitive behaviours and higher-order thinking in educational computer environments. *Learning and Instruction*, *2*(3), 215–238.

Needham, R., & Loë, R. (1990). The Policy Delphi: Purpose Structure and Application. *Canadian Geographer-Geographe Canadien - CAN GEOGR-GEOGR CAN*, *34*, 133–142. https://doi.org/10.1111/j.1541-0064.1990.tb01258.x

Nelson Laird, T. F., & Kuh, G. D. (2005). Student experiences with information technology and their relationship to other aspects of student engagement. *Research in Higher Education.*, *46*(2), 211–233.

Nelson, M. (1999). Collaborative problem solving. In C. Reigeluth (Ed.), *Instructional-design theories and models: a new paradigm of instructional theory (Vol. II)* (pp. 241–267). Mahwah, NJ: Lawrence Erlbaum.

Newman, R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology*, *3*(2), 56–77.

Ng'ambi, D., & Lombe, A. (2012). Using podcasting to facilitate student learning: A constructivist perspective. *Educational Technology and Society*, *15*(4), 181–192.

Ng, C. S. L., Cheung, W. S., & Hew, K. F. (2009). Sustaining asynchronous online discussions: Contributing factors and peer facilitation techniques. *Journal of Educational Computing Research*, *41*(4), 477–511. https://doi.org/10.2190/EC.41.4.e

Nicholas, H., & Ng, W. (2012). Factors influencing the uptake of a mechatronics curriculum initiative in five Australian secondary schools. *International Journal of Technology and Design Education*, *22*(1), 65–90.

Nichols, T. (2010). Ensuring higher order thinking skills development in distance learning. *Distance Learning: For Educators, Trainers, and Leaders*, *7*(3), 69–73.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*, 509–523.

Nixon, H., & Hateley, E. (2013). Books, toys and tablets: Playing and learning in the age of digital media. In K. Hall, T. Cremin, B. Comber, & L. Moll (Eds.), *The Wiley Blackwell international handbook of research on children's literacy, learning and culture* (pp. 28–41). Oxford: Wiley Blackwell.

Nixon, H., & Kerin, R. (2012). The 3D model of l(IT)eracy and the English curriculum. In Green & C. Beavis (Eds.), *An integrated perspective in theory and practice* (pp. 62–75). Camberwell: ACER Press.

Nokelainen, P. (2006). An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students. *Educational Technology and Society*, *9*(2), 178–197.

Noor, A. M., Attaran, M., & Alias, N. (2015). Students' Experiences in Using Spectrum: Textbook or Classroom? *Procedia - Social and Behavioral Sciences*, *176*, 667–673. https://doi.org/10.1016/j.sbspro.2015.01.525

Nordin, H., Faekah, T., & Ariffin, T. (2016). Validation of a Technological Pedagogical Content Knowledge Instrument in a Malaysian Secondary School Context. *Malaysian Journal of Learning and Instruction*, *13*(13), 1–24. Retrieved from http://mjli.uum.edu.my

Novakovich, J. (2016). Fostering critical thinking and reflection through blog-mediated peer feedback. *Journal of Computer Assisted Learning*, *32*(1), 16–30. https://doi.org/10.1111/jcal.12114

Oliver, K. (2010). Integrating Web 2.0 across the curriculum. *Techtrends: Linking Research & Practice to Improve Learning*, *54*(2), 50–60.

Olivero, G., Bane, D., & Kopelman, E. (1997). Executive coaching as a transfer of training tool: Effects on productivity in a public agency. *Public Personnel Management*, *26*, 461–469.

Orooji, F., & Taghiyareh, F. (2015). Supporting participants in web-based collaborative learning activities from a holistic point of view: a tale of seven online and blended courses. *Journal of Computers in Education*, *2*(2), 183–210. https://doi.org/10.1007/s40692-015-0031-4

Osman, S. Z. M., Jamaludin, R., & Mokhtar, N. E. (2014). Flipped Classroom and Traditional Classroom: Lecturer and Student Perceptions between Two Learning Cultures, a Case Study at Malaysian Polytechnic. *International Education Research*, *2*(4), 16–25. https://doi.org/10.12735/ier.v2i4p16

Özçinar, H. (2015). Scaffolding computer-mediated discussion to enhance moral reasoning and argumentation quality in pre-service teachers. *Journal of Moral Education*, *7240*(September), 1–20. https://doi.org/10.1080/03057240.2015.1043875

Öztuna, D., Elhan, A. H., & Tüccar, E. (2006). Investigation of four different normality tests in terms of type 1 error rate and power under different distributions. *Turkish Journal of Medical Sciences*, *36*(3), 171–176.

Palloff, R., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom.* San Franscisco, CA: Jossey-Bass.

Palloff, R., & Pratt, K. (2001). *Lessons from the Cyberspace classroom: The realities of online teaching*. San Francisco: Jossey-Bass.

Palmer, D. (2005). A motivational view of constructivist-informed teaching. *International Journal of Science Education*, *27*(15), 1853–1881.

Palmer, S., Holt, D., & Bray, S. (2008). Does the discussion help? The impact of a formally assessed online discussion on final student results. *British Journal of Educational Technology*, *39*(5), 847–858.

Pamuk, S. (2012). Understanding preservice teachers' technology use through TPACK framework. *Journal of Computer Assisted Learning*, *28*(5), 425–439. https://doi.org/10.1111/j.1365-2729.2011.00447.x

Panda, S., & Mishra, S. (2007). E-learning in a mega open university: Faculty attitude, barriers and motivators. *Educational Media International*, *44*(4), 323–338. https://doi.org/doi:10.1080/09523980701680854

Papastergiou, M., Gerodimos, V., & Antoniou, P. (2011). Multimedia Blogging in Physical Education: Effects on Student Knowledge and ICT Self-Efficacy. *Computers and Education*, *57*(3).

Park, S., Jang, J. Y., Chen, Y. C., & Jung, J. (2010). Is Pedagogical Content Knowledge (PCK) Necessary for Reformed Science Teaching?: Evidence from an Empirical Study. *Research in Science Education*, *41*(2), 245–260. https://doi.org/10.1007/s11165-009-9163-8

Patahuddin, S. M., Lowrie, T., & Dalgarno, B. (2016). Analysing Mathematics Teachers' TPACK Through Observation of Practice. *Asia-Pacific Education Researcher*, *25*(5–6), 863–872. https://doi.org/10.1007/s40299-016-0305-2

Patton, M. Q. (2002). *Qualitative evaluation and research methods* (3rd ed.). Newbury Park: Sage Publications.

Paulsen, M. F. (2003). Experiences with learning management systems in 113 European institutions. *Educational Technology and Society*, *6*(4), 134–148. https://doi.org/10.2307/jeductechsoci.6.4.134

Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. *Journal of the Learning Sciences*, *13*(3), 423–451.

Pegrum, M., Bartle, E., & Longnecker, N. (2015). Can creative podcasting promote deep learning? The use of podcasting for learning content in an undergraduate science unit. *British Journal of Educational Technology*, *46*(1), 142–152. https://doi.org/10.1111/bjet.12133

Perry, B., Mouton, H., & Reigeluth, M. (1983). Gagne-Briggs theory of instruction. In C. Reigeluth (Ed.), *Instructional theories and models* (pp. 11–43). Hillsdale, NJ: Lawrence Erlbaum Associates.

Peters, L., & Hewitt, J. (2010). An investigation of student practices in asynchronous computer con- ferencing courses. *Computers & Education*, *54*, 951–961.

Petko, D., Egger, N., & Graber, M. (2014). Supporting learning with weblogs in science education: A comparison of blogging and hand-written reflective writing with and without prompts. *Themes in Science & Technology Education.*, *7*(1), 3–17.

Pham, V. P. H., & Usaha, S. (2016). Blog-based peer response for L2 writing revision. *Computer Assisted Language Learning*, *29*(4), 724–748. https://doi.org/10.1080/09588221.2015.1026355

Picciano, A. G. (2015). Planning for Online Education : A Systems Model. *Online Learning*, *19*(5), 17.

Pifarré, M., & Li, L. (2012). Teaching how to learn with a wiki in primary education: What classroom interaction can tell us. *Learning, Culture and Social Interaction*, *1*(2), 102–113. https://doi.org/10.1016/j.lcsi.2012.05.004

Ping, M. (2012). *Development of a self-regulated vocabulary learning strategy instrucional module for Chinese EFL learners.* University of Malaya.

Polly, D., & Brantley-Dias, L. (2009). TPACK: Where do we go now? *Tech Trends: Linking Research & Practice to Improve Learning*, *53*, 46–47. https://doi.org/10.1007/s11528-009-0324-4

Poole, M. (2000). Student participation in a discussion-orientated online course: A case study. *Journal of Research on Computing in Education*, *33*(2), 162–177.

Pringle, R. M., Dawson, K., & Ritzhaupt, A. D. (2015). Integrating Science and Technology: Using Technological Pedagogical Content Knowledge as a Framework to Study the Practices of Science Teachers. *Journal of Science Education and Technology*, *24*(5), 648–662. https://doi.org/10.1007/s10956-015-9553-9

Prochaska, J., & Diclemente, C. (1982). Trans-Theoretical Therapy - Toward A More Integrative Model of Change. *Psychotherapy: Theory, Research & Practice*, *19*, 276–288. https://doi.org/10.1037/h0088437

Raitman, R., Augar, N., & Zhou, W. (2005). Employing wikis for online collaboration in the e-learning environment: Case study. In *3rd International Conference on Information Technology and Applications* (pp. 142–146).

Raman, M., Ryan, T., & Olfman, L. (2005). Designing knowledge management systems for teaching and learning with wiki technology. *Journal of Information Systems Education*, *16*(3), 311–320.

Razak, R., Yusop, F., Halili, S., & Chukumaram, S. (2015). Electronic Continuous Professional Development (E-CPD) for Teachers : Bridging the Gap between Knowledge and Application, *14*(4), 14–27.

Reigeluth, M. (1983). *Instructional-design theories and models: An overview of their current status*. Mahwah, NJ: Erlbaum. Retrieved from https://books.google.com.my/books?id=OUq55prZIMEC

Reigeluth, M. (1999). *Instructional-design theories and models: A new paradigm of instructional theory (Volume II)*. Mahwah, NJ: Erlbaum.

Reigeluth, M., & Frick, W. (1999). Formative research: A methodology for creating and improving design theories. In C. Reigeluth (Ed.), *Instructionaldesign theories and models: A new paradigm of instructional theory* (2nd ed., pp. 633–651). Mawah, NJ: Lawrence Erlbaum Associates Publishers.

Reigeluth, M., & Merrill, D. (1983). The Elaboration theory: Guidance for scope and sequence decisions. In C. Reigeluth (Ed.), *Instructional-design theories and models* (pp. 425–453). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reiser, A., & Dempsey, J. (2007). *Trends and issues in instructional design and technology* (2nd ed.). Upper Saddle River, NJ: Pearson.

Resta, P., & Laferriere, T. (2007). Technology in Support of Collaborative Learning. *Educational Psychology Review*, *19*(1), 65–83. https://doi.org/10.1007/s10648-007-9042-7

Rhodes, C., Stokes, M., & Hampton, G. (2004). *A Practical Guide to Mentoring , Coaching and Peer-Networking*. *Teacher professional development in schools and colleges*. London, UK: Routledge.

Richardson, S. (2009). Mathematics teachers' development, exploration, and advancement of technological pedagogical content knowledge in the teaching and learning of algebra. *Contemporary Issues in Technology and Teacher Education*, *9*(2), 117–130.

Richey, R. C., Klein, J. D., & Nelson, W. a. (2004). Developmental research: Studies of instructional deisgn and development. *Handbook of Research for Educational Communications and Technology*, 1099–1130. https://doi.org/10.1007/978-1-4614-3185-5_12

Richey, R., & Klein, J, D. (2007). *Design and Development Research: Methods, Strategies, and Issues*. L. Erlbaum Associates. Retrieved from https://books.google.com.my/books?id=AW8jvKjJX34C

Rienties, B., Brouwer, N., Carbonell, Katerina, Townsend, D., Rozendal, A., Loo, J., Dekker, P., & Baker, S. (2013). Online training of TPACK skills of higher education scholars , a cross- institutional impact study. *European Journal of Teacher Education*, *36*(4), 480–495. https://doi.org/10.1080/02619768.2013.801073.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education*, *29*, 122–131. https://doi.org/10.1016/j.tate.2012.09.002

Robbins, P. (1999). Mentoring. *Journal of Staff Development*, *20*, 40–42.

Roblin, N., & Margalef, L. (2013). Learning from dilemmas: teacher professional development through collaborative action and reflection. *Teachers and Teaching: Theory and Practice*, *19*(February 2013), 18–32. https://doi.org/10.1080/13540602.2013.744196

Rodrigues, S., Marks, A., & Steel, P. (2003). Developing science and ICT pedagogical content knowledge: a model of continuing professional development. *Innovations in Education and Teaching International*, *40*(4), 386–394. https://doi.org/10.1080/1470329032000128413

Rogoff, B. (1998). Cognition as a collaborative process. In D. Kuhn & R. S. Siegler (Eds.), *Handbook of child psychology* (5th ed., pp. 679–744). New York: Wiley.

Ronen, T., & Pasher, E. (2011). *Complete Guide to Knowledge Management A Strategic Plan to Leverage Your Company's Intellectual Capital*. Hoboken, NJ: Wiley.

Roschelle, J., & Teasley, S. (1995). Computer Supported Collaborative Learning. In In C. O'Malley (Ed.) (Ed.), *Computer supported collaborative learning* (pp. 69–97). Berlin: Springer. https://doi.org/10.1007/978-3-642-85098-1

Roscoe, J. (2002). Continuing professional development in higher education. *Human Resource Development International*, *5*(1), 3–9. https://doi.org/10.1080/13678860110076006

Rossett, A. (1995). Needs assessment. In G. J. Anglin (Ed.), *Instructional technology: Past, present and future* (2nd ed., pp. 183–196). Engelwood, CO: Libraries Unlimited Inc.

Rostami, A., & Hoveidi, A. (2014). Improving descriptive writing skills using blog-based peer feedback. *International Journal of Language and Applied Linguistics World*, *5*(2), 299–308.

Rothkopf, E, Z. (1971). Experiments on mathemagenic behavior and the technolology of written instructions. In *Verbal learning research and the technology of written instruction*. New York: Teachers College.

Roussinos, D., & Jimoyiannis, A. (2013). Blended collaborative learning through a wiki- based project: A case study on students' perceptions. *Fostering 21st Century Digital Literacy and Technical Competency*, 130.

Rowe, N., & Ilic, D. (2009). What impact do posters have on academic knowledge transfer? A pilot survey on author attitudes and experiences. *BMC Medical Education*, *9*, 71. https://doi.org/10.1186/1472-6920-9-71

Rowsell, J., Saudelli, M. G., McQuirter Scott, R., & Bishop, A. (2013). iPads as placed resources: Forging community in online and offline spaces. *Language Arts*, *90*, 351–360.

Sabah, S., Fayez, M., Alshamrani, S., & Mansour, N. (2014). Continuing professional development (CPD) provision for science and mathematics teachers in Saudi Arabia: Perceptions and experiences of CPD providers. *Journal of Baltic Science Education*, *13*(1), 91–104.

Sahin, I. (2011). Development of Survey of Technological Pedagogical and Content Knowledge (TPACK). *Turkish Online Journal of Educational Technology - TOJET*, *10*(1), 97–105.

Salaber, J. (2014). Facilitating student engagement and collaboration in a large postgraduate course using wiki-based activities. *International Journal of Management Education*, *12*(2), 115–126. https://doi.org/10.1016/j.ijme.2014.03.006

Salas, G., & Alexander, J. S. (2008). Technology for institutional enrollment, communication, and student success. In I. R. Junco & D. M. Timm (Eds.), *Using emerging technologies to enhance student engagement. New Directions for Student Services Issue* . (Vol. 124, pp. 103–116). San Francisco, CA: Jossey-Bass.

Salaway, G., Caruso, J. B., & Nelson, M. R. (2007). *The ECAR study of undergraduate students and information technology*. Washington, DC: Educause. Retrieved from http://www.educause.edu/ir/library/pdf/ers0706/rs/ERS0706w.pdf

Salyers, V. (2007). Teaching Psychomotor Skills to Beginning Nursing Students Using a Web-Enhanced Approach: A Quasi-Experimental Study. *International Journal of Nursing Education Scholarship*, *4*(1), 1–12. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=24627078&site=ehost-live

Sanden, S., & Darragh, J. (2011). Wiki Use in the 21st Century Literacy Classroom: A Framework for Evaluation. *Contemporary Issues in Technology and Teacher Education*, *11*(1), 6–20. Retrieved from http://www.editlib.org/p/35420

Saudelli, M. G., & Ciampa, K. (2016). Exploring the role of TPACK and teacher self-efficacy: an ethnographic case study of three iPad language arts classes. *Technology, Pedagogy and Education*, *25*(2), 227–247. https://doi.org/10.1080/1475939X.2014.979865

Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in the knowledge age* (pp. 67–98). Chicago: Open Court.

Scardamalia, M., & Bereiter, C. (2003). *Knowledge building*. (J. Guthrie, Ed.) (2nd ed.). New York: Macmillan Reference, USA.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: theory, pedagogy, and technology. In *The Cambridge handbook of the learning sciences* (pp. 97–115). Cambridge: Cambridge University Press.

Schmidt, D., Baran, E., Thompson, A., Mishra, P., Koehler, M., & Shin, T. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149. https://doi.org/doi:10.1080/15391523.2009.10782544

Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. *Computers and Education*, *71*, 247–256. https://doi.org/10.1016/j.compedu.2013.09.016

Schott, F., & Driscoll, P. (1997). On the architechtonics of instructional theory. In R. Tennyson, F. Schott, N. Seel, & S. Dijkstra (Eds.), *Instructional design: International Perspectives, Vol. I: Theory and research* (pp. 135–173). Mahwah, NJ: Erlbaum.

Schrire, S. (2006). Knowledge building in asynchronous discussion groups: Going beyond quantitative analysis. *Computers and Education*, *46*(1), 49–70. https://doi.org/10.1016/j.compedu.2005.04.006

Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research and Development, 47*(4), 83–90.

Schuck, S., Aubusson, P., Kearney, M., & Burden, K. (2013). Mobilising teacher education: A study of a professional learning community. *Teacher Development*, *17*(1), 1–18.

Schunk, D. H. (2000). *Learning theories: An educational perspective* (3rd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Seel, M. (1997). Models of instructional design: introduction and overview. In D. Tennyson, F. Schott, N. Seel, & S. Dijkstra (Eds.), *Instructional-design: International perspectives. Vol. 1. Theory, research and models* (pp. 355–360). Mawah, NJ: Lawrence Erlbaum Associates Publishers.

Seel, N., Lehmann, T., Blumschein, P., & Podolskiy, O. (2017). *What is Instructional Design? Instructional Design for Learning*. https://doi.org/10.1007/978-94-6300-941-6_1

Seels, B. B., & Richey, R. C. (1994). *Instructional technology: The definition and domains of the field*. Washington, DC: Association for Educational Communications and Technology.

Shana, Z. A., & Abulibdehb, E. S. (2015). Engaging students through blogs: Using blogs to boost a course experience. *International Journal of Emerging Technologies in Learning*, *10*(1), 30–38. https://doi.org/10.3991/ijet.v10i1.4240

Shanteau, J., Weiss, D. J., Thomas, R. P., & Pounds, J. C. (2002). Performance-based assessment of expertise: How to decide if someone is an expert or not. *European Journal of Operational Research*, *136*(2), 253–263. https://doi.org/10.1016/S0377-2217(01)00113-8

Sherwood, C. (1993). Australian experiences with effective classroom integration of information technology: implications for teacher education. *Journal of Information Technology for Teacher Education*, *2*(2), 149–166.

Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *American Education Research Association*, *15*(2), 4–14. https://doi.org/10.1017/CBO9781107415324.004

Shumar, W., & Renninger, K. (2002). Introduction: On conceptualizing community. In A. Renninger & W. Shumar (Eds.), *Building virtual communities* (pp. 1–19). Cambridge: Cambridge University Press.

Sigala, M. (2007). Integrating web 2.0 in e-learning environ- ments: A socio-technical approach. *International Journal of Knowledge and Learning*, *3*(6), 628–648.

Simpson, A. (2015). Designing Pedagogic Strategies for Dialogic Learning in Higher Education. *Technology, Pedagogy and Education*, *25*(2), 135–151. https://doi.org/10.1080/1475939X.2015.1038580

Sinha, S., Rogat, T., Adams-Wiggins, K., & Hmelo-Silver, C. (2015). Collaborative group engagement in a computer-supported inquiry learning environment. *International Journal of Computer-Supported Collaborative Learning*, *10*(3), 273–307. https://doi.org/10.1007/s11412-015-9218-y

Siraj, Saedah. (2008). *Futuristic Curriculum*. Kuala Lumpur, Malaysia: Universiti Malaya Press.

Skinner, B, F. (1968). *The technology of teaching*. New York: Appleton.

Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology*, *21*(1), 43–69.

Slepcevic-Zach, P., & Stock, M. (2018). ePortfolio as a tool for reflection and self-reflection. *Reflective Practice*, *19*(3), 291–307. https://doi.org/10.1080/14623943.2018.1437399

Sloan, C. (2015). The relationship of high school student motivation and comments in online discussion forums. *Journal of Educational Computing Research*, *52*(1), 114–135. https://doi.org/10.1177/0735633114568857

Smet, M., Keer, H., & Valcke, M. (2008). Blending asynchronous discussion groups and peer tutoring in higher education: An exploratory study of online peer tutoring behaviour. *Computers and Education*, *50*(1), 207–223. https://doi.org/10.1016/j.compedu.2006.05.001

Smith, L., & Ragan, J. (2005). *Instructional Design*. Wiley. Retrieved from https://books.google.com.my/books?id=_cAkAAAAQBAJ

Smith, R., Cavanaugh, C., & Allen Moore, W. (2011). *Instructional multimedia: An investigation of student and instructor attitudes and student study behavior*. *BMC medical education* (Vol. 11). https://doi.org/10.1186/1472-6920-11-38

Smyth, J. (1995). *Critical Discourses on Teacher Development*. Cassel, London.

Snelbecker, E. (1987). Contrasting and complementary approaches to instructional design. In C. Reigeluth (Ed.), *Instructional theories in action: lessons illustrating selected theories and models* (pp. 321–337). Hillsdale, NJ: Lawrence Erlbaum Associates.

Snelbecker, E. (1999). Some thoughts about theories, perfection, and instruction. In Lawrence Erlbaum (Ed.), *Instructional design theories and models: A new paradigm of instructional theory* (2nd ed., pp. 31–47). Mawah, NJ.

Snelson, C., & Elison-Bowers, P. (2009). Using YouTube videos to engage the affective domain in e-learning. *Research, Reflections and Innovations in Integrating ICT in Education*, *3*, 1481–1485.

So, H.-J., & Bonk, C. J. (2010). Examining the Roles of Blended Learning Approaches in Computer- Supported Collaborative Learning (CSCL) Environments : A Delphi Study. *Educational Technology & Society*, *13*, 189–200.

So, H.-J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Comput. Educ.*, *51*(1), 318–336. https://doi.org/10.1016/j.compedu.2007.05.009

So, H., & Kim, B. (2009). Learning about problem based learning: Student teachers integrating technology, pedagogy and content knowledge. *Australasian Journal of Educational Technology*, *25*(1), 101–116. Retrieved from http://www.ascilite.org.au/ajet/ajet25/so.pdf

Spector, M. (2016). *Foundations of Educational Technology: Integrative Approaches and Interdisciplinary Perspectives* (2nd ed.). Routledge/Taylor & Francis Group. https://doi.org/10.1111/j.1467-8535.2012.01347_11.x

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research*, *69*(1), 21–51.

Squillante, J., Wise, L., & Hartey, T. (2014). *Analyzing Blackboard : Using a Learning Management System From the Student Perspective*. *Mathematics and Computer Science Capstones.* La Salle University.

Stafford, T., Elgueta, H., & Cameron, H. (2014). Students' engagement with a collaborative wiki tool predicts enhanced written exam performance. *Research in Learning Technology*, *22*(May). https://doi.org/10.3402/rlt.v22.22797

Stahl, G. (2000). A model of collaborative knowledge-building. In *Paper presented at the Fourth International Conference of the Learning Sciences (ICLS '00)* (pp. 70–77). Arbor, Ann: Lawrence Erlbaum Associates.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. *Cambridge Handbook of the Learning Sciences*, *2006*, 409–426. https://doi.org/10.1145/1124772.1124855

Stes, A., Maeyer, S., Gijbels, D., & Petegem, P. (2011). Instructional development for teachers in higher education: effects on students' learning outcomes. *Teaching in Higher Education*, *17*(3), 295–308.

Stoddart, A., Chan, J. Y. Y., & Liu, G. Z. (2016). Enhancing successful outcomes of wiki-based collaborative writing: a state-of-the-art review of facilitation frameworks. *Interactive Learning Environments*, *24*(1), 142–157. https://doi.org/10.1080/10494820.2013.825810

Stodel, E., Thompson, T., & MacDonald, C. (2006). Interpretations through the Community of Inquiry Framework. *The International Review of Research in Open and Distributed Learning*, *7*(3), 1–15. https://doi.org/10.1093/itnow/bwi0164

Sun, Z., Lin, C. H., Wu, M., Zhou, J., & Luo, L. (2018). A tale of two communication tools: Discussion-forum and mobile instant-messaging apps in collaborative learning. *British Journal of Educational Technology*, *49*(2), 248–261. https://doi.org/10.1111/bjet.12571

Suthers, D. (2006). Technology affordances for intersubjective meaning-making. *International Conference for Computers in Education*, *1*(2), 1–24.

Sysomos.com. (2016). *Inside blogger demographics: Data by gender, age, etc.* Retrieved from www.sysomos.com/reports/blogger-demographics

Tabak, I. (2004). Synergy: a complement to emerging patterns of distributed scaffolding. *The Journal of the Learning Sciences*, *13*(3), 305–335.

Tai, S. (2015). From TPACK-in-action workshops to classrooms: CALL competency developed and integrated. *Language Learning & Technology*, *19*(1), 139–164. Retrieved from http://llt.msu.edu/issues/february2015/tai.pdf

Tal, T., Krajcik, S., & Blumenfeld, C. (2006). Urban schools' teachers enacting project- based science. *Journal of Research in Science Teaching*, *43*, 722–745.

Tang, K.-S., & Tan, S.-C. (2017). Intertextuality and Multimodal Meanings in High School Physics: Written and Spoken Language in Computer-supported Collaborative Student Discourse. *Classroom Discourse*, *8*(1), 19–35. https://doi.org/10.1080/19463014.2016.1263576

Tanner, P., & Chapman, J. (2012). Poster presentations speak for themselves. *The Language Teacher*, *36*(3), 15–20.

Tee, M. Y., & Lee, S. S. (2011). From socialisation to internalisation: Cultivating technological pedagogical content knowledge through problem-based learning. *Australasian Journal of Educational Technology*, *27*(1), 89–104.

Tennyson, R. D. (2010). Historical Reflection on Learning Theories and Instructional Design. *Contemporary Educational Technology*, *1*(3), 1–16. https://doi.org/9780805858617

Tennyson, R., & Scott, F. (1997). Instructional Design Theory, Research and Model. In R. D. Tennyson, F. Schott, N. Seel, & S. Dijkstra (Eds.), *Instructional design: International Perspectives, Vol. I: Theory and research* (pp. 1–18). Mahwah, NJ: Erlbaum.

Thanabalan, V. (2011). *Development of a digital story pedagogical module to facilitate reading among indigenous primary school students*. University of Malaya.

Thomas, S. (2017). Journalogue: Voicing student challenges in writing through a classroom blog. *Educational Technology and Society*, *20*(1), 112–122.

Tobi, S. (2016). *Qualittaive Research,Interview Analysis & NViVo Exploration*. Kuala Lumpur, Malaysia: ARAS Publisher.

Toci, V., Camizzi, L., Goracci, S., Borgi, R., De Santis, F., Coscia, L., … Chiara Pettenati, M. (2015). Designing, producing and exemplifying videos to support reflection and metacognition for in-service teacher training. *Journal of E-Learning and Knowledge Society*, *11*(2), 73–89.

Top, E. (2012). "Blogging as a social medium in undergraduate courses: sense of community best predictor of perceived learning",. *The Internet and Higher Education*, *15*(1), 24–28.

Torrisi-Steele, G., & Drew, S. (2013). The literature landscape of blended learning in higher education: the need for better understanding of academic blended practice. *International Journal for Academic Development*, 1–13. https://doi.org/http://dx.doi.org/10.1080/1360144X.2013.786720.

Trif, L. (2015). Training Models of Social Constructivism. Teaching Based on Developing A Scaffold. *Procedia - Social and Behavioral Sciences*, *180*(2015), 978–983. https://doi.org/10.1016/j.sbspro.2015.02.184

Tseng, J.-J., Lien, Y.-J., & Chen, H.-J. (2016). Using a teacher support group to develop teacher knowledge of Mandarin teaching via web conferencing technology. *Computer Assisted Language Learning*, *29*(1), 127–147. https://doi.org/10.1080/09588221.2014.903978

Tuapawa, K. (2016). Interpreting experiences of teachers using online technologies to interact with students in blended tertiary environments. *International Journal of Information and Communication Technology Education*, *12*(4), 76–87. https://doi.org/10.4018/IJICTE.2016100107

Tubbs, S. L. (1995). *A systems approach to small group interaction* (5th ed.). New York, NY: McGraw-Hill.

Tuckman, B. W. (1972). *Conducting Educational Research*. Harcourt Brace Jovanovich. Retrieved from https://books.google.com.my/books?id=xGkkAQAAMAAJ

UNESCO. (2011). *UNESCO ICT Competency Framework for Teachers*. *United Nations Educational*. https://doi.org/10.1017/CBO9781107415324.004

Valcárcel, A., Basilotta, V., & López, C. (2014). ICT in collaborative learning in the classrooms of primary and secondary education. *Comunicar*, *21*(42), 65–74. https://doi.org/10.3916/C42-2014-06

Valdmann, A., Rannikmae, M., & Holbrook, J. (2016). Determining the Effectiveness of a Cpd Programme for Enhancing Science Teachers' Self-Efficacy Towards Motivational Context-Based Teaching. *Journal of Baltic Science Education*, *15*(3), 284–297. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=116937245&site=ehost-live

van den Akker, J. (1999). Principles and methods of development research. In van den Akker, R. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.), *Design approaches and tools in education and training* (pp. 1–15). Dordrecht: Kluwer Academic Publishers.

Vangrieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review*, *15*, 17–40. https://doi.org/10.1016/j.edurev.2015.04.002

Vermunt, D., & Endedijk, M. (2011). Patterns in teacher learning in different phases of the professional career. *Learning and Individual Differences*, *21*, 294–302.

Voogt, J. J., & Knezek, G. G. (2013). Building a global community of policymakers, researchers, and educators to move education systems into the digital age. *Journal of Computer Assisted Learning*, *29*, 399–402.

Vovides, Y., Sanchez-Alonso, S., Mitropoulou, V., & Nickmans, G. (2007). The use of e-learning course management systems to support learning strategies and to improve self-regulated learning. *Educational Research Review*, *2*(1), 64–74. https://doi.org/10.1016/j.edurev.2007.02.004

Vries, S., Grift, W., & Jansen, E. (2013). How Teachers' Beliefs about Learning and Teaching Relate to their Continuing Professional Development. *Teachers and Teaching*, *20*(3), 338–357. https://doi.org/10.1080/13540602.2013.848521

Vygotsky, L. (1962). *Thought and language.* Cambridge, MA: The MIT Press.

Vygotsky, L. (1988). The Genesis of higher mental functions. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology* (pp. 144–188). London, UK: Erlbaum in association with The Open University.

Vygotsky, S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wachira, P., & Keengwe, J. (2011). Technology Integration Barriers: Urban School Mathematics Teachers Perspectives. *Journal of Science Education and Technology*, *20*(1), 17–25. https://doi.org/10.1007/s10956-010-9230-y

Walls, S. M., Kucsera, J. V., Walker, J. D., Acee, T. W., McVaugh, N. K., & Robinson, D. H. (2010). Podcasting in education: Are students as ready and eager as we think they are? *Computers and Education*, *54*(2), 371–378. https://doi.org/10.1016/j.compedu.2009.08.018

Wang, H. (2005). Questioning skills facilitate online synchronous discussions. *Journal of Computer Assisted Learning*, *21*(4), 303–313.

Wang, M., Chen, Y., & Khan, M. J. (2014). Mobile cloud learning for higher education: A case study of moodle in the cloud. *International Review of Research in Open and Distance Learning*, *15*(2), 254–267. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84900404790&partnerID=tZOtx3y1

Ward, L., & Parr, J. M. (2010). Revisiting and reframing use: Implications for the integration of ICT. *Computers and Education*, *54*(1), 113–122. https://doi.org/10.1016/j.compedu.2009.07.011

Weatherly, N., Grabe, M., & Arthur, L. (2002). Providing introductory psychology students access to lecture slides via Blackboard: A negative impact on performance. *Journal of Educational Technology Systems*, *31*(4), 463–474.

Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. *Academy of Management Journal*, *40*(6), 1282–1309.

Wenger, E. (1999). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: University Press, Cambridge.

Werry, C. (1996). Linguistic and interactional features of Internet relay chat. In H. SC (Ed.), *Computer-mediated communication: linguistic, social and cross-cultural perspectives* (pp. 47–63). Philadelphia: John Benjamin's Publishing Co.

Wertsch, V. (1998). *Mind as action.* New York, NY: Oxford University Press.

Wever, B., Hämäläinen, R., Voet, M., & Gielen, M. (2015). A wiki task for first-year university students: The effect of scripting students' collaboration. *Internet and Higher Education*, *25*, 37–44. https://doi.org/10.1016/j.iheduc.2014.12.002

Willermark, S. (2018). Technological Pedagogical and Content Knowledge: A Review of Empirical Studies Published From 2011 to 2016. *Journal of Educational Computing Research*, *56*(3), 315–343. https://doi.org/10.1177/0735633117713114

Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J. (2000). Teachers and ICT: current use and future needs. *British Journal of Educational Technology*, *31*(4), 307–320.

Williams, J. (1999). The Chat Room as an Integral Part of the Virtual Classroom in Distance Learning Program Design for Adult Learners. *Reproductions Supplied by EDRS*, (7), 29. Retrieved from http://search.proquest.com/docview/62392173?accountid=14744

Wilson, E., & Wright, V. (2010). Images over time: the intersection of social studies through technology, content, and pedagogy. *Contemporary Issues in Technology and Teacher Education*, *10*(2), 220–233.

Wilson, J. W. (2007). The Blackboard Jungle: A case study of instructors and student perceptions of the learning technology tool Blackboard. In *3rd Annual Symposium : Graduate Research and Scholarly Projects.* (pp. 15–16). Wichita State University. Retrieved from http://soar.wichita.edu/bitstream/handle/10057/599/16.pdf?sequence=1&isAllowed=y

Wolff, T. E. (2010). The patent information user group-collaborating via the PIUG wiki and discussion forums. *Computers & Education*, *32*(2), 141e144.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, *17*(2), 89–100. https://doi.org/http://doi.org/10.1111/j.1469-7610.1976.tb 00381.x.

Wu, B., Hu, Y., Gu, X., & Lim, C. (2016). Professional Development of New Higher Education Teachers With Information and Communication Technology in Shanghai: A Kirkpatrick's Evaluation Approach. *Journal of Educational Computing Research*, *54*(4), 531–562. https://doi.org/10.1177/0735633115621922

Yang, C., & Chang, Y. S. (2012). Assessing the effects of interactive blogging on student attitudes towards peer interaction, learning motivation, and academic achievements. *Journal of Computer Assisted Learning*, *28*, 126– 135.

Yang, D., Sinha, T., & Adamson, D. (2013). "Turn on, Tune in, Drop out": Anticipating student dropouts in Massive Open Online Courses. *Proceedings of the NIPS Workshop on Data Driven Education*, 1–8. Retrieved from http://lytics.stanford.edu/datadriveneducation/papers/yangetal.pdf

Yang, H. (2009). Using blogs to enhance critical reflection and community of practice. *Educational Technology & Society*, *12*(2), 11–21.

Yeh, Y. F., Hsu, Y. S., Wu, H. K., & Chien, S. P. (2017). Exploring the structure of TPACK with video-embedded and discipline-focused assessments. *Computers and Education*, 49–64. https://doi.org/10.1016/j.compedu.2016.10.006

Yeh, Y. F., Hsu, Y. S., Wu, H. K., Hwang, F. K., & Lin, T. C. (2014). Developing and validating technological pedagogical content knowledge-practical (TPACK-practical) through the Delphi survey technique. *British Journal of Educational Technology*, *45*(4), 707–722. https://doi.org/10.1111/bjet.12078

Yim, S., & Warschauer, M. (2017). Web-Based Collaborative Writing in L2 Contexts: Methodological Insights From Text Mining. *Language Learning & Technology*, *21*(211), 146–165. Retrieved from http://llt.msu.edu/issues/february2017/yimwarschauer.pdf

Zainuddin, N., Idrus, R., & Jamal, A. F. M. (2016). Moodle as an ODL teaching tool: A perspective of students and academics. *Electronic Journal of E-Learning*, *14*(4), 282–290.

Zanjani, N., Edwards, S. L., Nykvist, S., & Geva, S. (2017). The important elements of LMS design that affect user engagement with e-learning tools within LMSs in the higher education sector. *Australasian Journal of Educational Technology*, *33*(1), 19–31. https://doi.org/10.14742/ajet.2938

Zawilinski, L. (2009). HOT Blogging: A Framework for Blogging to Promote Higher Order Thinking. *The Reading Teacher*, *62*. https://doi.org/10.1598/RT.62.8.3

Zhang, K., & Carr-Chellman, A. (2001). Peer Online Discourse Analysis. In *Annual Proceedings of Selected Research and Development [and] Practice Papers Presented at the National Convention of the Association for Educational Communications and Technology* (pp. 152–160). Atlanta, GA,: Reproductions supplied by EDRS.

Zhao, Y. (2003). *What teachers should know about technology: Perspectives and practices. Information Age Publishing*. Greenwich, CT.

Zheng, B., Niiya, M., & Warschauer, M. (2015). Wikis and collaborative learning in higher education. *Technology, Pedagogy and Education*, *24*(3), 357–374. https://doi.org/10.1080/1475939X.2014.948041

Zhu, E. (2006). Interaction and cognitive engagement: An analysis of four asynchronous online discussions. *Instructional Science*, *34*, 451–480.

Zion, M., Adler, I., & Mevarech, Z. (2015). The Effect of Individual and Social Metacognitive Support on Students' Metacognitive Performances in an Online Discussion. *Journal of Educational Computing Research*, *52*(1), 50–87. https://doi.org/10.1177/0735633114568855

Zwaard, R., & Bannink, A. (2014). Video call or chat? Negotiation of meaning and issues of face in telecollaboration. *System*, *44*(1), 137–148. https://doi.org/10.1016/j.system.2014.03.007