DEVELOPMENT OF A SMARTPHONE APPLICATION AND ITS EVALUATION ON ITS USABILITY IN FACILITATING SELF-DIRECTED LEARNING OF CLINICAL SKILLS AMONG UNDERGRADUATE NURSING STUDENTS

BY

AIRUL AZIZAN ZAINUDIN

A thesis submitted in fulfillment of the requirement for the degree of Doctor of Philosophy in Nursing

Kulliyyah of Nursing

International Islamic University Malaysia

FEBRUARY 2022

ABSTRACT

Introduction: Self-directed learning (SDL) has been proven effective to enhance learning experience and it is essential for the effectiveness of mobile learning interventions. Although a lot mobile-based interventions have been implemented in nursing education, it did not provide a consistent result on the improvement of knowledge and skill among nursing students. Many mobile learning interventions were built without implying the important elements of use behaviour of a technology.
Objectives: This study aimed to explore the important factors of perceived behavioral intention to use smartphone application, develop and evaluate the usability of a smartphone application prototype that facilitate SDL of clinical skills among undergraduate nursing students.
Methods: A sequential exploratory mixed-method design was used and adapted in this study. Phase 1 includes the qualitative aspect using in-depth, semi-structured interview to investigate the challenges of SDL of clinical skills among nursing students, at the same time, to explore the perception of using smartphone application to cope with the challenges. In Phase 2, a quantitative aspect utilizing survey instrument based on Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) was used to identify the significant factors that give positive effect on behavioural intention to use the smartphone application. In Phase 3, the relevant smartphone features were identified and mapped with its significant behavioral determinant using methodological triangulation followed by the development of smartphone application prototype. In Phase 4, usability studies and end-user perception were carried out to evaluate the prototype using observation, in-depth interview, and survey. Qualitative data was analyzed using thematic analysis meanwhile quantitative data was analyzed by performing PLS-SEM analysis.
Findings: The first interview findings suggested that undergraduate nursing student were lack of self-management skill, lack of desire of learning and lack of self-control skill. Meanwhile, in assessing their perception for adopting smartphone application for SDL of clinical skills, an additional factor which is self-management of learning was found. On larger scale study, the most significant factors that give positive effect on behavioural intention to use the smartphone application were habit, facilitating condition and social influence. On analysis of usability and end-user perception of the prototype, tasks completion rate, usability score and perceptions were good. But there is still a need of improvement in terms of navigability, flow process and interface design of the app. Likewise, the mobile features' improvement such as profile personalization, content credibility, interface design, and app notification, were indeed necessary.
Conclusion: This finding proves that the smartphone application developed based on UTAUT2 is useful in exploring needed mobile apps features and requirements in facilitating SDL of clinical skills among undergraduate nursing students.

ملخص البحث

المقدمة: وقد ثبت أن التعلم الذاتي التوجيه فعال في تعزيز خبرة التعلم، وهو ضروري لفعالية تدخلات التعلم المتنقلة. وعلى الرغم من تنفيذ الكثير من التدخلات المتنقلة في مجال تعليم التمريض، فإنها لم تحقق نتائج متسقة فيما يتعلق بتحسين المعارف والمهارات لدى طلاب التمريض. وقد بُنيت العديد من التدخلات التعلمية المتنقلة دون أن تنطوي على العناصر الهامة لسلوك استخدام التكنولوجيا.

الأهداف: وتهدف هذه الدراسة إلى استكشاف العوامل الهامة للنية السلوكية المتصورة لاستخدام تطبيقات الهواتف الذكية وتطوير وتقييم قابلية استخدام نموذج أولي لتطبيق الهواتف الذكية ييسر التعلم الذاتي التوجيه للمهارات السريرية لدى طلاب التمريض في مرحلة ما قبل التخرج.

المناهج: وقد استُخدم في هذه الدراسة تصميم استكشافي متسلسل للطريقة المختلطة وتم تكييفه. وتشمل المرحلة 1 الجانب النوعي باستخدام مقابلات متعمقة وشبه منظمة لبحث تحديات التعلم الذاتي التوجيه للمهارات الإكلينيكية لدى طلاب التمريض، في الوقت نفسه، لاستكشاف تصور استخدام تطبيقات الهواتف الذكية لمواجهة التحديات. وفي المرحلة 2، استخدم جانب كمي يستخدم أداة استقصاء تستند إلى النظرية الموحدة لقبول التكنولوجيا واستخدامها 2 لتحديد العوامل الهامة التي تعطي أثرا إيجابيا على النية السلوكية لاستخدام تطبيق الهاتف الذكي. وفي المرحلة 3، تم تحديد خصائص الهاتف الذكي ذات الصلة ووضع خريطة مع محدده السلوكي الهام باستخدام المثلث المنهجي يليه تطوير نموذج تطبيق الهاتف الذكي. وفي المرحلة 4، أجريت دراسات قابلية الاستخدام وإدراك المستخدم النهائي لتقييم النموذج الأولي

باستخدام الملاحظة والمقابلة المتعمقة والمسح. وقد تم تحليل البيانات النوعية باستخدام التحليل المواضيعي، في الوقت الذي تم فيه تحليل البيانات الكمية عن طريق إجراء تحليل لنظام الإدارة السليمة بيئياً.

النتائج: وتشير نتائج المقابلة الأولى إلى أن طالب التمريض في مرحلة ما قبل التخرج هو الافتقار إلى مهارات الإدارة الذاتية، والافتقار إلى الرغبة في التعلم، والافتقار إلى مهارات التحكم الذاتي. وفي الوقت نفسه، وعند تقييم تصورهم لاعتماد تطبيقات الهاتف الذكي من أجل التعلم الذاتي التوجيه للمهارات السريرية، وجد عامل إضافي هو الإدارة الذاتية للتعلم. وعلى نطاق أوسع، كانت أهم العوامل التي تؤثر إيجابياً على النية السلوكية لاستخدام تطبيقات الهاتف الذكي هي العادة، مما يسهل الظروف والتأثير الاجتماعي. وفيما يتعلق بتحليل قابلية الاستخدام وإدراك المستخدم النهائي للنموذج الأولي، كان معدل إنجاز المهام ودرجة قابلية الاستخدام والتصورات جيدة. ولكن لا تزال هناك حاجة إلى تحسين من حيث قابلية التطبيق للملاحة، وعملية التدفق، والتصميم البيني. وعلى نحو مماثل، كان تحسين السمات المتنقلة، مثل إضفاء الطابع الشخصي على الصورة، ومصداقية المحتوى، وتصميم الوصلات البينية، وإخطار التطبيق، ضروريا بالفعل.

الخاتمة: وتثبت هذه النتيجة أن تطبيق الهاتف الذكي الذي تم تطويره استنادا إلى UTAUT2 مفيد في استكشاف خصائص ومتطلبات التطبيقات المتنقلة اللازمة في تيسير تعلم المهارات السريرية الموجهة ذاتيا بين طلاب التمريض في مرحلة ما قبل التخرج.

APPROVAL PAGE

The thesis of Airul Azizan Zainudin has been approved by the following:

_____
Hazwani Mohd Mohadis
Supervisor

_____
Norfadzilah Ahmad
Co-Supervisor

_____
Mohamad Fauzan Noordin
Co-Supervisor

_____
Mohd. Zulfaezal Che Azemin
Co-Supervisor

_____
Mohd. Said Nurumal
Internal Examiner

_____
Khatijah Abdullah @ Lim Geok Khim
External Examiner

_____
Ariffin Abdul Mutalib
External Examiner

_____
Mohamad Haniki Nik Mohamed
Chairman

DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Airul Azizan Zainudin

Signature…… Date……

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH

DEVELOPMENT OF A SMARTPHONE APPLICATION AND ITS EVALUATION ON ITS USABILITY IN FACILITATING SELF-DIRECTED LEARNING OF CLINICAL SKILLS AMONG UNDERGRADUATE NURSING STUDENTS

I declare that the copyright holder of this thesis are jointly owned by the student and IIUM.

1. Any material contained in or derived from this unpublished research may only be used by others in their writing with due acknowledgement.

2. IIUM or its library will have the right to make and transmit copies (print or electronic) for institutional and academic purpose.

3. The IIUM library will have the right to make, store in a retrieval system and supply copies of this unpublished research if requested by other universities and research libraries.

By signing this form, I acknowledged that I have read and understand the IIUM Intellectual Property Right and Commercialization policy.

Affirmed by Airul Azizan Zainudin

…… ……..

Signature Date

ACKNOWLEDGEMENT

Alhamdulillah, all Praise be to Allah SWT the Most Compassionate and Most Merciful, whose blessing helped me through entirety of this thesis.

I would like to express my deep and sincere gratitude to my research supervisor, Dr Hazwani, for giving me the opportunity to do research and providing invaluable guidance throughout this research work. Her dynamism, vision, and motivation have deeply inspired me. She has taught me the methodology to carry out the informatics-related research, to provide assistant in managing grant, conference, and publication, and to present the research works as clearly as possible. I am also extremely grateful to Dr Fadzilah for what she has offered me. I would like to thank for her guidance especially in carrying out the qualitative research which is new to me. Her comments and questions were very beneficial in my completion of the thesis and especially at viva time. Besides, a special dedication to the other supervisory team members, Dr Zulfaezal and Prof Fauzan for many stimulating discussions to make this research a meaningful experience.

Regardless of any difficulties, I am extremely grateful to my parents, Mr Zainudin and Mdm Noraini, for their love, prayers, caring and sacrifices for educating and preparing me for my future. I am very much thankful to my wife, Noor Khadijah, and my sons, Muadz Baihaqi and Mus'ab Fatihi, for their love, understanding, prayers and continuing support to complete this research work. Also, I express my thanks to my siblings, Airul Irwan, Nur Syahidah, and Airul Azizi, my father-in-law, Ahmad Iffandy, my late grandmother, Merah bt Long and all family members, who always give any kinds of supports and prayers.

Undivided support and encouragement from all staff of Kulliyyah of Nursing will never be forgotten and permanently carved in my appreciation sculpture. The Kulliyyah and its members had provided a lot of programs and classes to help me excel during this postgraduate journey. Not to forget all my friends, alumni, sponsors, Doctorate Support Group (DSG), all participants from IIUM, UiTM, and UNIMAS that supported and encouraged me and makes this research a wonderful experience.

Last but not least, I always hold to the motto of "You Will Never Walk Alone", the saying that I felt very close and relatable to me along this delightful Ph.D. journey. I can feel the engulfment of love, compassion, sustenance, and encouragement from all the wonderful people around me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

To fulfil the demanding roles often assumed by industries, it is necessary to prepare nursing students for high-skilled training. Students who are prepared for those roles must demonstrate their commitment to lifelong learning. According to Longworth (1999) lifelong learning can be defined as "the development of human potential through a continuously supportive process that stimulates and empowers individuals to acquire all the knowledge, values, skills and understanding they require throughout their lifetimes and apply them with confidence, creativity and enjoyment in all roles, circumstances and environments." Higher education has recognised the shift from a teacher-centred approach to a student-centred approach, placing learners as the centre of learning (Schreurs & Dumbraveanu, 2014).

One of the fundamental components of nursing is clinical competence. In nursing education, clinical skill training is essential as it combines theoretical and practical learning experiences, allowing students to combine their sensory, motor and cognitive learning processes (Haraldseid et al., 2016). It also helps to gain knowledge, skills and attitude for providing nursing care (Jamshidi et al., 2016). Nursing students spend most of their time in clinical environments. In Malaysia, there are 52 weeks of clinical practice that must be completed by a student. Besides, 78 out of 120 credit hours that must be fulfilled by the students in the curriculum must be in the areas of basic medical science, nursing science and behavioral science (Malaysian Nursing Board / Malaysian Midwives Board, 2018a). Therefore, the standards provided by the board indicate that fulfilling clinical skill training requirements is highly important.

1.2 SELF-DIRECTED LEARNING

Since nursing education is becoming more complex in terms of the acquisition of clinical skills, there are now emerging approaches to learning that are becoming popular, including self-directed learning. Outcome-based learning has sparked a shift to

independent and active learning strategies as part of nursing clinical skills training, such as simulation, online learning, and mobile learning. Nevertheless, there is still a debate on how much self-directed learning contributes to one's learning success.

1.2.1 Adult Learning

Adult learning, or andragogy, examines the process by which adults learn, which is in contradiction with pedagogy, the art and science of teaching children (Knowles, 1973). Knowles instituted four main assumptions that must be made to the mature learners, which are: 1) they become increasingly more self-directed; 2) they accumulate useful experience as a learning resource; 3) their motivation to learn becomes more job-oriented; and, 4) they expect education material to have an immediate application (Knowles, 1980).

The concept of learning among adults is self-directed, opposing the concept of children's education (such as the teacher is expected to be responsible for determining instructional content and method); they need the instructor to facilitate the movement towards self-directedness of learning. Adults usually learn from their set of experiences; thus the instructor is required to highlight the subject material. If adults realise the need or have an interest in assimilating new knowledge, they will become prepared to learn. Here, the facilitator is the helping hand that ensures the subject interest would become useful for adult learners. Therefore, adults will believe that education needs to be directly applicable and will immediately help them to achieve full potential in their lives (Knowles, 1980).

1.2.2 Self-Directed Learning

Self-directed learning (SDL) is defined as, "… a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975). SDL has been an important area of study among adults and has shifted the focus of education from teacher-directed to self-directed.

SDL promotes self-control in the learning process and provides space and opportunities for the learner to interact with people outside the classroom to reach the learning goal (Hsieh & Hsieh, 2019). For any university student to engage in continuous learning, the capacity to self-direct in one's learning is an important element. The benefit of acquiring this ability can allow the students to understand their strengths and use their skills to plan, manage and assess education for themselves. However, being self-directed "does not necessarily mean learning on your own" (C. Lee et al., 2017).

1.2.3 Self-Directed Learning in Nursing Education

Self-directed learning (SDL) has been a popular concept among researchers in health professional education (Murad et al., 2010). In the field of nursing, the self-directed learning concept in nursing education is not new (Nolan & Nolan, 1997). An early study of the SDL readiness of students identified in the nursing literature was a controlled experimental study conducted by Wiley (1983) using the Self-Directed Learning Readiness Scales (SDLRS). The learner's readiness to engage in SDL is defined as ''the degree the individual possesses the attitudes, abilities and personality characteristics necessary for self-directed learning" (Wiley, 1983, p. 182). SDL is a method of instruction that can be defined in terms of the amount of responsibility the learner accepts for his or her learning (Fisher et al., 2001). A two-step Delphi technique was used to develop the SDLRS for Nursing Education (SDLRSNE), involving 11 nursing training experts to evaluate the validity of the structure and content of the items expressing self-directed readiness for learning in the first step, followed by the administration of scale to 201 nursing students in the second step (Fisher et al., 2001). Eventually, this study managed to include items from three sub-scales: self-management, learning desire, and self-control.

Self-management is a structure for the ability of the students to achieve their study objectives and efficiently use their available learning tools. This sub-scale includes elements such as the ability to manage time efficiently, use systematic and methodical learning methods, establish learning times, prioritise, and follow additional understanding, find further data and methods and solve problems (El et al., 2017). Then, the desire for learning subscale is applied to assess the motivation of learning and

whether or not they can reflect on this motivation. It also implies the preference of the students in assuming responsibility for learning (El et al., 2017). Meanwhile, the self-control subscale is used to determine the ability of the students to self-evaluate and determine their learning goals and results. This means that the learner is the one who takes control of the learning context for them to achieve the targeted learning goals. In this sense, control did not mean independence, but rather cooperation or collaboration with other people within the context of the study (El et al., 2017).

1.3 MOBILE TECHNOLOGY IN LEARNING

1.3.1 Technology

Technology is an enabler or vehicle for the dissemination of knowledge. It is an encompassing term that deals with the use and knowledge of the tools and crafts of humanity. Technology is a broad concept that refers to the use and knowledge of instruments and crafts, and how the capacity to control and adapt to the environment is affected by these tools and crafts.

1.3.2 Mobile technology

The use of smartphones has become increasingly popular as a platform for Internet access, and there is no sign of slowing down in terms of their use. In particular, the use of the Internet in Malaysia has contributed as accurate as 93.1 per cent to smartphone users. As the number of mobile broadband subscribers in Malaysia reached more than 36.2 million in the second quarter of 2018, it is not surprising that the demand for smartphone applications has rapidly increased (Malaysian Communications and Multimedia Commission, 2018).

Malaysia, along with Singapore and Thailand, is the top three countries in Southeast Asia known for having the highest Internet penetration, accounting for more than 80 per cent of the total population (ASEANUP, 2019). This statistic reflects the motivation of society to discover new opportunities in different disciplines of knowledge. By inculcating 12.1 per cent of the total internet users in Malaysia who are

full-time students, as reported by the Malaysian Communications and Multimedia Commission or MCMC (2018), smartphone technology is viewed as a high stake in the potential for a radical revolution in education and as a response to the government's push for an industrial revolution 4.0 (IR4.0).

Mobile technology has steadily improved over the years from a mere communication tool to a tool that can perform almost the same as that of a computer device. In this sense, the smartphone application helps students to connect with educational content ubiquitously and has a significant impact on learning performance. On the other hand, Mobile learning or m-learning is a popular subset of e-learning in distance learning due to the breakthrough of mobile technology reengineering. A bigger screen size, longer battery life, better data processing, and a larger memory system are the features of mobile technology that make it a powerful learning tool.

1.3.3 Mobile learning

M-learning has broadened the possibilities of e-learning and distance learning by enabling the use of mobile wireless communication technology to create an environment for teaching and learning within educational institutions regardless of time, location or on the move (Althunibat, 2015; Singh et al., 2016). Researchers value m-learning by highlighting its important characteristics such as mobility, access, ubiquity, and convenience (Baran, 2014).

Since the early 2000s, most researchers have been making inroads into m-learning research. This is where the number of publications has begun to increase, and more researchers have been attracted to the m-learning projects. Since then, topics such as readiness, perception, benefits, and challenges to mobile learning have been explored and reviewed. Many researchers, particularly those known to study mobile learning, agreed that self-directed learning is essential for the effectiveness of mobile learning and the success of lifelong learning (Waard, 2017). In addition, it has been reported that the effectiveness of mobile learning can also be linked to the design of the system (Pedro et al., 2018). The application of design-based research has influenced the research methodology of mobile learning studies as the effectiveness of mobile learning has also depended on the design and application of the technological intervention.

Several scholars have carried out an analysis on the use of design-based analysis as a research technique in conducting various research studies from the past 20 years (Jayatilleke et al., 2018; Krull & Duart, 2017). Significant results from these studies have shown that the majority of the researchers performed studies in the area of design-based research on technological interventions and applications. For example, the technological intervention applications reported by Jayatilleke et al. (2018) were the most researched field in the early 2000s. Meanwhile, a more recent review of design-based research by Krull & Duart (2017) revealed that mobile learning applications and systems are the most researched areas. This concludes that design-based research is highly recognised by researchers in learning.

1.3.4 Mobile learning in nursing education

Nursing education is one of the programs that offer a wide range of practical experience in their curriculum, now surpassing traditional conservative teaching techniques by evolving through contemporary academic resources online (Terry et al., 2016). In response to many challenges from the clinical learning environment (Baraz et al., 2015), technology affordances are in concurrence with learning environments from retrieving and sharing information to instant access and interaction with faculty and peers, making it plausible that students may be using various technologies to facilitate and augment their learning experiences and effectively meeting academic challenges.

Besides, teaching methodologies have been empowered by technologies. Advanced and outcome-based learning has been adopted as an important learning strategy. There is therefore a great deal of pressure on nursing education institutions to become more dynamic to engage this fast-growing educational technology in their curriculum. With the growing dependence of younger generations on mobile devices, especially Generation Y that is defined as a unique group of people with “the most technically literate, educated, and ethnically diverse” (Eisner, 2005), the authority must take this opportunity to associate these qualities into nursing educational interventions.

Mobile learning has been a significant component of university education and learning processes. The interactive environment between instructors and students, according to Akour (2010), results in the traditional idea of the classroom being

manipulated. Mobile interventions driven by modern technology advancements, such as wireless internet and mobile technology, can be used to enhance the knowledge and practice of nursing education as they work dynamically (C. Chang et al., 2018). As more literature suggests increasing the efficiency of mobile-enhanced learning in the prevention of resource limitation and improving opportunities for students to learn, we must explore the potential of mobile technology to encourage the acquisition of knowledge and the practice of clinical skills among undergraduate nursing students.

1.4 NURSING EDUCATION SYSTEM IN MALAYSIA

1.4.1 Malaysian Nursing Body

The Nursing Board Malaysia (NBM) is an administrative body governing the practice of nursing in Malaysia under the Nursing Division of the Ministry of Health of Malaysia. In addition to addressing issues relating to complaints from the public and private sectors, it fulfils its roles in the registration of nurses, as well as the processing of annual practice certificates and temporary practice certificates. NBM also works in accrediting the course curricula, monitoring the adequacy of learning facilities and providing continuous professional education opportunities for all Malaysian registered nurses alongside the education sectors (Malaysian Nursing Board / Malaysian Midwives Board, 2018b)

1.4.2 Malaysian Nursing Education System

Malaysia's nursing education system has introduced a two-tier system, one of which is run by the Ministry of Education and the other by the Ministry of Health (MoH). The first system is subject to the standards of the Malaysian Qualifications Framework (MQF), whereas the latter is subject to the MoH Directive and not to the MQF standards. Registered nurses shall obtain their basic nursing qualification from one of the above-mentioned systems provided either by the MoH hospital program or the university or private college nursing program.

There are two ways for a candidate to enrol in a university undergraduate nursing program. A 3-year diploma nursing course can be directly attended by high school graduates. In the meantime, students can enrol from the diploma level, foundation study or form six of high school, to study in a 4-year nursing degree course. In addition to more than 70 local private nursing colleges and the Ministry of Defense's nursing institution, there are 10 public universities that offer nursing programs in Malaysia. Moreover, there are at least seven public universities, including Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia, International Islamic University Malaysia, Universiti Malaysia Sarawak, Universiti Teknologi MARA, and Universiti Sains Malaysia, that are currently providing four-year bachelor nursing programs in Malaysia.

It provides a comprehensive curriculum with the introduction of a four-year bachelor's nursing program by integrating five core components of the program, which are basic medical sciences, behavioural science, nursing sciences, clinical placement, research and statistics and electives (Malaysian Nursing Board / Malaysian Midwives Board, 2018a). As shown in Table 1, the distribution of curriculum design is proportionately balanced:

Table 1 Distribution of curriculum subject in Bachelor of Nursing program

Core	Minimum credit
Basic Medical Sciences	16
Behavioural Science	10
Nursing Sciences	52
Clinical Placement	26
Research and Statistics	12
Electives Courses in Nursing	4

As stipulated in the above table, a minimum of 26 credit hour is required for a student to complete their clinical placement before they are allowed to sit for the Malaysia Nursing Board examination. This credit hour is equal to a minimum of 52

weeks of clinical placement that need to be attended throughout their 4-year bachelor program.

1.4.3 Contemporary Issues in Nursing Education in Malaysia

Due to the demanding nursing work on the market, there is a growing concern about the quality of nursing graduates in Malaysia. In comparison to public colleges, statistics from the Ministry of Higher Education (Ministry of Higher Education, 2010) indicated a significant gap in the number of private colleges. With more than 70 private colleges in operation compared to only 10 public colleges, the diploma program is widely available compared to the bachelor's degree program (Ministry of Higher Education, 2010). More than 5000 graduates have been reported to be produced annually from all nursing institutions in Malaysia (DoHE, 2010). Unfortunately, the trend for a growing supply of nurses has worried some researchers particularly on the competitive qualities of teaching and learning. For example, Barnett et al. (2010) raised their concern mainly on lower standard entry requirements where the same pool of high school graduates was the subject of competition for many colleges. If there is also a lack of staff and resources to support a large number of students to progress through the course within the time required, making the situation more difficult (Barnett et al., 2010).

The current challenges for nursing students include the ongoing shift from conventional educational programs based on classroom to online learning, especially due to the Covid-19 pandemic (Ramos-Morcillo et al., 2020). Appana (2008) addressed that the traditional environment has been criticised for its passive learning approach, disregarding individual differences and the needs of problem-solving and critical thinking. Meanwhile, some of the opportunities invested in online learning include increased access and quality of learning, reduced cost and improved collaborative learning (Appana, 2008). Using the online format will have a definite benefit for younger students including learning enjoyment and increased participation (Cheng, 2015) as they are likely to have grown up with the appropriate technologies. There is still, however, many weaknesses in providing suitable online learning environments, such as resources, training, and management, which restrict the use of online learning to the fullest (Alsswey, 2019).

MQA (2017) has released the guidelines for universities to improve the program quality by focusing on five clusters of learning outcomes, namely: i) Knowledge and understanding, ii) Cognitive skills, iii) Functional work skills, iv) Personal and entrepreneurial skills, and v) Ethics and professionalism. For the third cluster, functional work skills have six focus areas, which are: a) Practical skills, b) Interpersonal skills, c) Communication skills, d) Digital skills, e) Numeracy skills, and f) Leadership, autonomy, and responsibility. With regards to this study, digital skills are important for a student in pursuing higher education or advanced skill training as technology usage in learning has been diffused in the daily living of the students. However, the implementation of digital skills in universities, especially in nursing faculties in Malaysia, is yet to be emphasised. Therefore, the production of online or mobile learning content would be beneficial in enriching the educational outcomes of the programs.

1.4.4 Self-Directed Learning in Kulliyyah of Nursing

Kulliyyah of Nursing is one of 10 faculties in the International Islamic University of Malaysia (IIUM). Located on the eastern coast of the peninsula of Malaysia, Kulliyyah of Nursing has been offering Bachelor of Nursing programme since 2004 and currently is managing more than 300 students for the undergraduate programme. This faculty primarily received the admission of their first batch of undergraduate students in 2004, which practises the mixture of conventional and modern teaching and learning approaches in their curriculum. The nursing students mostly accommodate themselves for learning primarily through classroom lectures, clinical skills hands-on in the clinical skill centre, problem-based learning, and other self-directed learning strategies.

The Bachelor of nursing program in Kulliyyah of Nursing is accredited by the Malaysia Qualification Agency (MQA). Students' achievements are measured through their attainment of the learning outcomes of the program and its courses. These learning outcomes are statements on what students should know, understand, and perform upon completing their program. MQA (2019) expects students to be able to finish the curriculum with:

1) Utilising facts to describe and discuss concepts, principles, and processes in a specific field of study.
2) Applying fundamental principles in the field of study to identify and solve problems.
3) Conducting academic activities such as collect, analyse, organise, and process data/information to make conclusions individually or in groups.
4) Communicating effectively orally and in writing.
5) Utilising basic digital technology applications to seek and process data related to a specific field of study.
6) Searching, interpreting, and using relevant information to pursue lifelong learning independently.

Student learning time is also designed to emphasise the need for face-to-face learning and independent learning time. If the educator has to offer the subject material directly to the student in a face-to-face learning approach, self-directed learning (such as problem-based learning and self-practice) would become less reliant as the load of learning responsibility is on the shoulder of the students.

As stipulated in the standard operating procedure by NBM, for every unit of credit hour assigned in a lecture or clinical practice in the skill laboratory, one to two units of credit hour must be allocated for independent learning time as well. The table below shows a complete guideline for independent learning time allocation provided by the NBM:

Table 2 Guideline for independent learning time allocation prepared by (Malaysian Nursing Board / Malaysian Midwives Board, 2018b)

Components	Lecture/ Clinical	Independent Learning Time (ILT)
Lectures (L)	1 hour	1-2 hours
Tutorial (T)	1 hour	1-2 hours
Skill Laboratory	1 hour	1-2 hours
Nursing practicum	7 hours	1 hour
Presentation	1 hour	3-4 hours
Coursework/Assignment	2000 words	10-12 hours
Examination	3 hours	10-20 hours

Since the earlier establishment of the faculty, self-directed learning activities have been implemented in the curriculum; a method that prepares students to study independently. The implementation has contributed great assistance to the students in theory and practice learning. In theory learning, problem-based learning (PBL) is a popular method where students work in groups and discuss cases or scenarios brought to them. The students may determine their learning objectives, then independently engage in self-directed activities to acquire necessary knowledge (Wood, 2003). In the Kulliyyah of Nursing, PBL is one of the important components of learning activities. Besides PBL, collaborative learning is another SDL approach that has been implemented routinely in the teaching-learning session. It was found to be useful for improving nursing students' knowledge and skill performance, together with enhancing student group skill and learning behaviours (Zhang & Cui, 2018). In the Kulliyyah of Nursing, collaborative learning approaches include group learning. This approach helps the group members achieve deep learning by tutoring, assessment and correction with group members in a continuous learning process (Zhang & Cui, 2018). In addition, the SDL of theory learning in the Kulliyyah of Nursing is facilitated by e-learning, where students learn in part or entirely over the Internet (Means et al., 2010). The university has established a web-based platform named *i-Ma'alum* Student Portal (International Islamic University Malaysia, 2021) where online notes, assignments, consultation and appointments can be handled individually by the students through a website. In parallel,

using online teleconference services such as *Zoom* and *Google Meet* is useful for conducting online teaching, complementing the face-to-face learning approach through its powerful engagement features that connect students with the program.

Meanwhile, the students are also emphasised on practice-based learning explicitly designed to improve the students' clinical skill learning. The nursing students are provided with the simulated ward where they can train their skills in an environment that closely resembles the real ward environment. Besides providing a clinical environment, the use of simulation is also imperative as learning pedagogy provides students with clinical opportunities through various real-life situations. There are several types of simulation provided in the Kulliyyah of Nursing, from low to high levels of fidelity. The low fidelity simulation helps in mastering individual tasks and smaller key concepts; therefore, the use of the plastic type of mannequin, for example, plastic arm for wound dressing, is quite popular for nursing education. Meanwhile, the high-fidelity simulation emphasises realistic situations; therefore, high-fidelity mannequins such as iSTAN ® are utilised. However, a study by mannequins such as iSTAN ® are utilized. However, a study by Ahmad (2018) addressed that the use of high-fidelity simulation in Malaysian universities encountered several challenges, such as inadequate training, lack of resources, and lack of prior planning, which have negatively influenced the intention to use the technology.

The Kulliyyah of Nursing is motivated for individual learning of clinical skill; therefore, they seriously introduced the implementation of a logbook system, namely Clinical Performance Enhancement Program (CLEP), to keep track of the activities of the students in practising clinical skill procedures (such as the frequency of attendance at the clinical skill centre and the number of procedure attempts made). The faculty has allocated one to two hours of independent learning time for every one credit hour of skill laboratory sessions. It is mandatory for a student to own this logbook, by which the content of the book includes the overview of the program goal, the list of subjects categorised by semester, and the instructor’s verification table where the students must get their instructor’s signature to mark the completion of the procedure. The logbook is held in the clinical skill centre and is available for the students if they attend the clinical skill centre. The students have to document the name of the procedure and receive verification from the clinical instructors to use the logbook. This logbook, however,

does not provide the students with any formative evaluation load in the student assessment.

Besides, a clinical instructor, who is a licensed nurse assigned by the nursing faculty to help nursing students achieve their learning outcomes, is responsible for planning and conducting instruction as well as evaluating students' performance. They are also assigned to promote independent learning in the acquisition of clinical skills by providing input and encouragement, as well as tracking the improvement of skills of the students in the clinical skill centre. Therefore, clinical instructors are important personnel who help the development of self-directed learning among students.

According to Mohd Said et al. (2009), it is part of the university's concern to provide a positive learning atmosphere for good learning opportunities. Kulliyyah of Nursing paid great attention to managing its resources, such as structuring lecturers, clinical teachers, and facilities to cater to a larger number of students, in addition to providing physical structures and facilities. The administrative staff, therefore, dealt with the excellent job of providing each stakeholder with the optimal scheduling options to work at their best level.

Since the Kulliyyah of Nursing has gone through over 15 years of experience in the healthcare industry generating nurses, the faculty needs to plan for the industrial revolution 4.0 (IR4.0). Every aspect of the learning component that takes place in this era will constantly generate broad and varied data, further urging the research process to produce useful information for relevant stakeholders. Malaysia's Ministry of Education presented that IR4.0 will take the education industry from 'teacher as facilitator' to 'learners as connectors, creators and constructivists' through the conversion of the idea of 'teacher as facilitator.' The university should therefore be empowered with character building, higher-order thinking, soft skills, and lifelong learning to overcome the challenges of IR4.0. Therefore, this study discusses one of Malaysia's enabling environments for the Fourth Industrial Revolution (MyHE4.0), which is mobile computing.

The year 2020 has changed the way people live and work as a result of the Covid-19 pandemic. The government of Malaysia has repeatedly encouraged the people to adapt to new norms in daily living such as wearing face masks in public areas,

keeping out the distance from each other, and sanitising hands as an effort to fight the infection rate in the community. In the education sector, face-to-face and practice-based learning sessions with the students are not encouraged as the classroom and clinical skill centre are not resourceful and it is risky to allocate a bigger number of students at one time. The congested area will likely spread the infection easily. Therefore, the lecture session needs to be changed to an online session, while the practice-based session of nursing students in the clinical skill centre needs to be minimised. However, when only a limited number of students are allowed to utilise the skill centre, most of the students are not having opportunities to practice individually. This can create a major concern on the students' competency in the future, especially on the assessment of their skill performance. Therefore, having a technology system that can keep track of the students' activities on their clinical skill activities while they are away from the faculty area will help the faculty members to explore the level of understanding of the practice. Further, it helps the faculty members to plan an improved learning approach based on the problems they are facing.

1.5 THEORETICAL UNDERPINNINGS

1.5.1 Developmental Ecology Theory

An individual's behaviour is integrated into a dynamic network of intrapersonal characteristics, interpersonal processes, institutional factors, community features and public policy. Interactions between individuals and their environment are believed to be reciprocal, implying that a person is influenced by his or her environment and that the environment influences the individual. It is also assumed that the environment consists of several overlapping stages (Renn & Arnold, 2003).

The first ring known as the 'microsystem' reflects intrapersonal relationships played out regularly with particular players (such as families, colleagues, peer groups). The outer ring 'macrosystem' represents social forces such as culture and social norms, but also includes the patterns shaped by economics, politics, and philosophy at the national and international levels. In comparison to the socio-ecological model, which is an approach commonly used for developing health promotion interventions (Mcleroy

et al., 1988), the innermost section is labelled as an individual or intrapersonal level surrounded by interpersonal, organisational, community, and public policy factors.

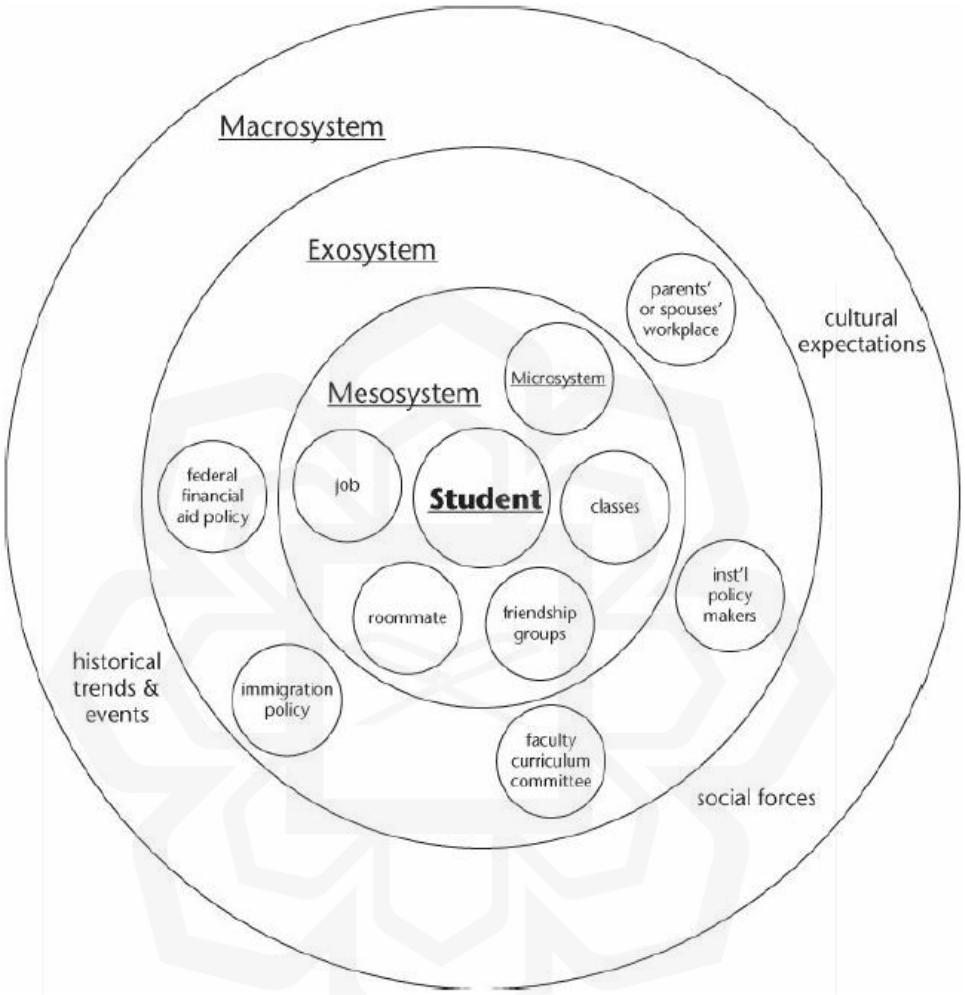


Figure 1 An example of the context of college student development by Renn & Arnold (2003)

The ecological model is popular because it goes beyond just individual influences on behaviour and considers an assortment of environmental factors that can also affect behaviour (Figure 1). At the intrapersonal level, the aim is to change individuals' knowledge, beliefs and skills. At the intrapersonal level, the aim is to change individuals' knowledge, beliefs and skills (Mcleroy et al., 1988). It is where new knowledge is internalised, absorbed, and continues at a metacognitive level. In contrast, since nursing students deal with faculty, campus and dormitory as their environment for

self-directed learning, interpersonal and institutional levels are designed to communicate with the social network and social support system besides creating change in social relations and organisational environments (Golden & Earp, 2012; Mcleroy et al., 1988). According to Mahn et al. (2012) who worked on Vygotsky's sociocultural theory, it was suggested that interpersonal learning is where new mental processes first exist in shared contexts before they are internalised, while learners are active and interactive agents in their learning. Since students are often affected by other individuals, environments, and resources, it is considered appropriate to use the student developmental ecology theory to study environmental factors of SDL of clinical skills among undergraduate nursing students.

1.5.2 Unified Theory of Acceptance and Use of Technology 2

Professor Venkatesh is recognized for his work on technology acceptance theory and has been recognized for developing an instrument that can help to understand the individual acceptance and use of technology. Theory of reasoned action (TRA) and theory of planned behaviour (TPB) are among early theories that study human behaviour. The Theory of Reasoned Action (TRA) is "one of the most fundamental and influential theories of human behaviour" (Venkatesh et al., 2003). TRA was developed on the assumption that people are characteristically rational and make logical use of the information at their disposal (Ajzen & Fishbein, 1980). Attitude and subjective norms have been used to identify behavioural intentions, which measure the relative influence of a person on behaviour. Meanwhile, Planned Behaviour Theory (TPB) (Ajzen, 1991), was used to determine user acceptance of innovations by considering core beliefs about behavioural beliefs, normative beliefs, and control beliefs. TPBs include more variables than may be important in most IT systems technology implementations (Taylor & Todd, 1995), and can therefore be used to study broader acceptance situations.

Technology Acceptance Model has been adapted from the TRA, accentuating the perception that the technology will help users improve performance (perceived usefulness) and the perception that the technology used is effortless (perceived ease of use). The advantage of TAM is that it is specifically designed to address the acceptance of information system technology, although Mathieson (1991) believed that the

framework lacks an external control factor and further prevented the adoption of specific information system technology. Therefore, the external factors such as subjective norm, voluntariness, job relevance, output quality, and result demonstrability (Mathieson, 1991, p.87), were used to extend the model (TAM2).

As a result of an analysis of the literature on technology acceptance, the researchers indicated that additional factors need to be included which were not included in the original TAM models. The effort to extend TAM ended with the finding that it was only able to predict the success of the adoption to only 30% of the cases (D. R. Compeau & Meister, 2002). Eventually, the effort to incorporate both human and social variables led to the development of the Unified Theory of Acceptance and Use of Technology model (refer Figure 2).

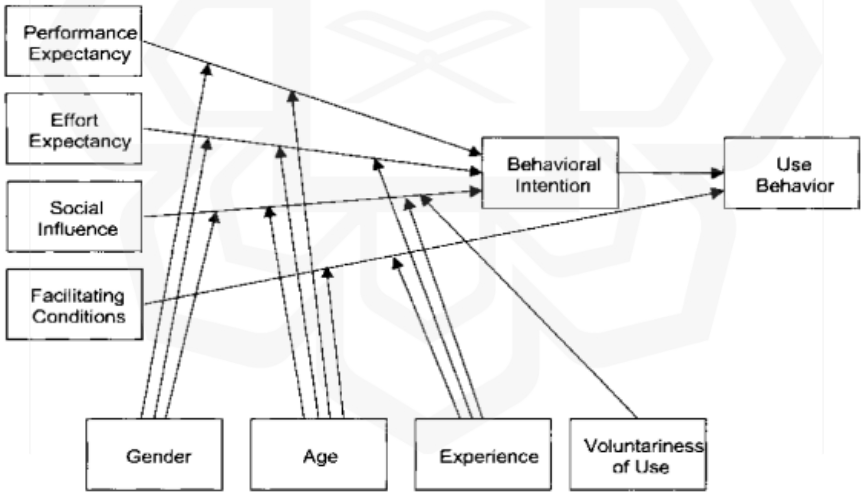


Figure 2 The unified theory of acceptance and use of technology based on Venkatesh et al. (2003)

The UTAUT model identifies key factors in the acceptance of ICT as measured by the behavioural intention to use technology and actual use. The combination of constructs and moderating factors increased predictive efficiency to 70%, a significant improvement over previous TAM model rates. The four determining constructs are

performance expectations, effort expectations, social influence and facilitating conditions that directly determine the use and intent of behaviour. Meanwhile, the four mediating variables in the framework are gender, age, experience, and voluntary use, which are important to mediate their impact on the individual's intended use and behaviour (Venkatesh et al., 2003).

This unified view of multitude acceptance models integrates eight leading theories from social psychology theories and sociology. The eight models reviewed by Venkatesh are the theory of reasoned action (TRA), the technology acceptance model (TAM), the motivational model (MM), the theory of planned behaviour (TPB), a model combining the technology acceptance model and the theory of planned behaviour (C TAM-TPB), the model of PC utilization (MPCU), the innovation diffusion theory (IDT), and the social cognitive theory (SCT) (see Table 3).

The constructs pertaining to performance expectancy are perceived usefulness (TAM, and combined TAM-TPB), extrinsic motivation (MM), job-fit (MPCU), relative advantage (DOI), and outcome expectancy (SCT). Respectively, this construct is referring to the beliefs that: 1) using a particular system would enhance his or her job performance., 2) the enthusiasm to carry out a given activity with reinforcement values of outcomes, 3) capabilities of a system enhance an individual's job performance, 4) using an innovation is perceived as being better than using its precursor, and 5) performance expectations deal with job related outcomes.

Effort expectancy is drawn upon three known constructs which are perceived ease of use (TAM), complexity (MPCU) and ease of use (IDT). These constructs represent, respectively as: 1) a person's belief that using a system would be free of effort, 2) the system is perceived as relatively difficult to understand and use, and 3)

using an innovation is perceived as being difficult to use.

Social influence is another construct of UTAUT, referring to subjective norms (TRA, TAM2, TPB and C-TAM-TPB), social factors (MPCU) and image (IDT). Social influence is depicted, in respect to each construct as: 1) a person's perception that most people who are important to him think he should or should not perform the behaviour in question, 2) a person's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific

social situations, and 3) the degree to which use of an innovation is perceived to enhance one's image or status in one's social system.

Facilitating conditions are embodied from three different constructs which are perceived behavioural control (TPB, C-TAM-TPB), facilitating conditions (MPCU), and compatibility (IDT). This construct is the reflection of 1) perceptions of internal and external constraints on behaviour and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions, 2) objective factors in the environment that observers agree make an act easy to do, including the provision of computer support, and 3) the degree to which an innovation is perceived as being consistent with existing values, needs, and experiences of potential adopters.

TRA, TPB, TAM and C TRA-TPB have been important to the development of UTAUT construct as discussed above, that support multiple avenues of perceived usefulness (PE), perceived ease of use (EE), subjective norms (SI), and perceived behavioural control (FC). The other models that have not yet been mentioned that contribute to the construct of UTAUT are the motivational model (MM), the model of PC utilization (MPCU), the innovation diffusion theory (IDT), and the social cognitive theory (SCT).

Model of PC utilization (MPCU) is a theory that predicts PC utilization. Thompson (1991) mentioned "Behaviour is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have usually done (habits), and by the expected consequences of their behaviour." There are six determinants to technology acceptance in this model which are job fit, complexity, long-term consequences, affect toward use, the social factor, and the facilitating conditions. In UTAUT, MPCU contributes for all main constructs such as job-fit (PE), complexity (EE), social factor (SI) and facilitating conditions (FC).

Table 3 Definitions and origin for the four constructs (Venkatesh et al. 2003)

Construct	Definition	Origin
Performance expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in performance.	- Perceived Usefulness from TAM and C-TAM-TPB - Extrinsic Motivation from MM - Job-fit from MPCU - Relative Advantage from IDT - Outcome Expectations from SCT
Effort expectancy	The degree of ease associated with the use of the system	- Perceived ease of use from TAM, Complexity from MPCU - Ease of Use from IDT
Social influence	The degree to which an individual perceived that important other believe he or she should use the new system	- Subjective Norm in TRA, TAM2, TPB and C-TAM-TPB - Social Factors in MPCU - Image in IDT
Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.	- Perceived behavioural control from TPB, C-TAM-TPB - Facilitating Conditions from MPCU, - Compatibility from IDT

The IDT model, one of the earliest theories to explore factors that may influence an individual to adopt an innovation or a new technology, consists of relative advantages, ease of use, compatibility, complexity, observability, result demonstrability, trialability and voluntariness of use. It was designed to understand how the process of uncertainty reduction of new technology works, as individuals are used to synthesize information gathered about using the technology. Relative advantage (PE), ease of use (EE), image (SI) and compatibility (FC) are the constructs that are important for the development of UTAUT.

Social Cognitive Theory (SCT) was introduced by Bandura (1986), with notions that learning may occur in a social context with a dynamic and reciprocal interaction of

the personal factors, environmental factors, and behaviours. It posits that user acquire and maintain behaviour while considering the social environment in which they develop the behaviour. It gives prominence to the concept of self-efficacy (D. Compeau et al., 1999). Therefore, 'outcome expectation' of SCT is used for the development of PE construct.

As increasingly technologies applied to individual use settings, UTAUT was tailored to the user context by adding in three additional constructs: hedonic motivation (HM), price value (PV), and habit (HT) (Venkatesh, 2012) or namely as UTAUT2 (refer Figure 3). Many constructs have been identified related to HM, such as enjoyment and perceived enjoyment, it has shown a progressively important influence in technology use. In addition, HM will complement UTAUT's strongest predictor that emphasizes utility, as a result of users' consumers' innovativeness, novelty seeking, and perceptions of novelty of a target technology. Innovativeness is "the degree to which an individual is receptive to new ideas and makes innovation decisions independently" (Midgley & Dowling, 1978). Novelty seeking is the tendency of an individual to seek out novel information or stimuli (Hirschman, 1980). When consumers begin to use a particular technology, they will pay more attention to its novelty (such as the new interface and functionality of the iPhone). As experience increases, the attractiveness of the novelty that contributes to the effect of hedonic motivation on technology use will diminish and consumers will use the technology for more pragmatic purposes, such as gains in efficiency or effectiveness.

Price value is introduced on the stance of a consumer use setting, which is different from organizational use setting, usually bearing the monetary cost of the users, therefore it may have a significant impact on technology usage (Venkatesh, 2012). The price value is positive when the benefits of using a technology are perceived to be greater than the monetary cost and such price value has a positive impact on intention.

Habit has been defined as the extent to which people tend to perform behaviours automatically because of learning (Venkatesh, 2012). This has something to do with practice in the way that habit grows through continuous use and the passage of time after its first use. However, different habits develop with the passage of time and different rates of use.

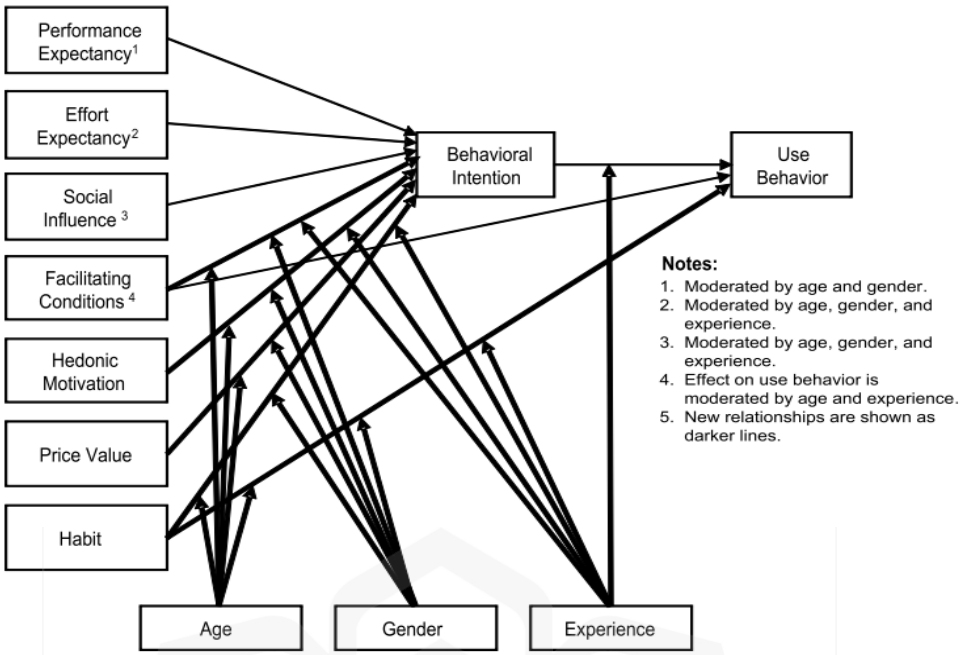


Figure 3 The Unified Theory of Acceptance And Use Of Technology 2 based on Venkatesh et al. (2012)

1.6 CONCEPTUAL FRAMEWORK

This study utilized the Unified Theory of Acceptance and Use of Technology 2 (UTAUT) as basic structure to understand the phenomenon of study to examine the perceived acceptance of nursing students in using smartphone application for self-directed learning of clinical skills. Figure 4 below is the conceptual framework used in this study.

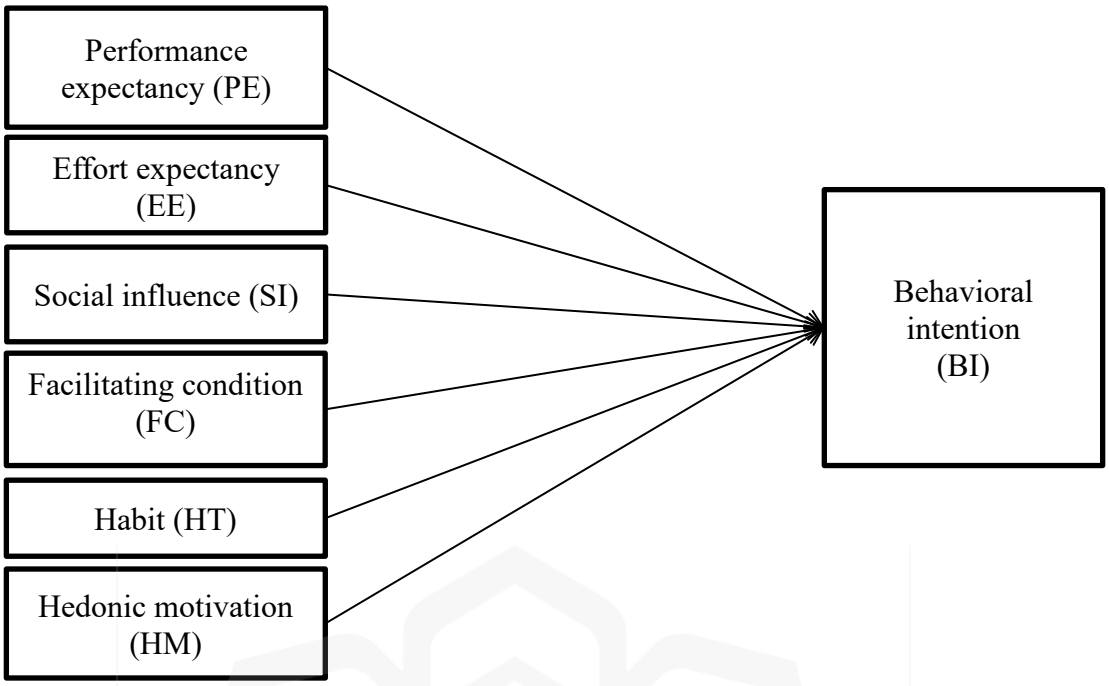


Figure 4 Conceptual framework

1.7 PROBLEM STATEMENT

Nursing graduates are seemed as academically equipped when they enter the clinical setting but lacks the ability to apply their knowledge to practice. Malaysia faces the decline in quality nursing graduates which can be evidenced by the rate of unemployment increasing as reported by (Arumugam et al., 2014; Barnett et al., 2010; Tan et al., 2018). Students' interest and achievement in nursing education in Malaysia were debatable, as this issue might be resulted from curriculum complexities which is less focusing on outcome-based education (Tan et al., 2018) and lack of emphasis on clinical environment that play a vital role in preparing the student as close as to real clinical area (Mohd Said et al., 2009). Both curriculum reform and the clinical environment are equally important in preparing nursing students with a learner-centred approach to education. Because nursing students experience difficulties in new and unpredictable clinical situations, efficiency in nursing education has been promoted by the advancement of the technology, thus a variety of nursing practice contents have been developed to help independent learning of students. However, systematic reviews of technology-enhanced learning for clinical nursing skills have shown inconsistent findings on knowledge and skills (Lahti et al., 2014). Besides, another systematic review on the incorporation of mobile technologies into teaching and learning strategies

in nursing education also did not provide consistent results on the improvement of knowledge and clinical skills of nursing students (H. Lee et al., 2018). The study that oversees the socioecological challenges of nursing students on clinical skill learning is still limited, thus the input used to integrate technologies features and function with students' learning behaviours may be limited too. An investigation on perceived acceptance on using technology, especially smartphone application on self-directed learning of clinical skills will facilitate the enhancement of mobile learning intervention especially on knowledge and practice of nursing students.

1.8 RESEARCH QUESTIONS

The following are the five research questions investigated in the study (labelled as RQ1a, RQ1b, RQ2, RQ3 and RQ4):

RQ1a: What are the challenges on the current implementation of self-directed learning of clinical skills among undergraduate nursing students?

RQ1b: What are the perceptions on using a smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ2: What are the significant predictors on perceived behavioural intention to use smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ3: What are the relevant features of a smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ4: What are the factors influencing usability and perception on using smartphone application prototype to facilitate self-directed learning of clinical skills among undergraduate nursing students?

1.9 RESEARCH OBJECTIVES

This study uses exploratory sequential mixed-method design with the main aim of identifying factors that influence the behavioural intention, developing a smartphone application, and evaluate its usability in facilitating self-directed learning of clinical skills among undergraduate nursing students. Accordingly, the specific objectives of the study are as below:

1) Research Objective 1 (**RO1**):

To explore the challenges of current implementation of self-directed learning of clinical skills and the perception of using smartphone application in facilitating self-directed learning of clinical skill:

i. Specific Research Objective 1a (**RO1a**)

To explore the challenges of current implementation of self-directed learning of clinical skills experienced by undergraduate nursing students.

ii. Specific Research Objective 1b (**RO1b**):

To explore the perception of using smartphone application in facilitating self-directed learning of clinical skill

2) Research Objective 2 (**RO2**):

To identify the significant predictors for perceived behavioural intention to use smartphone application in facilitating self-directed learning of clinical skills among undergraduate nursing students.

3) Research Objective 3 (**RO3**):

To identify relevant features and develop a smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

i. Specific Research Objective 3a (**RO3a**):

To identify relevant features of a smartphone application that facilitate self-directed learning of clinical skills for undergraduate nursing students.

ii. Specific Research Objective 3b (**RO3b**):

To develop a smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

4) Research Objective 4 (**RO4**):

To evaluate the usability and perception of using smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

i. Specific Research Objective 4a (**RO4a**):

To evaluate the usability of a smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

ii. Specific Research Objective 4b (**RO4b**):

To identify the perception of using smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

1.10 SIGNIFICANCE OF STUDY

The researcher has a key interest in exploring the potential of using information communication and technology to make the quality of graduates of the nursing program a step forward. Extensive research has been carried out on the benefits of mobile devices for students learning, but studies on adoption of a smartphone application and implementation for clinical learning are still limited. Likewise, there is still a lack of

effort to identify the types of challenges nursing students have and how mobile learning can address these challenges. First, by exploring this area in depth, the researcher could understand the challenges on the current implementation of self-directed learning of clinical skills among undergraduate nursing students. It is important for researchers to pay close attention to the needs of undergraduate nursing students to prepare them to become independent learners.

Second, the conduct of this study can assist academicians in planning for the implementation of curriculum and preparation of teaching methods. By identifying the most influential factors in a student's use of a smartphone application for self-directed learning, the nurse academicians can provide a guideline which is best for teaching and learning.

Third, the researcher also implied the need of designing element in developing the prototype of the smartphone application in this study. The prototype is exceptional in this study because it is personalized according to the curriculum and tailored to the problems and needs of the students, which would make it distinct with the other kinds of applications which are available.

1.11 OPERATIONAL DEFINITION

It is important to understand some important terminologies and variables used in this study, which indicate how their interconnection are described, the following definitions are used:

- **Self-directed learning** from the definition provided by Hiemstra (1994) was adopted as follows:
    - individual learners can become empowered to take increasingly more responsibility for various decisions associated with the learning endeavour;
    - self-direction is best viewed as a continuum or characteristic that exists to some degree in every person and learning situation;
    - self-direction does not necessarily mean that all learning will take place in isolation from others;

- self-directed learners appear able to transfer learning in terms of knowledge and study skill, from one situation to another;
- self-directed study can involve various activities and resources, such as self-guided reading, participation in study groups, internships, electronic dialogues, and reflective writing activities;
- effective roles for teachers in self-directed learning are possible, such as dialogue with learners, securing resources, evaluating outcomes, and promoting critical thinking.

- **Clinical skill:** A set of knowledge and practices which aim to develop the competences necessary for professional practice.
- **Mobile learning:** Also known as M-learning, is a new way to access learning content using mobile devices.
- **Smartphone application:** A type of application software designed to run on a mobile device, such as a smartphone or tablet computer.
- **Usability evaluation:** It refers to how well users can learn and use a product to achieve their goals.
- **Undergraduate nursing student:** a person who is enrolled in bachelor's degree in nursing from an accredited school of nursing.
- **Technology acceptance:** A person's acceptance of a technology.
- **Performance expectancy:** The degree to which an individual believes that using the system will help him or her to attain gains in performance.
- **Effort expectancy**: The degree of ease associated with the use of the system
- **Social influence:** The degree to which an individual perceived that important other believe he or she should use the new system
- **Facilitating conditions:** The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.
- **Habit:** The extent to which people tend to perform behaviours automatically.
- **Hedonic Motivation:** The fun or pleasure derived from using a technology.

1.12 ORGANIZATION OF THESIS

The study consists of eight chapters as follows:

1) Chapter 1 provides an overview of the study, including the background to the study, an introduction to self-directed learning, mobile learning, clinical skills, and nursing education in the context of Malaysia, research objectives, research issues and the relevance of the study.
2) Chapter 2 contains the findings of the literature review in the areas of: 1) the smartphone technology in nursing education; 2) the developmental ecology factors of self-directed learning of clinical skill; and 3) the Unified Technology Acceptance and Use Theory 2 (UTAUT2) in education.
3) Chapter 3 describes the methodology utilized by the researcher in answering the research questions. It outlines the principle underpinning the research method such as research design, justification, and philosophical underpinning and the research setting. In addition, by highlighting the strengths of the use of approaches and methods, this chapter justifies the research method chosen.
4) Chapter 4 presents an initial study on the exploration of current challenges with SDL of clinical skills among undergraduate nursing students. Then, the research continues to explore what the behavioural intention of nursing students is to use the smartphone application for self-directed learning of clinical skill.
5) Chapter 5 is designed to generate and test a survey tool by adopting the instrument from Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), and then to identify the most important factors affecting the behavioural intention of undergraduate nursing students to use the smartphone application that facilitate self-directed learning of clinical skills.
6) Chapter 6 presents work on the identification of relevant features for smartphone applications and the development of a smartphone application prototype to facilitate self-directed learning of clinical skills for undergraduate nursing students.

7) Chapter 7 works on the evaluation on usability and the perception of using smartphone application prototype that facilitates self-directed learning of clinical skills for undergraduate nursing students.

8) Chapter 8 concludes this thesis by highlighting the integration of findings, summary of thesis, contributions, and implications as well as potential future works in the area.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents a review of the published literature to make it easier to understand the phenomenon of research interest and to identify emerging issues or problems that motivate the production of this thesis. There are few key research topics addressed by the researcher, these include: 1) smartphone technology in nursing education, 2) the ecology factors of self-directed learning of clinical skill, and 3) the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) in education.

At the beginning of this chapter, the researcher reviewed articles on smartphone technology in nursing education. The researcher analysed the state-of-the-art smartphone technology and the features of the smartphone application that could contribute to the success and failure of the study. The researcher suggested several ideas that need to be focused on further exploration in relation to smartphone technology and self-direction in nursing education.

The researcher then explained how the student developmental ecology model may contribute to identifying the motivating and challenging factors, such as how it impacts personal, interpersonal, and organizational factors. In this line of thinking, the researcher relates these views to self-directed learning. Finally, the researcher extended the review work by exploring the types of predictors that contribute or do not contribute to the behavioural intention of using the smartphone application in nursing education. The researcher makes use of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as research framework.

2.2 MOBILE-BASED INTERVENTIONS OF CLINICAL SKILLS LEARNING

2.2.1 Introduction

Previous studies have discussed in depth the types of concerns that are becoming central to the use of mobile devices in nursing education that make it difficult to adopt mobile

learning (Doyle et al., 2014; George et al., 2017; O'Connor & Andrews, 2015; Phillippi & Wyatt, 2011; Raman, 2015; Strandell-laine et al., 2014). However, given the promising and well-recognized benefits of mobile learning, further exploration of its potential uses is considered beneficial (Airth-kindree & Vandenbark, 2014; Beauregard et al., 2017; Doyle et al., 2014; George et al., 2017; Hay et al., 2017; O'Connor & Andrews, 2015; Phillippi & Wyatt, 2011; Raman, 2015; Strandell-laine et al., 2014). Hay et al. (2017) and Mosa et al. (2012) argued that the number of health professionals using mobile technology in clinical settings continues to increase, so that the use of smartphone technology among academics and students for effective learning intervention in clinical learning can potentially increase as well.

Narrative Approach to the Review

A narrative review was undertaken to integrate the multitude of credible evidence that has been reported on the experience of undergraduate nursing students in learning using mobile technology. Even though it was known narrative review as non-systematic review, however recent studies have increased its quality by borrowing the systematic review methodologies that are intended at reducing bias in the selection of articles for review and employing an effective bibliographic research strategy (Ferrari, 2015).

Narrative review may offer a major advantage to the researcher in providing a broader view of the phenomenon while systematically addressing the most recent and best available evidence to be used as a comparison of the narrow-focused approach of systematic review. This approach will therefore provide an understanding of the current lack of knowledge of the phenomenon and be a rationale for future research. For this study, a narrative review was considered appropriate for understanding the experiences and issues related to the use of mobile technology to improve SDL of clinical skills. In addition, the review provides an insight into the current learning trend of using mobile technology in nursing education. As a novice researcher, a systematic approach to narrative review was used to ensure the structure and consistency of the review process.

2.2.2 Aim of the Literature Review

Mobile learning environment enables students to control the pace of their learning and to develop advanced cognitive behaviours (Gokcearslan, 2017; Sha et al., 2012). Recently published systematic review studies, critically assess the literature on the implementation of mobile technology in undergraduate nursing education, used to summarize without highlighting the features and elements of mobile technology that have led to the success and failure of intervention (Lee et al., 2018). Without understanding the features used for interventions in a holistic way, one will not be able to understand the technological reasons behind the effectiveness of a mobile approach to learning. A review of the effectiveness of mobile learning intervention in nursing education is therefore needed, in particular to understand the features and elements of mobile technology that have led to the success and failure of interventions.

Review Questions

This review aims to answer the following questions:

i. What are the outcomes of implementing mobile technology for nursing education?

ii. What are the features that leading to the successful or failures of mobile learning in nursing education?

Review Methods

The review of the literature was conducted through the following stages:

- *Search Strategy*
- *Search Results*
- *Data management and data extraction*
- *Description of identified studies*

2.2.3 Search Strategy

The researcher started the search with four primary online databases: Ovid, Scopus, CINAHL and ProQuest. To ensure that a wide range of research was captured, the search was extended to other types of electronic databases relevant to the field of mobile technology in nursing education. Other approaches have been used to evaluate and retrieve literature that includes Google Scholar, as some of the relevant articles have not only been found in one database. In addition, the databases also provide many articles on mobile technology in other fields of study, such as medicine, pharmacy, education and engineering. Citation tracking and review of the reference lists were also carried out in the search for additional documents.

A combination of keywords for 'undergraduate nursing students' and 'mobile technology' has been used in the Ovid, Scopus, CINAHL and ProQuest academic search engines.

Inclusion criteria

The inclusion criteria were applied to narrow down the search and ensure its relevance with the aims of fulfilling the needs of review questions. The key screening of eligible articles included reviewing titles and abstracts to identify articles that have the following inclusion characteristics:

- The literature was published between 1st January 2013 until 31st December 2018 to ensure the broad range of mobile technology use in nursing education, but recent and up to date enough to illustrate what is already known about the topic.
- The papers related to the use of mobile devices such as smartphones and tablets as a learning tool in nursing education.
- The articles that are written in English language were taken in this study because it is comprehensible by the researcher and participants.
- The articles that include undergraduate nursing students only.
- The studies that conducted the actual observation or experiments among undergraduate nursing students utilizing mobile technology as learning intervention tools in their nursing studies were included.

Exclusion criteria

- The articles published in 2012 or earlier.
- The papers that related to the use of other types of electronic devices such as laptop and personal computer as a learning tool.
- The studies involve other than undergraduate nursing students such as master bachelor and doctorate.
- The articles that include opinion, abstract paper, or dissertation.

The main aim of the literature was to investigate the use of mobile technology in nursing education. Based on the literature search questions, the terms used in the search are "mobile," "smartphone," "device," "handheld," "handset," "smartphone," "PDA" and "tablet." These have been linked together to identify relevant articles on current practices for the implementation of mobile learning technologies, as well as the features used in mobile interventions as a training method or tools. The term "undergraduate" is also similar with the term "baccalaureate," "student" and "bachelor," which have been combined with "nursing" to fine the search that only targeted undergraduate nursing students. These terms were then added to the first keywords to ensure that all studies related to mobile learning among undergraduate nursing students were included.

2.2.4 Search Results

The PRISMA flow diagram for the identification of relevant studies is used in this study, as shown in Figure 5. The search identified a total of 504 potentially relevant articles from four electronic databases. Removal of duplicate studies was undertaken with the removal of 448 articles. A total of 56 titles and abstracts were reviewed; irrelevant abstracts or no full text resulted in the removal of 44 relevant articles and full texts. In filtering the literature, it is important for the researcher to be selective in choice and judgment when selecting and evaluating the research. Out of this total screening for inclusion and exclusion criteria, a total of 12 articles were retrieved for further review. Four articles have been identified from the reference lists of the relevant articles, while

four other irrelevant articles have been excluded. After the review of the 12 articles, they were all identified for assessment.

A few reviews have been identified through a literature search that has proved to be very helpful in providing background information on previous literature on the use of mobile technology in nursing education. All papers shall be published in international journals. Table 4 below shows the search steps, the keywords used, and the findings derived from each search.

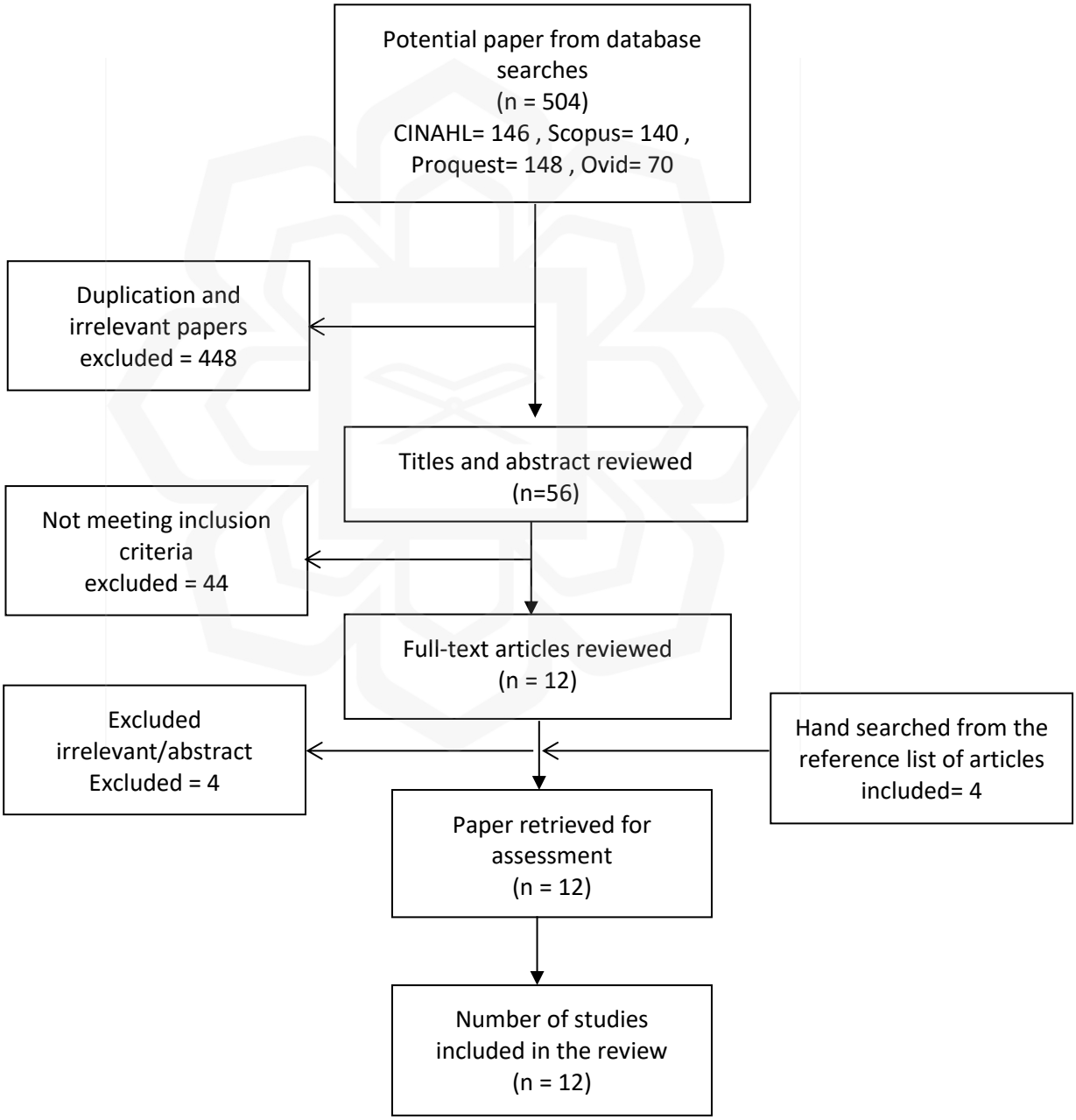


Figure 5 Flow diagram of the retrieval process of the review study

Table 4 Search strategies and findings of the review

Databases	Keywords used	Number of papers retrieved
CINAHL	**Nursing Undergraduate Baccalaureate Student Bachelor OR Mobile Device Handheld Handset Smartphone PDA Tablet OR **learning manage* assess* test* regulat* assess* direct* monitoring aware* judgment reaction evaluat* observ* reflect* OR AND	146
SCOPUS		140
OVID		70
PROQUEST		148
TOTAL		504

2.2.5 Data management and data extraction

The Mendeley bibliographic software package was used to manage academic journals for references. This has helped the researcher to facilitate the import of references from research studies obtained during the search process. The assessment of the selected papers was assessed individually by comparing the objective, objective, data collection

and data analysis method, the study participant, the methodology, the summary of the findings of the study and the implications of the study.

2.2.6 Description of Identified Studies

Country origin

Twelve (12) studies were identified in this review, in which they originated from four different countries. Most of the studies have been conducted in the last seven years (seven out of twelve) which show that there is an increasing interest in learning more about the effectiveness of mobile technology as a tool for learning in nursing education. The studies were mostly conducted in South Korea (8 studies), followed by Taiwan (2 studies) and one in Finland and Brazil (see Table 5).

Studies were initially reviewed by title and then abstract. Although there are many validated tools for assessing the quality of studies, there is a lack of widely accepted criteria for evaluating them as they are designed to evaluate specific study designs. The different quality criteria of the tool are almost the same as the Qualitative Research Checklist developed by the Critical Appraisal Skills Program (CASP, 2018), but this study does not include the score system as suggested by CASP. This tool is used to help the researcher systematically think about these issues.

Table 5 The countries where studies have been conducted

Country	Year	Authors
Brazil	2016	Alvarez et al.
South Korea	2016	Lee et al.
South Korea	2017	Kim et al.
Taiwan	2014	Wu
South Korea	2015	Yoo & Lee
South Korea	2015	Lee
South Korea	2018	Choi et al.
South Korea	2017	Jeong
South Korea	2018	Park & Kim
South Korea	2018	Jeong & Kwon
Taiwan	2018	Chuang et al.
Finland	2018	Strandell-Laine et al.

Details of Study Designs

The choice of research methodology is determined by the type of research questions and the phenomena under investigation (Creswell & Plano Clark, 2011). The best research method is therefore the one that responds most effectively to the research question. Researchers need to be clear about the approach that they intend to use from the outset to enable them to gather the appropriate data according to the method, otherwise the value of the research will be significantly reduced (Patton, 2002). Most of studies identified in this review were randomised, experimental or quasi-experimental. Seven of the twelve reported quasi-experimental pre-post-test study designs were used, while four used randomized controlled trials and one experimental pre-post-test.

Sampling

However, in terms of sample size, there is variation between these studies, with the smallest sample size being 22 participants (Wu, 2014) and the largest being 157 participants (Park & Kim, 2018).

The Types of Interventions

Various mobile technologies have been used in this study, such as mobile applications, smartphone-based video, and mobile web browsers. Seven of the studies have incorporated the use of video in their intervention. Seven studies used mobile intervention compared to conventional or standard intervention, such as lectures and demonstrations. In the meantime, three studies compared the mobile intervention group with other types of interventions such as problem-based learning (PBL), DVD and simulator.

Data collection

Based on Table 6, mobile learning has been recognized as an essential way to enhance learning among nursing students in all settings, such as classroom (Alvarez et al., 2016;

Davies, 2014; S. Kim et al., 2017; T. Wu, 2014), simulated skill laboratory (S. Kim et al., 2017; N. Lee et al., 2016; Yoo & Lee, 2015) and clinical site (Choi et al., 2018; Strandell-Laine et al., 2018). These studies discussed various features used in mobile technology, such as video, mobile apps and social media. In addition, mobile technology can serve a wide range of learning contexts for nursing students, such as health assessment, health education, skills performance and learning motivation.

Instruments Used in the Study

In the synthesis of the effectiveness of mobile technology in nursing education, the technological outcome measures have been impressed by the benefits that it can offer based on user context. Table 7 shows a summary of the skills, knowledge score, confidence and satisfaction levels that vary across the studies. Evaluation of skill performance by assessors using a structured checklist tool or institutional protocol has been reported in several papers (Chuang et al., 2018; H. Jeong & Kwon, 2018; S. Kim et al., 2017; N. Lee et al., 2016; Yoo & Lee, 2015). Knowledge tests were included in studies commonly involving the use of self-developed questions (Alvarez et al., 2016), multiple-choice questions and true-false questions and quizzes (Chuang et al., 2018; S. Kim et al., 2017). In the meantime, to determine the confidence score, the instruments used included five items C-scale (Chuang et al., 2018), action-based score (S. Kim et al., 2017), and surveys such as Instructional Materials Motivation Survey (N. Lee et al., 2016).

2.2.7 The Effect of Mobile-Based Learning

Accessibility and Portability

In this review, nursing students expressed their interest in the portability and accessibility of technology to a wide range of information. Indisputable mobile devices are more accessible than other technology-enhanced learning tools, such as computers (M. K. Lee, 2015). In addition to giving advantages due to its function, such as supporting internet connection, and designed to serve as a dynamic and interactive tool (Alvarez et al., 2016), students also benefit from the fact that it is accessible at anytime

and anywhere, particularly in the clinical context. In addition, Kim et al. (2017) believed that smartphone-based education provided them with an accessible environment for self-examination of their learning, as self-directed learning is refuted as one of the core elements of mobile learning environments (Gokcearslan, 2017; Jung, 2014).

Skill Performance

Six studies have been tested and half of the interventions (H. Jeong & Kwon, 2018; N. Lee et al., 2016; Yoo & Lee, 2015) have shown no significant difference between intervention and control groups. However, a statistically significant difference was found in the remaining three studies (Chuang et al., 2018; H. S. Jeong, 2017; S. Kim et al., 2017).

For instance, Kim et al. (S. Kim et al., 2017) reported statistically higher post-test scores related to performance measurement when providing care for infant airway obstruction between intervention groups using smartphone video demonstration with conventional intervention. There is also a significant difference in the post-test result ($p = 0.019$) between the group using smartphone video recording with the control group in intramuscular injection practice (H. S. Jeong, 2017). Meanwhile, Chuang et al. (Chuang et al., 2018) found that learning with additional smartphone video after demonstration of urinary catheterization is significant compared to the control group using DVD only.

However, in terms of skill performance outcomes, there were no statistically significant changes in students using mobile learning compared to those using the conventional method. In fact, lower skill scores were reported among students in intervention groups using mobile video for practicing urinary catheterization (N. Lee et al., 2016), mobile app for lung and heart assessment (Yoo & Lee, 2015), and social network video for tracheostomy care (H. Jeong & Kwon, 2018).

Cognitive Recall

The results from the reported studies were mixed based on the effect of mobile learning on cognitive recall. Higher knowledge scores on this group were reported in three studies. Higher knowledge scores for this group were reported in three studies (Chuang et al., 2018; T. Wu, 2014; Yoo & Lee, 2015); however, only one (S. Kim et al., 2017) was found not to be significant in knowledge retention after intervention. In the meantime, the post-test score for Alvarez et al. (2016) is significant ($p < 0.0001$) compared to its pre-test after using a virtual learning object when assessing acute pain.

Self-Efficacy and Satisfaction

Learner's self-efficacy with mobile technology in learning was positive in three studies (H. Jeong & Kwon, 2018; M. K. Lee, 2015; N. Lee et al., 2016), but it was not significant in the study conducted by Strandell-Laine et al. (2018). High level of learner satisfaction with mobile technology in learning were reported in two studies (H. S. Jeong, 2017; S. Kim et al., 2017). However, the learner satisfaction was found not significant between intervention and control group in studies with a poor result of skill practice intervention (H. Jeong & Kwon, 2018; Yoo & Lee, 2015).

Table 6 The type of mobile technology utilized, setting and aim of the study

Study	Mobile technology	Setting	Aim
(Alvarez et al., 2016)	Mobile-based virtual learning object (VLO)	Classroom	To assess the results in learning among undergraduate nursing students about assessment of acute pain in adults and newborns, before and after an online educational intervention.
(Lee et al., 2016)	Mobile-based video	Skill laboratory	To evaluate the effects of using a mobile-based video clip as an adjunct to the clinical teaching of urinary catheterization in undergraduate nursing students.
(S. Kim et al., 2017)	Smartphone app	Skill laboratory	To evaluate the effectiveness of smartphone application by measuring nursing students' knowledge, skills, and confidence in simulated performance when providing care for infant airway obstruction.
(Wu, 2014)	Mobile assistant learning system	Classroom	To evaluate the score of learning performance on mobile assistant learning during Problem Based Learning (PBL) activities.
(Yoo & Lee, 2015)	Mobile applications	Skill laboratory	To understand the effectiveness of mobile applications by comparing the effectiveness of a high-fidelity human patient simulator to that of a mobile application on student learning
(Lee, 2015)	Mobile application	Class, skill laboratory	To determine the effect of mobile-based discussion versus computer-based discussion on self- directed learning readiness, academic motivation, learner-interface interaction, and flow state

(Choi et al., 2018)	Mobile application	Clinical site	To examine the effect of an experiment that introduced a mobile AEMR application for undergraduate nursing students in their practicum
(Jeong, 2017)	Smartphone video recordings	Skill laboratory	To investigate the effects of learning with smartphone video recordings in general 'intramuscular injection' practice for sophomore nursing students.
(Park & Kim, 2018)	Smartphone application	Classroom	To describe the effectiveness of a smartphone-based dosage calculation training application learning achievement, metacognition, and flow based on prior knowledge among nursing students
(Jeong & Kwon, 2018)	Social network	Skill laboratory	To investigate the effect of learning core fundamental nursing skills with Social Network Service (SNS) on the learning satisfaction, self- efficacy, and core fundamental nursing skills (tracheostomy care) of nursing students.
(Chuang et al., 2018)	Smartphone- video	Skill laboratory	To study the effects of skill demonstration video delivered by smartphone on facilitating nursing students' nursing skill competency and confidence.
(Strandell-Laine et al., 2018)	Mobile applications	Clinical site	To evaluate the effectiveness of the mobile cooperation intervention in improving the competence and self-efficacy of students and the quality of the clinical learning environment.

2.2.8 Mobile Learning Features

The use of mobile technology is becoming famous for improving the learning and performance of students because it can accommodate many learning-beneficial features. The most popular feature found in the review utilized by the researchers for learning is the use of *video* (Chuang et al., 2018; H. Jeong & Kwon, 2018; H. S. Jeong, 2017; S. Kim et al., 2017; N. Lee et al., 2016). It has been used to help the students in learning many types of clinical skills learning such as urinary catheterization, tracheostomy care, intramuscular injection, and care of infant airway obstruction. The result of the studies varies in terms of knowledge, skill performance, motivation, confidence, and satisfaction. The findings of the studies also showed that a different result came out if one feature is combined with another feature in an intervention. For example, Lee et al. (2016) determined that there were no changes in skill performance, motivation and satisfaction after one week of intervention after using mobile-based video only for urinary catheterization procedure learning. Meanwhile, Kim et al. (2017) have found that there were significant changes in skills and confidence level among intervention groups that use *video* with combined *voice-narration* in the management of infant airway obstruction. Besides, Chuang et al. (2018) also confirmed that the use of *video* demonstration with combination of *feedback* components produced a positive result in the performance of skills and the retention of knowledge. However, even though the implementation of *feedback* and *expert involvement* is involved in the intervention, based on study by Jeong and Kwon (2018), there was no significant difference in skill, satisfaction and self-efficacy on the effectiveness of *social network-based video* in learning. Since a high level of complexity was the type of procedure given, more time must be given to help the students achieve the best result.

Meanwhile, an intervention study by Alvarez et al. (2016) showed that they have been empowered by the use of *virtual learning objects* (VLO) in contextualizing knowledge and promoting problem-solving. Then, Yoo and Lee (2015) highlighted that the learning impact of using the *auditory* element in a mobile application has a similar effect on learning to improve knowledge retention using the high-fidelity simulator.

With the presence of *feedback* function and interaction in the use of mobile assistance learning systems during problem-based learning, knowledge and skills were enhanced (T. Wu, 2014). The students received feedback immediately in this study,

further, helped to solve the problem they encountered. Strandell-Laine et al. (2018), who examined the level of collaboration during the practice of students, showed that there was a significant association with improving the management of learning situations. Mobile technology has helped students document their learning activities and communicate effectively over the course of their practice.

Table 7 Features of mobile interventions, comparison groups and results of the study

Study	Features of mobile intervention	Comparison group	Results
(Alvarez et al., 2016)	• Use of VLO for simulation • Tutorial, Feedback, Help link	• Virtual Learning Object • No control	• Post-test (7.51 ± 1.98) showed a significant increase in student learning compared to the results of the pre-test ($p < 0.0001$).
(N. Lee et al., 2016)	• Voice narration in the demonstration video • Online streaming rather than downloading. • Recording frequency of video play	• Mobile-based video • No intervention	• There was no significant difference between the groups for skill performance in urinary catheterization ($t = 1.194$, $p = 0.236$). • There was no significant difference between the groups in learning motivation ($r = 0.515$, $P = .001$) • There was no significant difference between the groups in class satisfaction ($r = 0.548$, $P = .001$)
(S. Kim et al., 2017)	• Use instructional content and voice narration during video demonstration.	• Smartphone application • No intervention	• There was no statistically significant difference between smartphone application group and control group in knowledge ($t = 0.886$, $p = 0.379$). • There was statistically significant difference in skills ($t = 4.774$, $p < 0.001$) and confidence in performance ($t = 2.888$, $p = 0.005$) • There was no statistically significant difference between the two groups in satisfaction ($t = .168$, $p = 0.867$)
(T. Wu, 2014)	• Sharing, exchange, and interaction among peers, teachers, and students • Receive guidance and feedback	• Tablet PC with PBL • PBL only • No intervention	• There was a statistically significant difference among the three groups in knowledge ($p = .000 < .05$). • There was no statistically significant difference between the two groups in cognitive ($p = .142 > .05$)

(Yoo & Lee, 2015)	• Providing heart and lung sound	• Mobile application • High fidelity simulator	• There was a statistically significant difference among the groups in knowledge (p =0.031). • There was no statistically significant difference between the two groups in practice clinical assessment skills with respect to lung assessment (p =0.258) and heart assessment (p = 0.258).
(Lee, 2015)	• Discussion and communication • Receive feedback	• Mobile application • Computer web-based discussion group	• There was a statistically significant difference between groups in extrinsic motivation (p = 0.011)
(Choi et al., 2018)	• Document function • Auto calculation • Data linked to student's email • Patient assessment tools	• Mobile application • No intervention	• There was no statistically significant difference between the two groups in satisfaction (t = 1.525, p = 0.134) • There was no statistically significant difference between the two groups in critical thinking (t = 1.920, p = 0.060)
(H. S. Jeong, 2017)	• Video recording only	• Smartphone video recordings • No intervention	• There was a statistically significant difference between groups in extrinsic practice competency (p=0.019) • There was no statistically significant difference between the two groups in satisfaction with practice (p = 0.152) and satisfaction with practice method (p = 0.879) • There was a statistically significant difference between groups in self-efficacy (p=0.019)
(Park & Kim, 2018)	• Practical game: Score and ranking	• Smartphone application • No intervention	• There was a statistically significant difference between groups among the above-mean group in extrinsic practice competency learning achievement (Z=3.16, p=.002) • There was a statistically significant difference between groups above-mean group in total metacognition (Z=2.50, p=.012) • All outcomes variables in the experimental group were lower than in the control group for 'below-mean group'

(H. Jeong & Kwon, 2018)	• Video recording • Expert comment	• Social network-based video • No intervention	• There was no statistically significant difference between the two groups in satisfaction (t=1.160, p=.250). • There was no statistically significant difference between the two groups in nursing skill (t=.403, p=.688). • There was a statistically significant difference between the two groups in self-efficacy (t=3.093, p=.003).
(Chuang et al., 2018)	• Video of demonstration • Receive 'reminder' to view the video	• Smartphone video + DVD • DVD only	• There was a statistically significant difference between the two groups in knowledge (F=4.219, p=0.04) • There was a statistically significant difference between the two groups in skill (F=6.739, p=0.013) • There was no statistically significant difference between the two groups in confidence level (F=2.201, p=0.142)
(Strandell-Laine et al., 2018)	• Schedule of practicum • Social networking-style element group, for teacher-learner interaction • Teacher able to control documentation and offer feedback and support	• Mobile application • No intervention	• There was no statistically significant difference between the two groups in competence (p = 0.57) • There was no statistically significant difference between the two groups in satisfaction on clinical learning environment (p = 0.24) • There was no statistically significant difference between the two groups in self-efficacy on clinical learning environment (p = 0.37)

2.2.9 Discussion

Due to the opportunity to review the learning content repeatedly, the enhancement of skills among the intervention group was highlighted. The students had the opportunity to study at their own pace and self-study (Alvarez et al., 2016; Davies, 2014; N. Lee et al., 2016) stimulated independence and autonomy, confidence, satisfaction, and motivation improvement in the learning process.

Because of the flexibility, the level of satisfaction of using video as a learning method is enhanced, and students can see how they perform by receiving feedback. Wu (2014) discovered that technology provided students with a reflection of their research that helped them develop critical thinking and promote knowledge acquisition. In the meantime, the use of mobile technology has promoted reflection of learning while respecting their individuality (Alvarez et al., 2016). The opportunity to consult educators has also contributed to receiving *feedback* on their own performance. In addition, the students were steered by self-assessment and peer-assessment to learn to accept multiple learning perspectives. This therefore stimulates more learning desires among learners.

This study highlighted how mobile technologies have been scrutinized for nursing education and how mobile features have been used to engage learners in learning. In comparison to traditional methods, the review collectively addressed positive learning outcomes, such as increased accessibility of learners to information, perceived improvement in knowledge and skills, and improved learning satisfaction. Based on the results obtained in this review it can be described that students who were actively involved in their learning are seen as a novel and motivating form of knowledge acquisition independently. Mobile learning helps the learner learn informally and independently with regard to self-directed learning (Karimi, 2016).

While some groups of students may feel that learning using a smartphone is helpful, groups who are not familiar with the use of technology still need to be considered. For continued engagement with mobile-assisted learning, it is important to keep all groups of students in mind. M-learning implementation, based on the evidence from Wang, Wu and Wang (2009), managed to give a significant result in terms of usefulness and ease of use, thus benefiting undergraduate nursing students.

Although mobile learning is seen as simple and enjoyable to use, the process for the development and the execution is complicated. From the beginning of a mobile learning project, some design requirements need to be addressed so that the design can be well delivered in the execution of the project. The level of readiness among targeted users to accept new technology is one of the popular barriers to implementing mobile learning projects.

After mobile learning implementation takes place, it is either knowledge or skills that show positive results. Mobile learning effectiveness depends on the types of features implemented within the technology and on the types of learning procedures. It can be assumed that mobile learning can be effective and useful in this sense, but not for processes that are too complex to perform. For example, a result has shown that learning the urinary catheterization procedure on male patients using a mobile-based tool has shown insignificant results in the acquisition of skills between control and case groups (N. Lee et al., 2016). Another justification for this finding suggested that the level of knowledge and skill acquisition among students is different in each person and it affects the total time spent on learning. For the students who can perform well in skill but not in knowledge acquisition, they may need a longer time to grasp all the necessary knowledge and rationale. Lee et al. (2016) stated that one week may not be enough for mobile-based video to learn about a complex procedure. A prior study conducted by Holland et al. (2013) it is reported that the study required 15 weeks to learn a less complex procedure (such as oral medication administration) using online video until it can record a lower number of failures. In short, by emphasizing the tasks, needs and objectives of users in the early design of the learning tool, a better result can be achieved.

Some studies in the review presented problems related to the method of study also. Pre-post-test studies without any comparison group may raise the concern about the actual effectiveness of the instrument due to confounding influences, such as previous knowledge and skill experience, that can affect the scores. It can achieve better results during an intervention by acknowledging the level of prior knowledge and experience between low performers and high performers through initial assessment. Kenny et al. (2009) suggested there may be a need to provide some differentiated instruction on the mobile-based product to be used in class based on the level of

experience on computing. According to Mao and Palvia (2008), as IT users becoming more experienced, their perceived internal influences and external influences are more consistent with the use of technology.

Moreover, it seemed that the use of a quantitative approach only to measure the satisfaction rate of the mobile device in learning was insufficient. In this type of research, a better strategy such as a mixed method that combines pre- and post-test design with qualitative exploration can be more encouraging. At the same time, in-depth information can be explored and any information that needs confirmation can be directly asked. Therefore, to capture many learning elements such as perception, knowledge, and satisfaction from a broader angle, mixed method study design will be more convincing. The approach of mixed method study design combining both qualitative and quantitative techniques is not a new concept in the field of information system, but it offers the potential to promote the construction of theory (P. F. Wu, 2012). Donaldson (2011) for example, used a mixed approach to examine the determinants associated with the behavioural intent of community college students to use mobile learning and mobile library resources.

Ethical issues must be considered when treating various groups of subjects for intervention studies. By controlling the useful resource from the control group, it must be appropriate while allocating the intervention subject. It is important to prevent data contamination across groups. For instance, Lee et al. (2016) discovered that data contamination was their limitation when conducting randomized controlled trial research that both the experimental and control group shared the same practice laboratory.

2.2.10 Extending literature from 2019 to 2020

On assessing the recent trend of mobile technology interventions in clinical skill learning among undergraduate nursing students, the researcher extended the literature search towards the year of 2020. A total of five studies were managed to be included, three studies were conducted using randomized-controlled trial study design (Ismail et al., 2020; Vicdan, 2019, 2020) and two studies using quasi-experimental design (C. Y. Chang et al., 2019; Salameh et al., 2020). The topics that have been covered in the

studies were childbirth education, intramuscular injection, electrocardiogram and acquiring blood pressure. Among these studies, mobile application is the most popular, followed by mobile messenger and social media. Four of the studies compared the use of mobile technology interventions with face-to-face teaching. To be more specific, video is the popular mobile feature (4 out of 5) used in the studies followed by social-based features such as feedback and chat. Other features that have been used were note, quiz and skill checklist.

The outcomes of the interventions from the RCT studies vary. The study on the evaluation of the effect of mobile-assisted education regarding intramuscular injection on the ventrogluteal site by using the Instagram application shows that there is no significant difference with control-group on knowledge and skill (Vicdan, 2020). However, on evaluation of the effect of mobile applications on acquiring blood pressure measurement skills, there is statistically significant ($p = 0.001$) level of knowledge and skill (Vicdan, 2019). Also, the effectiveness of using mobile messenger (*WhatsApp*) as an educational supporting tool between control-group is significant on level of knowledge ($p < 0.05$) (Ismail et al., 2020). Meanwhile, a significant difference between pre and post test results on learning achievement using quizzes ($p < 0.000$) was reported in an intervention using mobile application in learning ECG analysis and arrhythmia interpretations. Besides, a study investigating the effectiveness of using virtual reality to increase the learning performance of nursing students in childbirth education training also found that to be significant on learning achievement and learning motivation (C. Y. Chang et al., 2019). In brief, the most recent studies in the last two years show a similar trend with the studies from the past 8 years, indicating that mobile learning interventions in nursing education are still limited to using limited types of features such as video and social media as their main feature.

2.2.11 Summary

In summary, this review found that most of the studies highlighted the effectiveness and features associated with the use of mobile-based learning. There is still a lack of participation among undergraduate nursing students in the implementation of smartphones as one of their methods for learning clinical skills reported in literature

from different countries. More than half of the studies were conducted using video as a learning medium, but there were no clear results on its efficacy. The findings depended on the kinds of learning outcomes in which few were found to be effective in retaining knowledge, but few were not in acquiring skills. It is interesting to note that the direction of the subject discussed in all studies contributes indirectly to the exploration of the acceptance of mobile technology in nursing education, to the identification of motivating factors and barriers such as its utility, effectiveness, social interaction, and organizational support. This is therefore ideally suited for undergraduate nursing students who often face limited time and restricted freedom to engage in direct clinical skills face-to-face.

The following recommendations for mobile-based nursing education interventions have emerged from the findings of the review:

1) Given the benefits of mobile-enhanced learning, this should be considered in undergraduate nursing curriculum. More activities in the classroom and clinical skill laboratory with mobile supported tools should be incorporated as complementary with face-to-face teaching and learning.

2) More reflection-based activities should be incorporated within the mobile app features for learning such as peer and educator-assessment and forum to enhance interaction among learners while receiving multiple opinions or perspectives.

3) The design and development of learning tools must incorporate the needs of every stakeholder involved within the environment such as students, teachers, faculty management and the sponsor from the beginning.

4) Behaviour is a significant determinant for someone to utilize an innovative tool for learning. Hence, the acceptance criteria of the target population using such technology must be incorporated as a backbone for mobile intervention development.

2.3 DEVELOPMENTAL ECOLOGY OF NURSING STUDENTS' SELF-DIRECTED LEARNING

Students have spent a lot of effort learning how to safely care for patients, such as handling sterile procedures and avoiding medication errors (Sulosaari et al., 2015). Patient safety concerns every health care worker and contribute significantly to the burden of harm due to unsafe care. However, if any of the quality of patient care is dropped, the patient's safety can be compromised (Baraz et al., 2015). Since nursing education is becoming more complex in terms of the acquisition of clinical skills, nursing skills training has shifted from routine practice of hospital assignments to evidence-based university practice such as clinical skills laboratory practice (Ewertsson et al., 2015).

One of the popular tools for evaluating SDL in nursing education is Self-directed Learning Readiness for Nursing Education (SDLRNE), which is adapted by Fisher et al. (2001) based on Guglielmino's study. Self-management of learning, desire for learning and self-control of learning are the three prominent subscales of SDLRNE. This tool was used to understand the readiness of self-directed learning among multiple nursing personnel such as first year students, final year students, associate degree students, master students and working nurses.

First, as a subscale of self-directed readiness for learning, self-management focuses on student learning and learning skills that include the ability to be organized and logical, with the self-discipline to prioritize studies. This includes the ability to exercise metacognition, where students participate in a deep level of inquiry into what needs to be learned to meet their learning needs (Qamata-Mtshali, 2013). Second, the desire for learning highlights students' personal characteristics as self-directed learners who could actively build knowledge. Lastly, self-control of learning includes the skills in relation to motivation, ability to set the objective of the student, and the use of appropriate resources to address learning needs.

Various motivating and challenging factors that take place in the classroom and clinical skills centre can influence the magnitude of clinical skills learning among nursing students. The patterns of influences were learned at multiple ecological levels such as intrapersonal, interpersonal, and organizational to understand the challenges of this approach, self-directed learning among undergraduate nursing students at the

university. Similarly, Haraldseid, Friberg & Aase (2015) have identified three factors influencing the physical, psychosocial and organizational learning environment of clinical skills. In the meantime, Kuiper et al. (2010) who introduced self-regulated learning in nursing education, has revealed several views on factors affecting nursing student learning, particularly at the intrapersonal level.

As many understand that living as a university student is a part of human development process, there are few ways to understand how students interact with campus environments to promote or inhibit the development of self-directed learning attitudes. The developmental ecology theory is an approach that accounts for individual differences and multifaceted contexts in holistic student development. It will provide academics with an insight into how self-directed learning development can take place by highlighting complex interactions at ecological levels in the learning ecosystem, and to consider how to shape the environments to promote optimal student growth and development. A short description of each of the levels is provided in Table 8 below:

Table 8 Description of each ecological level

Level	Description
Intrapersonal	Characteristics of the individual including knowledge, attitudes and behaviour
Interpersonal	Social support systems in which an individual cohabits
Organizational	Social institutions in which an individual belongs

The microsystem consists of the immediate environment of the person, such as his or her family, school, workplace, and others. According to Bronfenbrenner (2005), it involves “a pattern of activities, roles and interpersonal relations experienced by developing persons, a face-to-face setting with particular physical and material features and containing other persons with distinctive characteristics of temperament, personality and systems of belief.” In microsystems, students expend a substantial

portion of their everyday lives. They meet and communicate face-to-face with other individuals, each with their distinctive characteristics of disposition, attitude, and belief systems, such as teachers and peers. Despite these factors, there are some other factors that also influence the performance of students in quality education that are linked to time management, attendance, health, and ethnicity (Khaliq et al., 2019).

2.3.1 Intrapersonal

When applying developmental ecological models to self-directed learning of clinical skill, the intrapersonal level represented an individual in the program. Knowledge, skill readiness and learning attitude are parts of factors affecting intrapersonal behaviours in self-directed learning of clinical skill. Practical skills are a complex measure, requiring theoretical knowledge and critical attitude tailored to each procedure or context. Apparently, it is quite evident that from the literature that the students showed the down sides of experience when dealing with clinical learning for example attitude problems, unprofessional behaviour, not asking questions, overconfidence, unmotivated to learn, lack of confidence, and dishonesty (Gemuhay et al., 2019). The lack of knowledge and preparation for the clinical environment disturbs their learning processes and thus makes them feel anxious.

Beliefs and motivation also fall under the intrapersonal level of developmental ecology. Fear and distrust have proven to be substantial barriers to learning clinical skills. There are beliefs among students that, as a result of lack of clinical experience, unfamiliar with the clinical environment and fear of making errors, anxiety-producing situations will cause a loss of control. Students may express the sign of exhaustion and show a great decrease of motivation because they have the idea that the instructors are always there to look for the deficiencies, besides always putting a higher expectation on them. Other literature have shown evidence that there were detrimental impacts on motivation because of several challenges such as loss of self-confidence (Arkan et al., 2018; O'Mara et al., 2014). These, unfortunately, may reduce the self-directedness of learning.

Interest has been conceptualized as an individual disposition and as a psychological state that is characterized by focused attention, increased cognitive and

affective functioning, and persistent effort (Ainley et al., 2002). Interest also has major influence reciprocal with self-efficacy. There was a positive correlation between individual interest and academic achievement while self-efficiency influences academic motivation, learning and achievement (Nuutila et al., 2020).

Metacognition refers to knowing one's own knowledge and one's capacity to understand, control, and manipulate one's cognitive processes involves the ability to use prior knowledge to prepare a learning task approach strategy, take appropriate steps to solve problems, focus on and assess outcomes as required (Meichenbaum, 1985). Fan et al. (2015) reported that students with high levels of metacognitive ability demonstrate better academic performance. Nursing students are usually said to have poor skills in reading, writing, oral communication, critical thinking, problem solving, creative thinking, self-discipline, and working with groups. (Anema & McCoy, 2009; Fan et al., 2015). Hence, teaching nursing students to think critically or challenging them to think is one way to cultivate their metacognitive ability.

2.3.2 Interpersonal

Interpersonal level in this study is a social support system in which an individual cohabits. When teaching nursing students, clinical skills labs provide simulative environments for the students to learn clinical skills (Mikkonen, 2017). Nursing students share the same provision of developing clinical skill with lecturer, clinical instructor and nurse, therefore the relationships among them are important. Studies have shown that relationship between nurse educators and nursing students have an effect on clinical skill performance (Bryan et al., 2013; Serçekus & Bas, 2016). Effective educator-student relationships can have an impact on the resilience of students (Froneman et al., 2016). So, there is suggested that clinical trainer support, direct communication and peer support are important to create a positive learning environment (Arkan et al., 2018).

A working partnership with the educator directly influenced student learning opportunities and therefore had a positive impact on learning performance and professional development. (Mikkonen, 2017). The partnership between students and mentors involves mutual trust, respect, support for professional equality and a positive

response to clinical mentorship (Mikkonen, 2017). On the contrary few reports agree that, due to neglect and discrimination, students could also become the subject of ineffective communication (Arkan et al., 2018; Jamshidi et al., 2016; Khoza, 2015; O'Mara et al., 2014; Serçekus & Bas, 2016). Students' challenges may also be driven by faculty members who are overly critical, favourite, or unpredictable. Uncertainty about the expectations or style of clinical teaching led to problems experienced before and during clinical learning (O'Mara et al., 2014).

Students indicated that their positive and negative interactions and cooperation with their friends also affect their learning. Peer interaction is a significant element in learning, as academic success of their peers and their positive interactions with their peers positively affect their learning. It was indicated that interaction and support of peers are effective in clinical learning (Serçekus & Bas, 2016).

2.3.3 Organizational

The third provision for self-directing clinical skill learning is organizational factor. Organizational refers to social institutions in which an individual belongs. In learning clinical skill, organizational factors are important because it incorporates behaviours that fit into role expectations of a student in the faculty or campus. Developing an engaging and inclusive learning environment is helpful to meet the needs of the learner. Some of the eminent examples of this factor found in literature are about the number of subject the students take, time allocation for the students to practice, and the adequacy of resources for the students to practice which can influence the good and bad perceptions of nursing students towards learning clinical skill (O'Mara et al., 2014).

The atmosphere dedicated for learning is impelled by the number of students and the number of overall academic subjects taken by the nursing students in a semester, thus it has an urge on the motivation of the students in clinical skill learning. In this situation, it restricts the time allocation for every student to focus on each subject. A smooth learning experience can be intimidated by too many students gathered in the same place for learning (Arkan et al., 2018). Students may realize that higher numbers of students in clinical practices and restricted resources negatively affect their learning and thus creates nervousness during practice.

Then, the need of adequate resources is important to prepare the environment as close as to a real clinical area. Resource is important because it is considered as a major factor for simulating an authentic learning environment (Mohd Said et al., 2009). In addition, it is pivotal because it provides an opportunity to improve personal experience in acquiring skill competency (Haraldseid et al., 2015; Houghton et al., 2012; McCallum, 2007). Learning clinical skills can provide less confusion if they can link the theory learned in the classroom into the role that they practice in the clinical area (Arkan et al., 2018; Serçekus & Bas, 2016). Students are affected negatively by physical inadequacies such as a lack of equipment and the absence of a common room in the clinical environment (Serçekus & Bas, 2016). Hence, without the authenticity of learning environment, knowledge transfer can be interrupted, and the theory-practice gap possibly cannot be minimized.

2.3.4 Summary

This study has explored few studies on challenges of SDL of clinical skills in the context of nursing education based on developmental ecology model. Some of the essential components of self-directed learning includes:

1. Intrapersonal: individual knowledge, awareness, attitudes, beliefs, perceptions, and skills of individuals.
2. Interpersonal: Educator-student relationship, communication, peer support
3. Organizational: Number of subjects taken, time allocation, adequacy of resources

In the next sub-section, the researcher will discuss the components of acceptance behaviours of using smartphones in education by using the popular acceptance model of Unified Theory of Acceptance and Use of Technology 2 (UTAUT2).

2.4 The Acceptance of Using Smartphone in Education

2.4.1 Performance expectancy (PE)

Performance expectancy (PE) is derived from five constructs namely extrinsic motivation (Davis et al., 1992), perceived usefulness (Venkatesh & Davis, 2000), outcome expectation (Bandura, 1986), job fit (Thompson et al., 1991), and relative advantage (Rogers, 2003). In the context of mobile learning, PE reflects the degree to which learners believe that using mobile learning will help to improve their learning performance and to gain better grades (Wang et al., 2009). Most articles (Ahmed et al., 2019; Aliaño et al., 2019; Amantha & Bervell, 2019) agreed that PE is among the strongest determinant for behavioural intention to use mobile technology in relation to learning. For example, Ahmed et al. (2019) conducted a survey in two engineering universities in Pakistan and discovered that PE significantly affects students' behavioural intention ($t = 2.452$, $p < 0.05$) in using mobile learning especially to increase their learning productivity. Also, Aliano et al. (2019) posited that PE is positively associated with BI in using mobile learning especially in reducing the completion time to perform a task. Then, Amantha & Bervell (2019) revealed that PE ($t = 2.440$, $p < 0.01$) is a significant predictor of BI towards Google classroom because the students are able to access course-related tasks and improve productivity. Likewise, PE is a dominant factor in online learning as it motivates students to improve content and efficiency (Decman, 2015; Tarhini et al., 2016) of learning. Based on this evidence, they can obtain information swiftly just using their mobile devices. In the context of this study, PE is perceived as the degree to which students believe that using smartphone applications will improve their self-directed learning of clinical skills. Therefore, strengthening this belief will improve students' BI to adopt mobile learning.

2.4.2 Effort expectancy (EE)

Effort expectancy (EE) is a construct representing the ease of use (Venkatesh & Davis, 2000), complexity (Thompson et al., 1991), and perceived ease of use (Rogers, 2003). EE has been proven in providing statistically significant influence on behavioural intention in learning using mobile technology. Momani et al. (2017) who conducted a

study on the adoption of mobile Blackboard in Jordan, has discovered that the effort expectancy of using technology (EE) has significantly influenced the students' BI (β = 0.354, p = 0.000). Next, in a qualitative study by Alasmari and Zhang (2019) on mobile learning in Saudi's higher education, the students perceived that they gain benefit a lot because the ease of use and learnability qualities of the technology. However, Moorthy, T'ing, and Kumaran (2019) identified that EE does not significantly influence BI because performing mobile tasks in relation to learning do not institute any efforts to understand and use technology. This construct is substantial to understand the magnitude of efforts perceived by the learners while interacting with the technology. In the context of this study, EE is perceived as the degree of effort that students imply when using a smartphone application for self-directed learning of clinical skill.

2.4.3 Social influence (SI)

Social influence (SI) construct is known as subjective norm (Davis et al., 1989) in preceding model, social factors (Thompson et al., 1991), and image (Moore & Benbasat, 1991). People who have important connections with students have a potential to influence the students' behavioural intention to use technology in learning. Aofan et al. (2016) discovered that the effect of SI on behavioural intention is significant ($p < .05$) in a study of mobile learning adoption in higher education in China. Meanwhile, a study by Badwelan et al. (2016) on m-learning in Saudi Arabia's higher education showed a similar outcome, in which SI significantly affects BI (β = .606) with the exertion of lecturer's influence. On the other hand, some cases showed that behavioural intention is not heavily relied on SI (Ahmed et al., 2019; Amantha & Bervell, 2019; Momani et al., 2017). In an example of Malaysian context, Mohd Suki and Mohd Suki (2017) addressed that using animation and storytelling in a lesson does not necessarily indicate that the teachers or related people in the faculty could successfully encourage the students to use of technology.

2.4.4 Facilitating condition (FC)

Facilitating condition (FC) is a construct that explains the perceived importance of resources and supports the horizons available for using technology. It is theorised based

on the acceptance model which includes perceived behavioural control (Taylor & Todd, 1995), compatibility (Rogers, 2003), and facilitating conditions (Thompson et al., 1991). By securing essential resources such as internet connection or organisational support and ensuring the compatibility of technology with other technologies owned by students, FC can foster an impact over the intention of using technology. Ahmed (2019) disagreed on the linkage between FC and BI in mobile learning adoption as he found that there is a negative association between these determinants as a result of the absence of learning management system. Likewise, Moorthy et al. (2019) showed a similar outcome where FC did not affect BI ($t = 0.609$, $p = 0.271$) in determining Malaysian students' adoption to mobile learning.

2.4.5 Habit (HT)

Habit (HT) can be explained by the extent to which an individual performs certain behaviour automatically because of prior learning and experience. This factor is significant in BI of mobile learning (Ahmed et al., 2019; Amantha & Bervell, 2019). Interestingly, HT can be the strongest determinant in forecasting the BI of using smartphone, for example Moorthy (2019) reported HT as the strongest determinant ($t = 4.660$) by informing that the behaviour can be induced by the implementation of rules and regulations set by the educational institutions. In another study on consumer behavioural intention to use smartphone application, Hew, Lee, & Wei (2015) conducted a survey on 288 private university students in Malaysia and noticed that HT affected BI by providing a β-value equal to 0.3239 and p value of less than 0.01. This is supported by the fact that technology is well diffused into people's daily lives, which involuntarily makes people rely much on smartphone application.

2.4.6 Price value (PV)

Venkatesh et al. (2012) described price value (PV) as an individual's insight into the trade-off between the perceived benefits obtained and the monetary costs charged for the implementation of the technology. Students are more likely to embrace e-learning systems when they discover that the benefit of using them is more than the financial cost of using them. According to Tarhini et al. (2016), there is considerable impact of

price value or perceived value on behavioural intention. Price value is introduced on the stance of a consumer use setting, which is different from organizational use setting, usually bearing the monetary cost of the users, therefore it may have a significant impact on technology usage.

2.4.7 Hedonic motivation (HM)

Like the construct of perceived playfulness, hedonic motivation (HM) is termed as the enjoyment and entertainment associated with using technology for learning. It is signified as a learner's sense for appealing and satisfaction while interacting with mobile technology for learning purposes. Smartphone are a top-notch device that run fun and up-to-date applications, and in this sense, students perceive smartphone applications as enjoyable. At present, there are three studies on mobile learning that signify the contributions of HM on BI, whereby all t-values passed 1.96, which are 2.108 (Ahmed et al., 2019), 2.274 (Amantha & Bervell, 2019), and 3.440 (Moorthy et al., 2019). Other than that, researchers have intensified gamification by instituting entertainment elements as a way of improving learning behaviour (Decman, 2015). Hence, if a smartphone application is fun to use, learners are happy when using it.

2.4.8 Summary

In this sub-chapter, this study explored the types of predictors that contribute or not contribute to the behavioural intention of using smartphone application in nursing education based on the acceptance theory of UTAUT2. There are seven factors that influence the behavioural intention of the students to use smartphone for learning which are performance expectancy, effort expectancy, social influence, facilitating condition, habit, price value, and hedonic motivation. However, it is indicated that the price value concept is crucial in attracting consumers. Since the researcher is not interested in determining the behavioural intention of the students based on consumerism in using the smartphone application for self-directed learning of clinical skill. Thus, the factor is omitted from this study.

2.5 Summary

This chapter presented a review of published literature to facilitate an understanding of the phenomenon of research interest and identification of emerging issues or problems that motivate the production of this thesis. The researcher analysed the state-of-the-arts of the smartphone technology and the features of smartphone application that can contribute to the success and failures of the intervention of the study. Then, the researcher also discussed the kind of challenges that seemed to be significant based on the concept of the model of developmental ecology as experienced by nursing students. And lastly the researcher explored the types of predictors that contribute or not contribute to the behavioural intention of using smartphone application in education.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The chapter includes the discussion on the principles underpinning the study method and philosophical underpinning used in this study, in need of meeting the research objectives.

3.2 PRINCIPLES UNDERPINNING THE STUDY METHOD

After outlining the study's research goals, research questions and research objectives (Chapter 1), the next step is to identify the most appropriate methodology to guide the direction of the study. Many researchers used qualitative study approach to explore the challenges of learning among undergraduate nursing students and to explore the experience of using mobile learning. This qualitative methodology is derived from the constructivist paradigm, mainly aimed at providing an understanding of certain aspects of experience through investigation of specific cases, yielding rich data (Polit and Beck, 2010). It is also used by the researcher to investigate a problem that calls for a phenomenon to be explored; depends on participants' opinions; asks large, general questions; gathers data consisting mainly of participants' words; explains and analyses these words for themes; and conducts the inquiry in a subjective and reflexive way (Clark & Creswell, 2015). The researchers conduct qualitative research studies to explore important topics related to the perspectives and experiences of a few individuals. Qualitative findings of research lead to a new understanding of the nature of the phenomenon. Even though qualitative studies do not usually cover a larger number of subjects, it provide valuable insights into many different perceptions, experiences and contexts that take place in the lives of individuals (Clark & Creswell, 2015).

Quantitative study approach has been used by researchers utilizing quantitative methods that decides what to study, poses specific questions or hypotheses, measures variables to facilitate the finding of answers, uses statistical analysis to obtain

information in order to answer the hypotheses, and makes an interpretation of the results (Mertler, 2016). The quantitative survey methodology is ideally suited to the need to understand the opinions of participants in the population as a whole and thus offers more general understanding. The quantitative understanding is resulted from the evaluation of a large number of people and the assessment of the answer to a few variables. As the aim of this study is to understand the important factors of using a smartphone application for self-directed learning of clinical skills, these factors can be determined by performing statistical investigation of different independent variables, which would provide results indicating generalizable perceptions across the total population of the undergraduate nursing students.

3.2.1 Mixed Methods Design

Mixed method is defined as a methodology (Creswell & Tashakkori, 2007) that entails collecting and analysing of deductive and inductive data and linking it into a single or multiple study. The findings from qualitative research and quantitative research are providing different pictures or perspectives to the researcher, but it also has its own limitations. One might argue that quantitative research is weak in understanding the context or setting in which people live. Also, the voices of participants are not directly heard in quantitative research. On the other hand, there are some deficiencies in using qualitative research such as the personal interpretations made by the researcher that can lead to bias and the limited number of participants that can cause difficulty in generalizing the findings. When researchers study a few individuals qualitatively, the ability to generalize the results to many is lost. When researchers quantitatively examine many individuals, the understanding of any one individual is diminished.

A) Explanatory sequential design

B) Exploratory sequential design

C) Convergent design

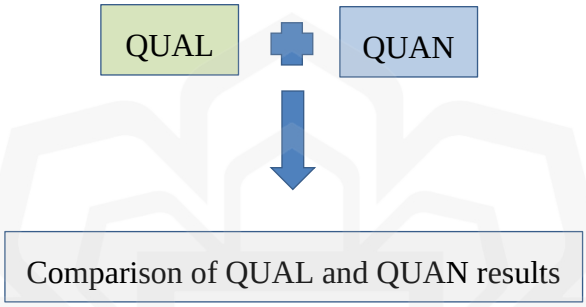


Figure 6 The main types of mixed-methods design based on Creswell (2015)

Given the rigor of quantitative methods and the subjective information gained through qualitative inquiry, the use of mixed methods is increasingly common in the assessment of a research problem. The limitations of one method can therefore be offset by the strengths of the other. This design is appropriate if the use of quantitative research or qualitative research alone does not provide a well understanding to a phenomenon or a problem. It provides more evidence for the study of a research problem than either quantitative or qualitative research alone. Besides, researchers are given with several options to use available data collection tools rather than being limited to those types typically associated with quantitative or qualitative research only.

3.2.2 Sequential Exploratory Design

Creswell and Plano Clark (2015) recommended three core mixed method designs that provide a useful framework for researchers to work with. It is urged to carefully select the best core design that could address the study problem and to provide the best

justification for mixing to make the study manageable and easy to implement. The three main mixed method designs are the convergent design, the explanatory sequential design, and the exploratory sequential design (see Figure 6).

The aim of the exploratory sequential design of this study was to explore the problem of SDL of clinical skills among undergraduate nursing students, followed by exploring their perceived behavioural intention to use the smartphone application for SDL of clinical skills through qualitative methods and analysis. The results were then taken in decisions related to the choice of measures for the modification or adaptation for the prototype development and evaluation. Therefore, in order to conduct this design, the following procedures by Creswell (2014) were considered:

i. Collect and analyse the qualitative data.
ii. Examine the results from the analysis of qualitative data (themes) and use that information to improve the quantitative components, including outcome measures.
iii. Use the quantitative components and test them for experimental trial (survey questionnaire and mobile app prototype).
iv. Report on how the new component improves the existing innovation program.

The exploratory sequential design is a three-phase design of mixed methods in which the researcher studies first a problem by using qualitative data collection and analysis. The second phase involves the development phase of translating the qualitative findings into a quantitatively tested approach or tool. This feature may include the generation of new variables, the design of an instrument, the development of intervention activities, or a digital product, such as a website or app. As an intermediate step between the stages, the researcher creates an instrument which builds on the qualitative results. In this phase, several options for the third phase can be considered, it includes the quantitative phase of the application of the measure, the testing of the new instrument, or the use of the new intervention and its experimental activities. The researcher then interprets how the quantitative outcomes are based on the initial qualitative outcomes from the participant's initial qualitative perspectives.

All phases are separated from each other with different research questions, data collections and data analysis procedures. The use of qualitative and quantitative methods allowed the researcher to validate and expand the findings from the qualitative results with the quantitative data. It can be important to link the different paradigms underpinning the qualitative and quantitative approaches to the specific research questions that the researcher need to answer. For example, the qualitative research questions here seek to explore 1) the challenges of current implementation of self-directed learning, and 2) the perception of using a smartphone application for self-directed learning of clinical skills. Meanwhile, the quantitative research questions are aimed at examining the perceived behavioural intention of using smartphone apps for SDL of clinical skills to a larger scale. The qualitative and quantitative elements are therefore complementary, as both are used but viewed at different angles for the same purpose.

Figure 7 shows three major phases in this design according to Creswell (2014), the initial qualitative phase followed by a second and third quantitative phase. In this study, the researcher modified these phases into two main phases (involving exploratory sequential design) and two additional phases involving the development and evaluation the smartphone application prototype. The researcher begins Phase 1 (qualitative study) with identifying the challenges in the current implementation of self-directed learning of clinical skill and identifying the perceptions on the use of smartphone application in facilitating SDL of clinical skills. This qualitative data collection yields specific quotes from participants. These data then form the accumulation of quotes, which yield codes, and the collection of codes produces themes. Using the findings from the specific research objective 2 of **RO1**, the key themes, later, could inform the next phase of the study, the quantitative study.

Phase 2 (quantitative study) allowed the researcher to achieve a more comprehensive understanding of the findings. After modifying and designing an adapted version of the survey instrument, a quantitative data collection is employed into a larger population (Chapter 5). The quantitative data analysis of this **RO2** results in identifying the most significant factor which could inform the next additional phase of the study. The following additional phase (Phase 3) starts with the smartphone application design and development, as described for **RO3** (Chapter 6). Lastly, the

evaluation study (Phase 4) utilizes the newly developed prototype to garner the feedback from the participants, as described in **RO4** (Chapter 7). This design is the most complicated of the three basic designs as it takes even more time to complete than the convergent or explanatory sequential methods (Creswell, 2014).

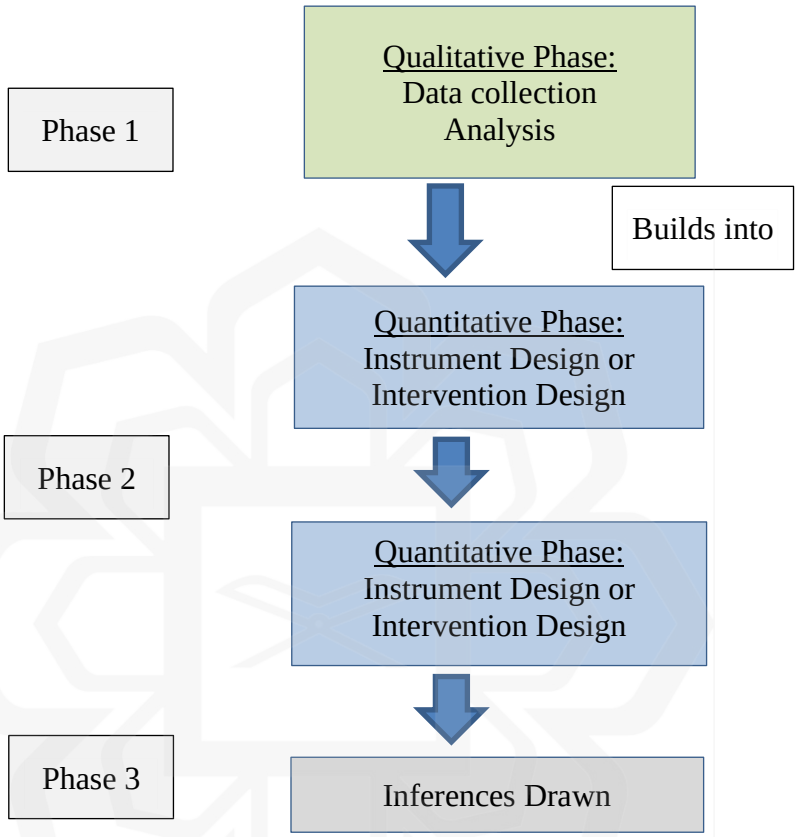


Figure 7 Exploratory sequential design based on Creswell (2014)

3.2.3 Justification for Using Exploratory Sequential Mixed Method Design

First, consistent with the pragmatist approach, research questions were formulated in accordance with knowledge gaps identified in the literature. There is a need to explore not only the current phenomenon (such as challenges or barriers) of how self-directed learning of clinical skills is made, but also to explore how alternative approaches (such as mobile application) can be crafted as an effort to cope with the challenging factors identified. The meta-analysis from Alrasheedi & Capretz (2015) has suggested that the critical success factors of mobile-learning depended on the content, technical competence of learners, user friendly design, learner community development, and

ownership. Meanwhile, in another review of current studies of mobile learning from 2013 to 2017 (Sönmez et al., 2018), learners' perceptions of mobile technologies and m-learning and students' acceptance of m-learning were the most popular topics discussed by researchers. In the field of nursing, a review on smartphone-based mobile learning had shown that it positively affected nursing students' attitude toward learning, knowledge, skills, and confidence (J. H. Kim & Park, 2019). Acceptance of technology is expected to play a vital role in predicting the implementation of smartphone applications in nursing education. Information on the acceptance of smartphone technology or information on the use of technology among nursing students for clinical skills learning in Malaysia has not yet been available. Mixed-method research is therefore adopted to provide a more holistic approach that reflects the different dimensions of the research problem.

Secondly, despite many technology acceptance model-based studies, there are a dearth of studies that uncover other types of factors in determining intentional behaviour prior to using mobile learning. Kumar & Chand (2019) systematically reviewed mobile learning adoption topics between 2009 to 2017, indicating that TAM was the popular adoption theory used. They also summarized that the determinants of attitude, intention, ease of use, enjoyment, experience, usefulness, learnability, personal and social were among major factors influencing mobile learning adoption. To enrich the determining factors that might improve explanatory power of adoption, the implementation of qualitative research is needed in sequential with quantitative study of this topic. Quantitative data alone may not be able to adequately grab some of the important co-founding factors in determining the acceptance of a technology. There are few studies that utilized exploratory sequential mixed methods in the study of acceptance of technology such as the study from (Donaldson, 2011).

Thirdly, the mixed-method approach offers not only "new tricks" for data collection and analysis; more importantly, it has the potential to foster the development of theory (P. F. Wu, 2012). There is a need to explore perception based on a model version that can better predict, such as UTAUT2, in which additional determinants have been added as compared to the previous model. The identification of a new variant or a new conceptual framework in the qualitative phase of research plays a role in helping to define the measures and questions of the survey instrument.

Fourthly, there are times when qualitative research can be best done because the researcher aims to explore the problem, honour the voices of the participants, map the complexity of the situation, and convey multiple perspectives of the participants. At other times, quantitative research may be best because the researcher seeks to understand the relationship between variables or to determine whether one group performs better on the outcome than another group (Creswell & Plano Clark, 2018). Quantitative survey methods appear to be well suited to the investigation of factors involved in the acceptance of technology systems by users. Many factors have been explored and empirically tested using survey tools, producing a rich set of findings for different user groups and a variety of technologies. Without a doubt, these studies have contributed a great deal to the understanding of the relationship between users and technology and human behaviour in general (P. F. Wu, 2012).

Fifthly, this design, exploratory sequential mixed method, can also intersect and be added into the methodological approach of evaluation. Many terms used to define this such as impact evaluations and program evaluations. Before evaluation methods can be carried out (such as develop and test the program), somehow the exploratory sequential mixed method design typically is required for needs assessment and theory development and adaptation. Besides, quantitative, and qualitative indicators of success of the program can be linked together across phases or merged to get a more complete picture of how to achieve positive program outcomes.

3.2.4 Philosophical underpinning

The philosophical assumptions that provide the basis for the design will vary depending on the specifics of the approach. Paradigms are conceptual and practical tools used to solve specific research problems; in other words, paradigms act as heuristics in social research (Kaushik & Walsh, 2019). Constructivism is usually associated with qualitative methods in which the researcher relies as much as possible on the view of the participants, shaped from the bottom up to broad patterns, and ultimately on broad understandings (Creswell & Plano Clark, 2011). In the meantime, post-positivist researchers interpret that research is a sequence of logically linked steps and that they make claims of knowledge based on objectivity, standardization, deductive reasoning and control within the research method (Kaushik & Walsh, 2019). Mixed method

approaches promote the use of different worldviews and encourage one to learn about paradigms that could include both quantitative and qualitative research, such as pragmatism (Creswell & Plano Clark, 2018). Pragmatism is dedicated not to any particular philosophical system, but rather to understanding the dilemma using all available methods (such as quantitative or qualitative) respectively. As a research paradigm, pragmatism is based on the assumption that researchers should use a philosophic and/or methodological approach that is best suited to the specific research issue being investigated (Tashakkori et al., 1998). In this regard, in the context of a pragmatic worldview, the focus is on the consequences of research and on research issues rather than on methods.

In this study, the researcher was examining the undergraduate nursing students' perceptions on the use of a smartphone application for self-directed learning of clinical skills. During the first phase, the researcher was implicitly using qualitative study which provided subjective meanings that provided multiple perspectives on their current experiences on implementing self-directed learning of clinical skill. This followed by their perception of the expectation of using a smartphone application for self-directed learning of clinical skills. This concludes with analysis producing codes or conceptual themes. The results of this analysis were used to direct the next, quantitative phase. In the second phase, the qualitative analysis provides critical feed for the development of specific research instruments for the quantitative phase. The researcher gathered statistical data that measures the undergraduate nursing students perceived behavioural intention to use smartphone application for self-directed learning of clinical skills. This study enables the researcher examining the behavioural patterns found in the first phase to a larger population. The researcher expected to identify the significant factors that influenced the use of smartphone application for SDL of clinical skill.

Next, in Phase 3, these significant factors were later mapped with potentially relevant design requirements. Chapter 6 describes the complete findings of this phase. The researcher utilizes the data from the literature review (Part 1), the qualitative findings (Phase 1) and quantitative findings (Phase 2), using methodological triangulation to address the design requirements and its relevance for developing smartphone application prototype. A framework mapping behavioural determinant with potential relevant mobile features was generated by the outcome of the identification.

Later, this framework was used to inform the design of the first prototype. Lastly, in Phase 4, the evaluation of the prototype would help the researcher to understand the effect of design features to the users, whether the nursing students were to be positively perceived while using it or not. Through these approaches, all objective and subjective values from each phase informed by the participants would then be integrated in one context. The overall flowchart diagram of the project of this study is illustrated in Figure 8.

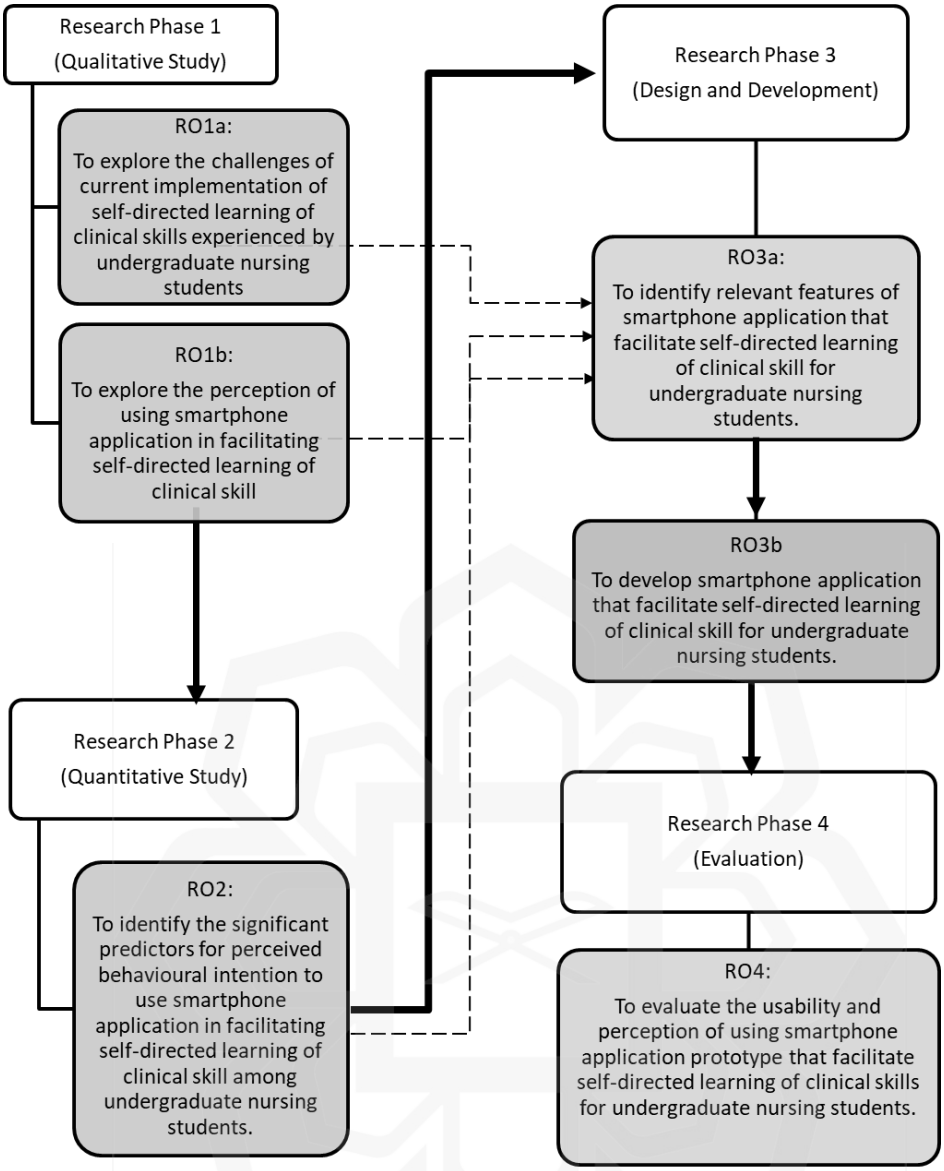


Figure 8 Flowchart process

3.3 RESEARCH SETTING

The data collection was conducted among undergraduate nursing students in Kulliyyah of Nursing, IIUM. The study involved four batches of student-years, Year 1 until Year 4. Since the faculty has vast experience in managing more than 14 batches of students, they are recognized as one of the independent nursing faculties in Malaysia. It has therefore helped the researcher to place particular emphasis on nursing education because of its supportive environment, which is always up to quality standards. It was understood that the faculty was well equipped with advanced learning technologies and facilities such as low-to-high-fidelity simulators, computer-assisted classroom learning, student portals, and updated nursing databases, which are conducive to research on how nursing education takes place, particularly SDL of clinical skill.

3.4 SUMMARY

To summarize, this study used a mixed methodology approach to explore the experience, particularly the barrier of current implementation of self-directed learning of clinical skill. Then followed by exploring the expectation of using smartphone application as an endeavour to facilitate self-directed learning of clinical skills among undergraduate nursing students. Then the findings were used to generalize towards a bigger population through survey design of the research population. The important variables are taken, and its related design elements are included in designing the smartphone application. Then, the researcher described what constitutes motivating and challenging factors based on the students' developmental ecology point of view such as intrapersonal, interpersonal, and organizational.

CHAPTER FOUR

PHASE 1: PROBLEM IDENTIFICATION AND NEEDS ANALYSIS

4.1 STUDY PURPOSE

This study begins the chapter by presenting an initial study on exploring current problems (or challenges) among undergraduate nursing students on self-directed learning of clinical skill. Afterwards, the researcher continues to explore what perceive the nursing students' behavioural intention to use smartphone application in facilitating the self-directed learning of clinical skill.

The first step for this research activity is identifying the problems. Identifying the problems experienced by the nursing students is imperative for this study because it would provide the researcher with the baseline information of the phenomenon besides it would help the researcher in intervening the problems with suitable solutions. Apart from the problem identification, the researcher is determined to explore the needs or expectations of the undergraduate nursing students in utilizing smartphone application as an effort to facilitate self-directed learning of clinical skills.

Therefore, the objective of this study is to explore the challenges of current implementation of self-directed learning of clinical skills and the perception of using smartphone application in facilitating self-directed learning of clinical skill. The specific research objectives of this phase are:

- Specific Research Objective 1a:
    - To explore the challenges of current implementation of self-directed learning of clinical skills experienced by undergraduate nursing students.
- Specific Research Objective 1b:
    - To explore the perception of using smartphone application in facilitating self-directed learning of clinical skills.

4.2 RESEARCH SETTING

The data collection was conducted in Kulliyyah of Nursing, International Islamic University Malaysia, a faculty that offered an undergraduate nursing program.

4.3 RECRUITMENT OF PARTICIPANT

4.3.1 Study Population

This qualitative phase focuses on undergraduate nursing students who are studying full-time in Kulliyyah of Nursing, International Islamic University of Malaysia. The study involved four batches of students, from Year 2 to Year 4. Year 1 is not included in this study because they are not yet fully exposed or completed a whole semester for clinical skill learning. There were two batches in Year 2 who enrolled in the program at two different semesters and one batch is from Year 3 and Year 4 respectively, which makes it a total of four batches.

4.3.2 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria of the participant has been included to help the assigned head of student to find suitable participants in their batch. The inclusion and exclusion criteria for this study were formulated based on the study's purpose. The inclusion criteria consisted of 1) undergraduate nursing student of Kulliyyah of Nursing, 2) student status is “active” in the database, 3) own and use a smartphone. Meanwhile, the exclusion criteria include 1) students not completing one semester for clinical skill, 2) students on leave.

4.4 ESTIMATION FOR SAMPLE SIZE

There is no specific rule of sample size in qualitative research. A smaller sample size of six to 10 may be used to describe the population experience (Moule et al., 2016). This is because qualitative studies are not generalizing but concerned with meaning (Mason, 2010). After all, the concept of 'saturation' has been used where the collection process has ended when there is no new information or themes in the data. In this study,

however, the researcher identified an initial 16 students as the basis for sampling, in which four students were selected from each program batch to minimize bias by selecting only a specific batch of students.

4.5 SAMPLING METHOD

In a qualitative study, the researcher uses purposeful sampling procedures to select individuals who can provide the necessary information to understand the central phenomenon. This study focuses on undergraduate nursing students, who are expected to have different perspectives on the central phenomenon. Sampling in qualitative research has several key features which are different from the quantitative method because it is not based on a statistical probability approach. In qualitative research, the number of samples is small, but the information discussed is in-depth and therefore produces a large amount of data.

4.6 DATA COLLECTION

4.6.1 Gaining Access

The approval of Kulliyyah of Nursing was obtained to gain access to the participants. The assigned batch representative was contacted by phone and briefed on the study objective. This is to obtain cooperation and ensure that the data collection process is well targeted at the population needed. Upon the understanding of the representative, a brief meeting was held with them, and the purpose of the study was explained again. A brief textual explanation was prepared and used to be distributed among nursing students in their batch, with the aim of finding an appropriate candidate to become the participant in the study interview.

Each participant who was willing to participate was personally contacted by the *WhatsApp* messaging application and personally informed about the purpose of the study and how to organize the interview session in terms of time and place. Once the agreement was reached, an interview session was arranged. A total of 16 nursing students participated in this study. The pseudonyms were given according to the number

of the participants. Details of the participants have been presented in the *Findings and Discussion* section.

4.6.2 Interview guide

The interview guide used in this study consisted of three sections which are:

1) Demographic details
2) Challenges in self-directed learning of clinical skill
3) Perceived intention to use smartphone application for self-directed learning of clinical skill.

It was developed based on literature review, the objectives of the study and the relevant thinking in line with the context of the research topic. In addition, a list of probing questions was prepared to prompt anything related to the subject to encourage the participant to elaborate their initial answer or to guide them back if they are side-tracked (Refer Appendix 2). Since the application is not yet developed, the researcher created several examples of snapshots of the smartphone application to help the students to understand how the smartphone application would look like. This is used as a Trigger for the students to gauge their perception and used to inform the interviewer about their expectation for SDL of clinical skills learning.

4.6.3 Pilot Interview

This interview guide was piloted with two postgraduate students and the audio recorded was checked by a lecturer at the host university, a researcher who was known for his experience in conducting an in-depth interview. This pilot interview also helped to improve the knowledge of the interview context and the use of recording equipment.

4.6.4 The Interview

a. In-depth Interview

The in-depth interview was the data collection method used by the researcher to investigate sensitive and complex issues, helping participants to respond easily. The choice of interview questions was based on the data needed to answer the first research question. By being physically present, the interviewer can reduce the number of "don't know" and "no answer" responses by looking for additional answers. In addition, the interviewer can clarify questions to the participants when needed.

b. Semi-structured Interview

This interview was open-ended to explore two topics: Part 1) the challenges on current implementation of self-directed learning of clinical skill, and Part 2) the perception of the expectation of using smartphone application to facilitate self-directed learning of clinical skill. The semi-structured interview was chosen as a method of data gathering for this study since the emotions, perceptions, intentions and beliefs of individuals cannot be observed as such, and so it is important to inquire directly to find out the viewpoints of the participants (Patton, 2002).

c. Interview Process

Interviews were conducted at the faculty area such as researcher workstation or postgraduate lounge. At the beginning of the data collection, the researcher made his own introduction and held a leisure conversation, such as asking for their recent day-to-day activities and well-being, which helps to foster a sense of ease and comfort for the participant. The interview was conducted in English or Malay to ensure the understanding of the questions and to make it easier for the researcher to seek clarification. The interview started in English first, however they were freely allowed to use the Malay language if this enabled them to express themselves more easily, and such statements were translated into English by the researcher.

The participant was informed about the objectives of the study and the importance of their participation in the study. The participant was provided with an information sheet and informed that they are encouraged to ask freely any questions relating to the study. They were also told that there was almost no risk of participating in this interview, and they might stop at any time during the interview session if they were not comfortable with the session. Participants were acknowledged and agreed to be audio taped during the interview session. Two audio recorders have been used in interviews, one of which is for backup purposes.

At the end of the interview, the participants were given the incentives as an appreciation for their contribution. After each interview session, the audio recorded was retrieved, copied, and stored in the storage device. To improve organization of audio file management, the researcher keeps each audio file with label as 'Participant #' followed by 'Part #' (such as Participant 1 Part 2). The researcher also stored the audio file in the cloud storage to secure the file from any hardware damage. It took about 45 minutes to one hour for an interview to complete.

4.7 TRANSCRIBING

Transcribing interview data is tedious and time consuming. As mentioned before, the data was collected using a digital voice recorder. The identities of the participants such as their names were removed during data transcription. All participants in this study were identified using code and pseudonyms to maintain confidentiality.

4.8 TRANSLATION

Some interviews were conducted in Malay language. The transcribed data were translated into English language. However, the structures of speech used by the participants were maintained to ensure the meanings were unchanged. To improve the trustworthiness of the data, cross-check was made with peer and researcher’s supervisory team.

4.9 METHOD OF DATA ANALYSIS

The use of qualitative descriptive approaches, such as descriptive phenomenology, content analysis and thematic analysis, is appropriate for researchers to use a relatively low level of interpretation, as opposed to grounded theory or hermeneutic phenomenology, which requires a higher level of interpretive complexity. Nursing researchers often use qualitative content analysis and thematic analysis as two analytical approaches in the qualitative descriptive study (Vaismoradi et al., 2013).

Thematic analysis as an independent qualitative descriptive approach is mainly described as "a method for identifying, analysing and reporting patterns (themes) within data" (Braun & Clarke, 2006). Thematic analysis can be described as a basis for qualitative analysis method (2006). The researcher used thematic analysis because it is a flexible and useful research tool which provides a rich and detailed, yet complex, account of the data (2006). It involves several processes of analysis including collecting, analysing, and reporting themes within data to organize and describe data sets in rich detail (2006). Content analysis uses a descriptive approach to both the coding of data and the understanding of the quantitative counts of codes (Vaismoradi et al., 2013). Conversely, thematic analysis provides a purely qualitative, detailed, and nuanced account of data (Braun & Clarke, 2006). It addresses issues related to people's experiences or views and perceptions about clinical skill learning. A deductive tool is effective in thematic analysis in order to evaluate a previous theory in different contexts, but it does not mean that there is an obligation to abide by that theory or framework (Vaismoradi et al., 2013).

4.10 THEMATIC ANALYSIS

Thematic analysis is a method of inspecting qualitative data and then identifying, and reporting patterns (Braun & Clarke, 2006). Thematic analysis is carried out through the coding process in six phases to create patterns from the data. Table 9 shows the phases of thematic analysis its descriptions:

Table 9 Phases of thematic analysis and its descriptions

Analysis Phase	Descriptions
Familiarising with data	Transcribing data, reading and rereading the data, noting down initial ideas.
Generating initial codes	Coding interesting features of the data systematically across the entire data set, collating data relevant to each code.
Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
Reviewing themes	Checking if the themes work in relation to the coded extracts and the entire data set, generating a thematic map.
Defining and naming themes	Ongoing analysis for refining the specifics of each theme and the overall story that the analysis tells, generating clear definitions and names for each theme.
Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a report of the analysis

In the first phase, data familiarization is often associated with researchers immersing themselves in the data collected. “Immersion usually involves ‘repeated reading’ of the data, and reading the data in an active way” (Braun & Clarke, 2006). This can be accomplished by listening to the audio files, reading the transcripts repeatedly and referring to field notes before starting coding. It helped the researcher to search for meanings and patterns of the data by providing an insight into the topics discussed.

Once the data were familiarized, a list of the initial codes would be generated based on the initial list of ideas. Codes are the most basic segment or element of raw data or information that can be assessed in a meaningful way with respect to the phenomenon (Boyatzis, 1998). The code may be in the form of a name or phrase that the researcher perceives as a significant or useful piece of information. The researcher makes full use of a software program of data management namely *NVivo 12.0*, to

process all the transcripts based on the initial codes. The initial ideas on possible themes were also noted while making codes as they could speed up the theme search process in the next phase, in addition to preventing the loss of content or issue (Braun & Clarke, 2013).

The next phase was searching for themes. After initial coding, searching for emergent themes based on the codes that the researcher combines would be helpful for themes development. The process of theme development involves examining the transcripts that should be in coherent with the study's guiding questions and literature review. In *Nvivo 12.0,* all codes which share similar meanings by the researcher will be grouped into nodes. Codes were sorted into categories based on how they could be linked or clustered together (Braun & Clarke, 2013) . The researcher also carefully justified the themes again and again for its relationships or differences among them, to ensure thoroughness and consistency (Braun & Clarke, 2013). For example, in a synthesis of ideas about the acceptance factors to smartphone application use, the following codes: 'save time', 'convenience', 'less time-consuming', 'better for us' were identified under the higher category 'perceive convenience.'

The researcher started phase 4 of analysis, reviewing the theme, by refining the initial themes. "During this phase, it will become evident that some candidate themes are not really themes" (Braun & Clarke, 2006). Some of the identified themes were not solid enough or being too specific or too diverse. This phase was crucial where consideration of the specificity takes place, to ensure the themes are related or should the themes further need to be broken down into subthemes (Braun & Clarke, 2013).

The next step, defining and naming themes took place by outlining the properties of the theme, the point at which the researcher defined and refined the themes that were presented in the analysis (Braun & Clarke, 2006). The researcher writes a detailed analysis of each theme, brings out the distinctions within the data, and clearly explains the theme in relation to the overall research study. This process will help during final preparation of the analysis, by providing the reader with a clear understanding of the outline of what the theme is talking about.

Lastly, the worked-out themes were ready to set out, this involves the final analysis and writing up the report. The evidence written in the report must be sufficient

by which each step in the thematic analysis was reviewed and discussed with the academic supervisors. Likewise, the final thematic analysis table was generated with proper monitoring by the academic supervisors. For example, the use of examples for the theme must be identifiable and relatable to the theme, besides, it should connect back to the research question.

4.11 METHODOLOGICAL RIGOUR

According to Lincoln and Guba (1985) the trustworthiness and rigor in qualitative study depends on these criteria; 1) credibility, 2) dependability, 3) transferability and 4) conformability. These criteria were adopted to ensure that readers had sufficient information to access the validity of this study.

a) Credibility

Credibility means the data presented is a true representation of the participants' view. The readers will be able to evaluate the sensibility of the research design, process of data collection and data analysis which is appropriate to answer the research questions. Several strategies were carried out to enhance the credibility of this study by adopting an appropriate research design to answer the research questions, applying purposive sampling to recruit the students from every year of study, prolonged engagement in the field, comparing students' transcripts, and having all the codes and themes applied cross-checked by peers and experts.

b) Dependability

Dependability refers to how constant the data were produced if the work was replicated using the same methods. Every step in the research process was reported in detail in the conduct of the present study. Similar findings would be achieved if the study is replicated using the same methods involving similar students. The researcher took notes on the participants' responses during interviews which will help to confirm the objectivity of the study.

By executing the 'Coding Comparison query' function of the software Nvivo 12, the researcher can evaluate the inter-coder reliability, in which it generates Cohen's

Kappa coefficient value. A value of 0.80 were considered as perfect agreement (McHugh, 2012) and hence to finalize both of specific objectives in this phase; 1) challenges during self-directed learning of clinical skills and 2) perceived behavioural intention to use smartphone application among undergraduate nursing students in self-directing their clinical skill learning.

c) Transferability

Transferability refers to the degree the findings can be applied to other situations or settings (Lincoln & Guba, 1985). It is the responsibility of the researcher to provide a detailed description of the data and setting so that others who are interested in making a transfer of the findings could decide in this regard because of the similarity of the context. Besides, the demographic context of the students has been explained to provide the contextual information about the study setting which other researchers can make comparison too.

d) Conformability

Conformability refers to the neutrality and accuracy of the data (Tobin & Begley, 2004), it relates to how the study findings were presented in an unbiased account. The findings of this study were solely generated based on students' own ideas and experience. Several steps were carried out to ensure the concept of conformability is fulfilled. The Malay quotes from the transcription were translated into English language to denote what they have said in this thesis. Most transcription has been assisted by another party, however there is one audio that has been made by the researcher to understand the intensity needed for research to be immense in the data. For transcriptions that have been provided by a third party, the researcher compared the audio and the text to confirm the exact word and meaning line by line.

4.12 FINDINGS AND DISCUSSION

4.12.1 Demographic detail

A total of 16 students, 12 females and 4 males, aged 20 to 24 years old participated in the interview session with each lasting for approximately 45 minutes to an hour. The

students were identified using pseudonyms to maintain ethics of the study. The details of the students' socio-demographic characteristics are summarized in Table 10.

All participants graduated from foundation study of the main university except one who had graduated from Malaysian high school certificate or STPM. In the following section, the researcher will present the interview findings among nursing students, which covers both specific research objectives which are 1) challenges of self-directed learning of clinical skills and 2) perception on the expectation of using smartphone application for self-directed learning of clinical skill.

Table 10 Participant demographic data

ID No	Pseudonym	Gender	Year/Batch	Study background
ID01	Participant 1	F	3	IIUM CFS
ID02	Participant 2	F	3	IIUM CFS
ID03	Participant 3	F	3	IIUM CFS
ID04	Participant 4	M	3	IIUM CFS
ID05	Participant 5	F	4	IIUM CFS
ID06	Participant 6	F	4	IIUM CFS
ID07	Participant 7	M	4	IIUM CFS
ID08	Participant 8	F	2/2	IIUM CFS
ID09	Participant 9	F	2/2	IIUM CFS
ID10	Participant 10	F	2/2	IIUM CFS
ID11	Participant 11	F	2/2	STPM
ID12	Participant 12	F	2/1	IIUM CFS
ID13	Participant 13	F	2/1	IIUM CFS
ID14	Participant 14	M	2/1	IIUM CFS
ID15	Participant 15	M	2/1	IIUM CFS
ID16	Participant 16	F	4	IIUM CFS

4.12.2 Challenges of Nursing Students' Self-directed Learning of Clinical Skill

In this study, the researcher presented the findings on the challenges of self-directed learning of clinical skills among undergraduate nursing students based on the developmental ecology model category, which signifying seven significant challenges identified by the undergraduate nursing students in the Table 11:

Table 11 Themes and subthemes on challenges of self-directed learning of clinical skill

Theme	Subthemes
Lack of self-management skill	Poor time management
	Lack of communication with educator
	Lack of assessment of learning needs
Lack of desire to learn	Not open to new ideas
	Lack of internal motivation
	Educator-dependent in the search of new information
Lack of self-control of learning	Lack of awareness on self-evaluation

The following sub-sections will describe in detail the trends of participants' quote for challenges of self-directed learning of clinical skills identified from the analysis, which are lack of self-management skill, lack of desire to learn and lack of self-control of learning.

4.12.2.1 Lack of self-management skill

Self-management skill is known as the capacity of the student in implementing set goals and how the students can effectively manage the resources relevant for their learning. There are three subthemes being addressed related to self-directed learning of clinical skills among undergraduate nursing students: a) poor time-management, b) lack of communication in learning and c) lack of assessment in learning needs.

a) Poor time management (Intrapersonal)

Good time management requires a student to plan and consciously control their activities to increase the efficiency and productivity of their life. A student in Year 2 addressed one of the weaknesses in time management is unable to prioritize learning activities. She insisted that she had difficulty going to a practical session in the clinical skill centre because of the load of assignments, as saying:

> "… we need to do a lot of hands-on practice but because of lack of time [and] so many assignments, so we don't have much time to do the hands-on [practice]…" (ID15, Y2S1)

Similarly, a student reported that she could not manage to conduct clinical skills practice due to the need to participate in co-curricular activities on campus:

> "… when I was in Year 2, it is a busy year and I was not able to practice in skill lab, I have to handle many programmes." (ID16, Y4)

Besides, the lack of time management is influenced by the lack of awareness among nursing students to address the academic timetable designed for them, especially for practical session. There was a participant saying:

> "…because we used [Self-directed Learning] slot for doing assignment." (ID01, Y3)

b) Lack of communication with educator (Interpersonal)

A good management of learning required a good collaboration and communication of the students with the educators. However, clinical skill learning activities were poorly accepted by the student resulting from a lack of understanding in communication. A response from the student showed that the students were not well-communicated in the preparation of the clinical assessment by saying:

> "…we do the procedure, but the lecturer expect us to do different thing. Like I just said, we learn from others [but] assessed by others." (ID15, Y2S1)

c) Lack of assessment of learning needs (Interpersonal)

The nature of the clinical skill procedures involves complex and long procedures such as sterility-related procedures. One student commented that the amount of learning is becoming more complicated over the course of the year of study, while the student admitted that there was a lack of a proper learning plan to deal with this issue, as follows:

> "At first time, learning the procedure during my first …is simple so we don't need a lot of practice. But for this semester… the procedure is quite complicated and there are a few factors that we need to take care of, like the sterility, the technique ..." (ID15, Y2S1)

From the interview analysis, students are well aware of limitations in the learning environment, such as crowded learning sessions and limited equipment, but unfortunately there is still a lack of concrete efforts to address this issue, as the researcher indicated as a failure to assess the need for learning:

> "…It's quite hard for us, we have 70 students, so every student wants to practice, it's impossible." (ID14, Y2S1)

> "… when we want to practice skin traction, plaster…is very limited, we [are]... competing [each other] to do that thing… those who [came] late they didn't get the [chance to] experience." (ID13, Y2S1)

4.12.2.2 Lack of desire to learn

Desire to learn associate the motivation level of the students with their capability of appropriately seeking new information, in consideration of improved learning needs. Three sub-factors have been identified to inform the characteristics of this theme, which are a) not open to new ideas, b) lack of internal motivation, and c) educator-dependent in the search for new information.

a) Not open to new ideas (Intrapersonal)

Many lecturers and clinical instructors have different clinical backgrounds depending on the clinical specialties (such as midwifery, emergency nursing, critical care nursing), and the experience they have gained in their industrial careers. Rather than finding this

as an opportunity, however, the students perceived it as an intimidation to become self-directed learners:

> "…there have been issues whereby the procedures are not being agreed by both sides. That's why some procedures, ok let's say for the injection of Hep B and also BCGs, some say we need to use dry swab, some say wet swab, so it needs to be agreed by both sides…" (ID05, Y4)

In addition, as part of the process checklist prepared by the faculty, students also get their reference from other international academic materials available on the internet. However, there were too many versions of the procedure checklists issued by one student which make it difficult to adapt to the Malaysian context:

> "It is not from the faculty version and sometimes it is different because the *Clinical Skill* [web program] is based on American, Europe, so sometimes there are different guidelines but same procedure." (ID13, Y2S1)

b) Lack of internal motivation (Intrapersonal)

A nursing student must foster an ardent attitude towards the ability to regulate and adapt to the demands of learning and to make it one of the top priorities of the learning process. This practice enables nursing students to evaluate and adjust their strategies as necessary to facilitate their progress. Anxiety is one of the most important findings among nursing students during clinical skills learning. Generally, the reason for such behaviour to happen is because of fear of wrongdoing:

> "… I really think whenever we get [to be] assessed, we will not be doing okay… we feel like very scared so we tend to do a lot of mistakes." (ID08, Y2S2)

In addition, loss of focus and confusion are further contributing to the lack of motivation among nursing students to learn clinical skills. The student stated that the problem was anticipated because there is a restriction on the opportunity to observe and learn during guided practice. A year 2 student said:

> "But when there are many, crowded people I would … lose focus." (ID13, Y2S1)

c) Educator-dependent in the search of new information (Interpersonal)

One of the criteria for a proactive learner is to take responsibility by monitoring their learning activities, with or without the help of others. Students whose lack of readiness for self-directed learning tends to be teacher centred. In this study, it is noted that students have relied heavily on their educator to conduct learning activities, as one of the students saying:

> "The lecturer also has their tight schedule, they only ask us to go to the skill laboratory and the clinical instructor only monitor us, so usually the clinical instructor will give their feedback." (ID15, Y2S1)

4.12.2.3 Lack of self-control of learning

The third theme of this study is the lack of self-control in learning. Self-control addresses the process by which a student is self-determined and sets out his or her learning objectives, takes on responsibilities, recognizes his or her own abilities and makes decisions of his or her own. The findings of the interview found that students are not aware of the importance of self-evaluation in their clinical learning skills, which reflects a low level of self-directed learning.

a) Lack of awareness on self-evaluation (Interpersonal)

The process of self-evaluation of clinical skills also often requires the use of assistive documents for recording purposes. Students typically use the logbook system to keep track of the procedures they practice in the clinical skills laboratory. From the analysis, a fourth-year student admitted that he had abandoned the logbook system since he was in Year 2:

> "Honestly, right now, no. Because last time I remember I only use the logbook until second year. But when enter third year, I'm not sure. I even don't know where is the book…" (ID07, Y4)

Furthermore, one person has admitted that students are exploiting the system even when they are not performing the procedure, taking advantage of the system's weakness to obtain clinical skill practice verification from the instructor, by saying:

> "…some of my friends sometimes they don't really do the procedures correctly. But they will say to the lecturer that they [have] done it and the lecturers or clinical instructor just gave the signature to them." (ID08, Y2S2)

On the other hand, as the researcher understands that the students concerned about carrying out the logbook system, there was also a case in which the student did not want to complete the logbook due to the uneventful process:

> "This did not affect the performance because our practice did not based on what in the log book. Some of the students practice but they did not get the signature for the log book." (ID14, Y2S1)

4.12.3 Perceived Acceptance to Use Smartphone Application for Self-directed Learning of Clinical Skills

This part presents the factors affecting the perceived acceptance of using smartphone application for self-directed learning of clinical skills based on categories of adapted Unified Technology Acceptance and Use of Technology 2 (UTAUT2) for self-management of learning. The seven most significant factors identified by undergraduate nursing students are summarized in the following Table 12:

Table 12 Themes and subthemes on perceived acceptance to use smartphone application for self-directed learning of clinical skills

Theme 1: Learning performance
Mobility
Perceived convenience
Useful content
Theme 2: Ease of use
Ease of use
Learnability
Simple attributes
Theme 3: Encouragement
Faculty member influence
Peer influence to use
Theme 4: Habit formation
Notification as reminder
Notify user login
Theme 5: Interactivity
Social interactive content
Colourful and animative
Social competitive attribute
Theme 6: Technical and support system
Hardware specification
Infrastructure- Internet access
Technical support
Theme 7: Self-management of learning
Reflection of learning
Self-monitoring of performance

The following sub-sections describe in detail participants' quotes for supporting subfactors identified at each category of adapted UTAUT2 model for using mobile application for self-directed learning of clinical skill.

4.12.3.1 Learning performance

The first factor developed in this research is learning performance. The nursing students found that it would be helpful to use the app if it had a positive impact on their performance in learning clinical skills. In this research, in comparison to the use of physical learning tools such as books, the participants felt that using the smartphone application was convenient and helpful. In addition, mobility has provided an advantage because it is easy to access anywhere and anytime. These qualities were, therefore, greatly appreciated by the participants:

> " saves time because once we have installed it, it is readily available. So once lecturer asked [about procedure], we suddenly feel the urge to search for it. It means no need [to] Google. [It] saves time…" (ID10, Y2S2)

> "As for the smartphone, we will bring it everywhere we go. Even you don't plan or even during boring time, we will try to scroll down what is interesting for us and I think the tendency to open that app is really much higher than opening a book." (ID05, Y4)

Perceived convenience is important factor for the acceptance of smartphone application for self-directed learning of clinical skill. In this study, this factor addressed how the use of the smartphone application will assist in quickly completing the task or more subtly improving learning. As one was saying:

> "It eases [us] actually. It eases in like, one, about medication, it includes all [medications]. It has all indications, side effects, all of it, so it eases us for learning." (ID10, Y2S2)

> "So, if we have this virtual guideline, it will use less time consuming" (ID13, Y2S1)

Likewise, the participants would be delighted by the useful content of the application that can help to improve their performance and provide motivation for learning. Somehow one participant gave an example of an app, *3-Min Workout*, a physical activity app that can motivate a user to perform a healthy lifestyle activity: There are many similarities of other apps that can be adapted to this research:

> "… you can start doing the exercise and it provide timer for you. It provides steps and timer, video of the exercise, it feels like you are doing the exercise with the coach." (ID13, Y2S1)

The participants expected the application would be the perfect guide for accessing important learning material such as procedure checklists. In addition, they also emphasized that the content should reflect the practice of the people in the faculty; therefore, the quality of the content should be credible and consistent to all users. Besides, it assists the student in recording their learning activities. Traditionally, physical form recording is regarded as burdening because it is not resourceful. With the advantage of the built-in camera smartphone, it is prudent to assist the student to record the entire clinical practice session without worrying about missing any steps during the teaching and learning of any procedures for clinical skills. The participant accordingly mentioned:

> "…it will affect my performance…if everyone uses this app, we have the same guideline. If the lecturer also refers to this app, then we didn't have different guideline." (ID13, Y2S1)

> "… Kulliyyah maybe can set that the procedure maybe can be done just like the video. So, the video can also be done by the CI or the lecturer. So, they need to set a standard to give mark based on the video on the apps." (ID15, Y2S1)

> "I'm more likely to use smartphones during learning, because even myself take note … using my smartphone." (ID15, Y2S1)

> "… we used our smartphones to record the skills [procedures] that were conducted by the CIs…" (ID02, Y3)

4.12.3.2 Ease of use

Another factor that supports the adoption of smartphone application for self-directed learning of clinical skills is ease of use. The nursing students believe that if operating the application is as simple as operating other similar kinds of applications, they will easily use it, as Participant 16 said:

> "No problem because easy to access … Nowadays, it's modern… everybody use smartphone, everybody uses Wi-fi, people are obliged to

> have one. If it's apps like this, like *WhatsApp*, right, [it's] easy." (ID16, Y4)

Participant 05, who admitted to having less interest in using the mobile application, claimed that there are still opportunities to learn by using this smartphone application. However, when compared to the other students, perhaps she needed more time to understand the system. At the same time, Participant 10 also believed that the app could include features that might help instruct the new user to use the application:

> "As for the usage of application in the smart phone, as for me, myself, honestly, I will need time extra time, more than other people to learn, the application is all about." (ID05, Y4)

> "[Among] instructions for first time users, it tells us, it instructs us, ok next. That is for first time. So that is to guide the newbies." (ID10, Y2S2)

The variability of the attributes of the application must be part of the application quality. Some of the considerations include the usability of interface design of the application, which must be organized and simple:

> "I think, maybe, for this apps right, [should be arranged] by topic right, better by year, [so] at least when one needs to access [a topic], okay year one, what are they learning, and then what are the topics learnt, when he/she looks at the apps, it is easier to search [for a topic]. To conduct quizzes. To search for procedures, so they are not disarray. It means [it is] better [to arrange] by year or by subject…" (ID03, Y3)

4.12.3.3 Encouragement

Another indication of acceptance of the use of smartphone applications for self-directed learning of clinical skills is encouragement. In this study, the faculty members such as the educators and clinical instructors are the most influential people for nursing students, followed by peers. Most students insisted that the educator would really influence them to use the smartphone app because it would benefit both the educator and the students, as students saying:

> "But most influence [to use apps] always by lecturer, because this apps so convenient to use. Like, lecturer doesn't always have to provide checklists, then the class rep to [give] copies [of the checklists] for everybody, wasted money for papers." (ID14, Y2S1)

> "Maybe actually lecturer or CI can influence us because since they need to make sure that our skills is updated or good, maybe they can ask us to use this app so that when they want to evaluate us for the next test or exam so they can identify improvement." (ID07, Y4)

In addition, the latter influencer for the application's adoption is peers. In addition to having the same level of experience as a nursing student, their age is usually similar; they therefore share a similar interest in learning. When the students have been asked about who could influence the use of the application by other people, one participant stated:

> "I would say my friends. Because they are same people that struggling with me in learning of the procedure…we share the same common interest." (ID05, Y4)

4.12.3.4 Interactivity

Interactivity has been a motivator for the nursing students, known as the generation of Gen Y, who usually inherit the interest of pleasant and hedonistic innovative technology. As one participant reiterated, the students are satisfied with colourful and interactive application:

> "I think the design should be like cheerful with some cheerful background colours because at least it could motivate us." (ID11, Y2S2)

> "The most important thing is, the picture is moving. That is important. And then colourful… sometime colourful [pictures] easy for us to recall." (ID04, Y3)

Then, the student posits the likeliness for the social interactive content of the mobile app features, such as game and motivational dialog, will increase their motivation to learn. The participants said:

> "…like quizzes… that can make us enjoy [the subject]." (ID14, Y2S1)

> "Motivation words and praise. You did a great job today. for example. Feel like it boosts up your spirit. Because if your life or your performance is always being criticized without praise it's going to let you down. So fun, enjoyable and self-boost kinda spirit..." (ID05, Y4)

Interestingly, the student also believes that it will help to induce social competitive culture by using the same application among peers, therefore helping them strive for better performance:

> "I think that all the members will have the same guidelines, better performance and actually when we use this app, maybe we can compete each other. You do this for 3 time, you 2 times. So, you have to beat me maybe. We can compete and it takes more fun." (ID09, Y2S2)

4.12.3.5 Habit formation

Another advantage for SDL of learning using smartphone applications as perceived by the students was habit formation. There was a belief that smartphone apps were particularly helpful for daily activities, and it was inevitable. There are two main reasons admitted by the students that would assist them to form a habit of learning because of using smartphone application which are a reminder of user learning activity and as a user behaviour monitoring. The participant noted each of the reasons accordingly:

> "For me, like now, our English lecturers ask us to install Binge. It is a vocabulary apps that keep on popping in the smartphones of new words every day. So, I hope that this apps also, we sometimes tend to forget, I hope that this app keeps on reminding us on what procedures that we still need to learn and improve." (ID11, Y2S2)

> "At any time, any place, we can open the apps to review […]. Because every time we use this apps, it can count… how many times we open the apps in a day." (ID14, Y2S1)

4.12.3.6 Technical and support system

The nursing students considered technical and support systems to be critical resources when using the smartphone application. Critical resources are necessary to support the students to accomplish a goal or carry out an activity for learning. To ensure that the smartphone application to run smoothly, the identification of the hardware specification is essential. Based on the interview, the types of smartphone platform and the smartphone memory capacity are the worrying things as informed by the students. The examples of both are indicated accordingly:

> "I prefer Android… compared to iOS. Even any type of brand that released by manufacturers [will] use Android. Only one [that] use iOS, only Apple. So, I think I prefer Android." (ID07, Y4)

> "Many apps downloaded depend on the memory. When [an apps] is downloaded, memory's full. So, it always can be a problem." (ID16, Y4)

The location and speed of the internet are examples of infrastructure support that is important for application engagement. The location of internet coverage in the skill centre, rest area, café and classroom must be made available:

> "I really think that the Kulliyyah of nursing should provide a high-speed Wi-Fi for us so that we can easily download and we don't have to buffer the video. So, we can like look at it right away, not loading…" (ID08, Y2S2)

Then, the reporting system is another crucial function which can help the student to make report and receive feedback for any issues pertaining the application failure, as Participant 13 stated:

> "I think it is very crucial for this app to have like report section... you can find it [in] many apps, if we found an error and report we can click the button and report." (ID13, Y2S1)

Besides, the students will probably need more time to learn about the app and the faculty must provide training before it can be used to the fullest extent, as a Year 2 student said:

> "In terms of...training. Because I think someone, if the lecturer or the developer or the person in charge itself could explain to us about the app, how to download it, how to use it so that we able to use it like efficiently, like sometimes we just download it and we don't know how to actually use it. So, if someone can teach us, then it will be fine." (ID08, Y2S2)

4.12.3.7 Self-management of learning

One of the factors in self-management of learning is the ability to self-manage one's own learning. Self-management of learning in this study possesses reflection of learning and self-monitoring. Reflection of learning will help the student to address their current performance. The two prominent quotes from these Year 2 and Year 4 students are:

> "…and then this apps can help in confirming the procedure, whether they do it correctly or not." (ID15, Y2S1)

> "Then I want to look back at what I did wrong, and I will review back the video or the apps, what equipment you need to have right. So there we can check back, in one app, we can know everything." (ID6, Y4)

With the help of this smartphone application, self-monitoring for the performance of clinical skills can also be done. The performance evaluation based on the completion of the task achieved by the students is a grade-based strategy. The procedure is done by the lecturer or clinical instructor most of the time. The time-based approach, meanwhile, is the evaluation of performance based on the students' completion time.

> "For example, this apps can let us know how much we have done, then, how much more we have not achieved. It can motivate us, encourage us to achieve that..." (ID10, Y2S2)

> "Actually, in our OSCE, we have to do the procedure in 5 minutes so... during our self-practice we also record like set the time 5 minute and try to do the procedure." (ID12, Y2S1)

4.13 DISCUSSION

This qualitative study aimed to explore the views and perspectives of nursing students of Kulliyyah of Nursing, IIUM on 1) exploring current problems among undergraduate nursing students on self-directed learning of clinical skills and 2) to explore what perceive the nursing students' behavioural intention to use smartphone application in self-directed learning of clinical skill.

4.13.1 Selection of participants

The nursing students were purposive, selected from each batch of year to obtain different thoughts of the experience in the program. Face-to-face interviews with the participants were found to be useful to obtain their personal opinions that they may not have been comfortable with sharing in the presence of other people (Setia, 2017) especially the lecturers or clinical instructors. The method of purposive sampling indicated that the participants had rich knowledge with different insights in the investigation of the phenomena (Palinkas et al., 2015).

4.13.2 Views of the current problems on SDL of clinical skill

Self-management of learning

The result of this study indicates that challenges in self-management of learning include assessment of learning, communication, and management of time. First, time management was the most prominent challenge in this study, with most students admitting that they had trouble managing their time in order to practice clinical skills. In this study, the students used time to perform other academic tasks reserved for clinical practice. This problem may arise when the student underestimates how long it will take for them to complete the practice of clinical procedure, even if they have experience before completing the same types of procedure. For example, if the student had experience in completing 20 types of procedure in the previous semester, it does not mean that he or she will still manage to complete another 20 types of procedure in the following semester. In addition, the level of difficulty of procedures changes throughout the year of the program, so it can be even more difficult to complete the procedures. Few supported findings from previous studies showed that a self-directed learner should appear efficiently organized in managing time (Rensburg & Botma, 2015) and have a motivational relationship (Ghiasvand et al., 2017).

Second, communication is another challenge to self-directed learning of clinical skills among nursing students. In this analysis, the communication between students and teachers was not entirely clear. The students considered that there is a problem with how each teacher carries out the evaluation on them, which differs from one teacher to another and differs from what they were taught during the learning session with what was expected during the evaluation session. Clinical skill centre is the best place to train clinical communication among nursing students, if not it can lead to ineffectiveness of nurses' and other healthcare teams' potential. O'Mara et al. (2014) even mentioned that if there is a lack of common understanding in the implementation of self-directed learning, the students may develop motivational problems. Arguably, the ability to interact with others is an important part of nursing students' lifelong learning ability (Su-Fen et al., 2010).

Third, lack of assessment of learning is another barrier to self-directed learning of clinical skills among nursing students. Most participants carried out their clinical skills practice in this study without properly mentioning the evaluation strategy or setting the goal for their learning. The focus of the learning assessment was on the inability to understand the complexity of the procedure for clinical skills. Students tend to give environmental excuses, such as the lack of opportunities to perform procedures and too many students. In reality, if the learners can effectively prepare their learning plan, this problem can be minimized.

Desire of learning

Other challenges which are related to desire of learning are not open to new ideas, lack of internal motivation and educator-dependent in the search of new information. First, the lack of openness among nursing students to accept different kinds of opinions or ideas from educators in relation to clinical skills may lead to difficulties with the desire for learning. Many understand that educators are the products of different healthcare and learning organizations, so nursing students value their experience. The learners demonstrated their discomfort and confusion because they did not adapt well to interaction and master the capacity to accept other people's ideas. Probably because they did not know that there is always the opposite of an opinion. By working to change the mind, such as respecting others' opinion and trying to approach the situation calmly, such as the debate, the student may have to deal with this situation. This will help create the personality of self-directed learners who accept the freedom to learn and openness to learning opportunities (Rensburg & Botma, 2015).

Second, internal motivation is another type of challenge that affects the desire to learn. Inner motivation is driven by one’s needs, values and feelings, which refers to doing something because it is inherently interesting or enjoyable (Ryan & Deci, 2000). In this study, the students were afraid of creating mistakes as they were not well-prepared to manage the mistake experience, because of this they were afraid of trying something new. Fear and anxiety can affect psychosocial conditions, which can lead students to be less involved in learning activities (Baraz et al., 2015). Psychological

empowerment can therefore be improved, as it has been recognized as the primary predictor of learning (Safari et al., 2011).

Third, the students rely too much on seeking help from the educator for learning clinical skills. This is not a good indication that the learning would take place with desire, because a lot of energy was spent on a particular issue that is not important repetitively. In this study, the students were not too happy that the lecturer was not always there when they were practicing in the clinical skill centre. Besides, this problem will lead to trust issues where they may limit peer-to-peer interaction, reluctant to think for themselves or make decisions for themselves.

Self-control of learning

Unable to self-evaluate one's own learning is another challenge which denotes the level of self-control of learning, which is another component of self-directed learning. For self-evaluation, the use of supporting documents (such as logbook of procedures and checklist of procedures) is quite common; in fact, most nursing schools use these documents as a means of guiding or monitoring student performance. Unfortunately, it has not been perceived as effective and efficient in maintaining student self-control. Due to lack of user-friendliness and poor implementation, students have missed several important skills activities and opportunities to self-assess their performance for future improvement. It was to be used to avoid unhealthy excesses of anything that could adversely affect, such as procrastination, in learning. Students with a high level of self-control are better able to manage their daily and routine learning activities, thus avoiding problems easily, coping with learning tasks and overcoming possible learning difficulties.

4.13.3 Views of the perceived adoption of smartphone application for SDL of clinical skill

In comparison to the use of any paper-based learning material, the participants felt that if they used the smartphone application, it would be convenient and useful. Mobility of the technology gave an advantage as it is easy to access anytime and anywhere. It is

agreed by many that, because of the mobility and capacity of the devices, the use of wireless technologies can help learners to be independent in learning (Barker et al., 2005). It helps users to complete tasks, such as looking up clinical procedures more quickly or improving learning more subtly, as it is convenient for users. As mentioned by O'Connor & Andrews (2016), learning could be improved by using mobile apps such as making educational information available quickly and easily on them, therefore it overcomes the lack of effectiveness of physical form tools for learning in clinical environments. Using smartphone applications is useful, benefiting them in the form of motivation because using mobile technology helped reduce their anxiety around learning, made them more independent and it meant they did not have to waste the educator's time with unnecessary or repeated questions.

Several students also reported that it is easy to use smartphone application for SDL, because the way they perceive using the application is similar to the way they will operate other similar kinds of applications. Gen Y, is portrayed as a multitasker with technology (Bhave et al., 2013), has an optimistic tendency towards technology. They believe that technology can boost their efficiency; they are also not easily intimidated by new technologies. Although there is one student with less interest in learning with a smartphone application, it did not directly prevent her from using such an application. She believed that, however, the application can be installed with the mobile feature that can help her to learn using the app for example using the *step-by-step instruction.* In response to the smartphone usability that led to the user's usability hurdle, it is necessary to design interfaces that are simple and easy to navigate. The explanation is that a complex interface with deep hierarchy design will increase the cognitive burden on users by forcing more choices (Xie et al., 2013). Therefore, it is not a big issue for students to use any new type of application if it is simple to operate, learnable, and designed with simple designs and attributes.

It is the responsibility of the educators to demonstrate high expectations and trust, promote caring relationships and provide ongoing opportunities for reflection and decision making for the nursing students (Froneman et al., 2016). Similarly, in this study, most students insisted that the educator would be the main person to influence them to use the application. Each student is expected to be given equal opportunities to interact with the teachers to improve student-educator relationships and

communication. This will further fulfil the idea that educators are good listeners, that students are always involved as fellow human beings, and that they take care of their relational needs. In addition to educators, peers are among the important individuals mentioned by the participants in this study who contribute to the use of smartphone applications. Most students were of the same age, so they have similar abilities or a commonality of experiences (Stone et al., 2013). Peers are important for adoption of the smartphone application in SDL because they will benefit from the interaction, as studies have shown that it is associated with increased levels of learning skills such as problem solving, communication, and leadership. On the same line, students will gain confidence and prevent anxiety when dealing with clinical situations.

The students found that it is interesting to use smartphone application because it inherits the pleasing features for visual satisfaction and provides an element of fun and enjoyment. Students love to use such a colourful application, while it would be an added value to design the app with playful interaction such as *game* and *motivational dialogues*. Smartphones and tablet devices provide diverse media to the user such as pictures, background music, videos, and animations. Such media offers a fun mobile atmosphere for students while learning. In addition, the students also indicated that the smartphone application is essential for the development of a culture of competition among students in clinical skills learning. By leveraging the natural drive of human beings to compete, the application can motivate learners to adopt a targeted behaviour. It is also reported in another mobile learning study saying that the use of digital games in education necessitates standardized curricula that promotes competition, achievement and reward structures (Camilleri & Camilleri, 2019). Therefore, a student who perceives smartphone application for SDL of clinical skills to be an enjoyable process will have a positive attitude toward mobile learning.

In this study, the students pointed out their interest in the *reminder* and *behaviour monitoring* element that the smartphone can offer. The integration of smartphone applications into daily life of the students also forms regular habits. Reminder and behaviour monitoring are perceived as part of the habit-forming elements that could reach students daily. *Reminder* can help a student to set in motion their target task, which will make students more likely to do so. For example, a mobile learning study on *English Practice* app (Pham et al., 2016) used push notifications to remind the

students to use the app frequently, further it helped increase session counts, time consumption and retention of using the app for learning.

Technical and support systems were important for a student to adopt the smartphone application for SDL of clinical skill. Among several technical supports mentioned in this study were the hardware specifications of the users' device. The issues of hardware, such as small screen and power capacity, have been discussed since earlier study of mobile learning in the early 2000s. However, smartphones nowadays are advanced with the highest pixel, in which the benefit has outweighed its weaknesses. Besides, the use of Android was more popular than iOS because Android is available on many types of brands that the student owns. The speed of the internet was also reported important for the student to continuously engage with the content of the smartphone applications, especially watching the video of the clinical procedure demonstration. In terms of smartphone application, the students are looking for how a reporting system can be made, in which it is important for them to issue a problem they found to the app provider. All these critical resources are important to be fulfilled to prevent uninstallation of the app. If a request does not work as expected, negative disconfirmation inevitably results in the application discontinued usage (Vagrani et al., 2017).

The students strongly placed value on self-management of their own learning. With assistance from the smartphone application, the student expressed benefits from being able to reflect on learning and self-monitoring. Reflection involves analysing practice experience so that it is not only used in coping with present success but also in educating and improving future practice in a constructive manner (Bulman et al., 2012). Besides, the students might be able to plan strategy, including using time and effort, to make progress towards achieving the learning goals. The students were able to solve more complex problems in less time in the self-monitoring state than those who did not monitor their problem-solving strategies.

4.13.4 Informing the findings into the quantitative phase

Taking into consideration the findings of all participants on the perception of the use of smartphone application for SDL of clinical skill, the integration of all themes was

integrated for the next quantitative phase of study. The themes, all of which are central to addressing the research question formed earlier encompasses 1) learning performance, 2) ease of use, 3) encouragement, 4) enjoyment, 5) habit formation, 6) technical and support system and 7) self-management of learning. It was shown that all relevant themes fit well within the framework for the UTAUT2 determinants. The breakdown of the UTAUT2 model and the themes can be seen in Table 13:

Table 13 Themes and related UTAUT2 construct

Themes	Related UTAUT2 Construct
Ease of Use	Effort Expectancy
Encouragement	Social Influence
Interactivity	Hedonic Motivation
Habit Formation	Habit
Technical and support system	Facilitating Condition
Learning Performance	Performance Expectancy
Self-management of learning	Self-management of learning

4.14 SUMMARY

This phase provides justification for choosing a qualitative study as a way 1) to explore the challenges of undergraduate nursing students engaged in SDL of clinical skill, and 2) to explore their perception on using smartphone application to facilitate self-directed learning of clinical skill. The results described in this chapter were obtained to answer the research questions raised at the beginning of the study. With regards to the first specific research objectives on this phase, the interview findings demonstrated that the participants realized there were several ecological challenges of self-directed learning of clinical skill, which consisted of lack of self-management, lack of desire to learn and lack of self-control of learning.

Students have been quite optimistic about using technology in self-directing their clinical skill learning. They are highly supportive and open to embracing technology because of their likelihood of being autonomous in learning. The students perceived that the use of smartphone application would be easy to use, would improve

their learning performance, would receive more encouragement for learning, would enjoy the interactivity with learning material, would form a habit for learning, would receive support in learning, and would improve their self-management skill of learning. Based on these findings, the themes were mapped into the relevant categories of UTAUT2. The identification of both challenges of self-directed learning of clinical skills and perception of using smartphone application to facilitate self-directed learning of clinical skills marked the achievement of the first research objectives **(RO1).** The next chapter will discuss phase 2 of the study, which refers to the construction and testing of the survey tool on account of findings in phase 1, followed by implementation of the survey tool to a larger population.

CHAPTER FIVE

PHASE 2: SURVEY

5.1 STUDY PURPOSE

Based on previous findings, this study generates and tests a survey instrument by adopting the UTAUT2 survey instrument (Venkatesh, 2012). The outcomes of the instrument are used to inform the researcher of the most important factors, assist in the identification of relevant features, and help in the development of smartphone application prototype. Thus, this phase of study aimed to identify the most significant predictors for perceived behavioural intention to use smartphone application in facilitating self-directed learning of clinical skills among undergraduate nursing students.

5.2 RESEARCH HYPOTHESES

As a result of findings found in the previous chapter, there is an addition of construct needed to be implied to this framework which is Self-management of learning (SL). SL refers to how individuals feel that they are self-disciplined when engaging in autonomous learning; mobile learning provides autonomy for the students to learn informally. In providing technology services for learning purposes, this construct is designed to understand students' technology adoption (Kim-Soon et al., 2015; Momani et al., 2017). Thus far, it is often used in other learning-related technologies for example library-related information (Donaldson, 2011), mobile blackboard (Momani et al., 2017) and Microsoft Excel (Lowenthal, 2010). However, some studies reported that this construct has no effect on BI (Al-adwan et al., 2018; Aliaño et al., 2019; Aofan et al., 2016). While many believe informal learning is an effective approach that helps students become active learners, Karimi (2016) perceived that there is insufficient empirical evidence for mobile learning in informal learning.

In addition, this study did not investigate the effect of gender, age, or experience in behavioural intention to use mobile learning. Most students in higher education are

of almost the same age and with small variations in technological experiences. Similar findings obtained in other studies conducted elsewhere gender, experience and age were also dropped in the proposed research models (Jairak et al., 2009; Nassuora, 2013; Thomas et al., 2013). The adapted framework of the study is illustrated in Figure 9.

Acknowledging the outcome of previous studies, the hypothesis of this study is formulated:

H_1: The Performance Expectancy (PE) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.

H_2*: The Effort Expectancy (EE), is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

H_3*: The Social Influence (SI) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

H_4*: The Facilitating Conditions (FC) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

H_5*: The Habit (HT) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

H_6*: The Hedonic Motivation (HM) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

H_7: *The Self-management of Learning (SL) is a significant predictor on behavioural intention (BI) to use smartphone application for enhancing self-directed learning of clinical skill.*

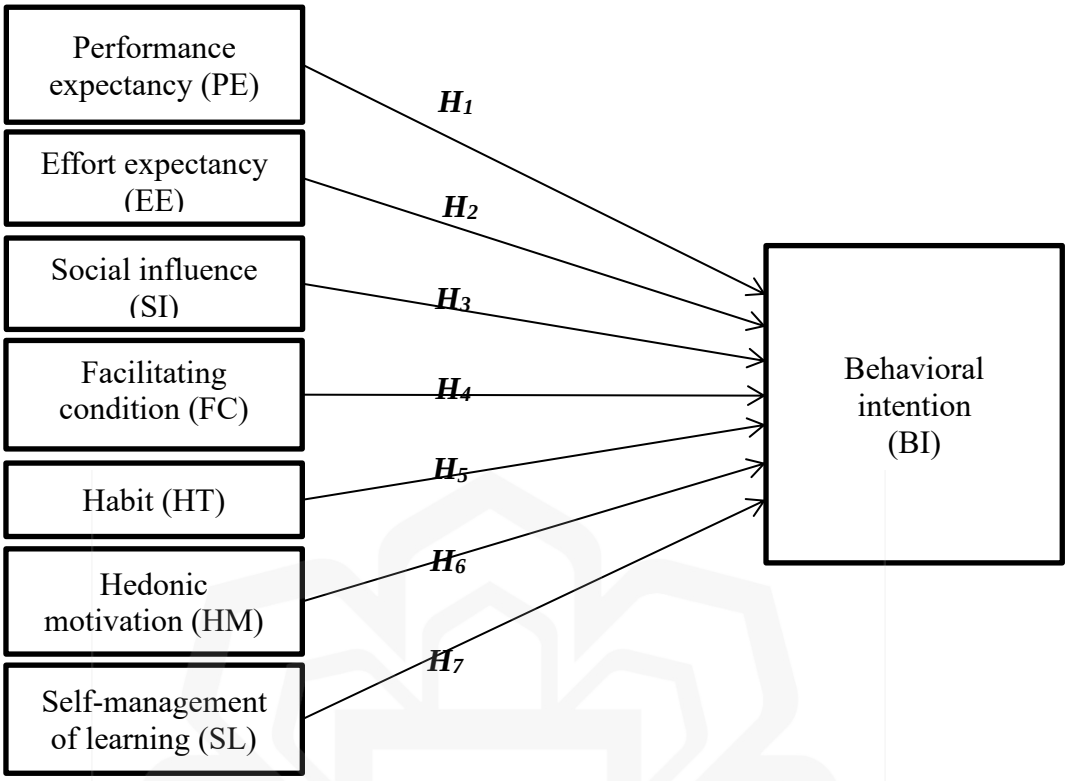


Figure 9 The adapted model UTAUT2 framework used in this study.

5.3 RESEARCH SETTING

The research setting of this phase is Kulliyyah of Nursing, International Islamic University of Malaysia, Kuantan Campus in Pahang.

5.4 SAMPLING METHOD

The survey is targeting undergraduate nursing students who are studying full-time in Kulliyyah of Nursing, International Islamic University of Malaysia. The eligibility for inclusion criteria was based on the following: 1) respondent must be undergraduate nursing student of Kulliyyah of Nursing, 2) had experience learning clinical skill, 3) student status is “active” in the database, 4) own and use a smartphone. Meanwhile the exclusion criteria include: 1) students on leave at the time of data collection.

Convenience sampling is a non-probability sampling technique where data is collected from members of the population who are easily accessible and available to the researcher (Saunders et al., 2009). This sampling method is time saving and helpful to

ensure the required sample size is met, then it enables the researcher to perform hypothesis testing. Although convenience sampling can lead to under- or over-representation of samples within the sample, however this study is not focusing on investigating the effect of individual difference such as age, gender and experience that moderate the effect on the behavioural intention to use mobile application, but it aims to signify which factors that affect the behavioural intention to use mobile application in enhancing self-directed learning of clinical skills among undergraduate nursing students.

5.5 ESTIMATION OF SAMPLE SIZE

By the time this survey was conducted, Year 4 participants from the phase 1 (qualitative phase) had graduated from the university. Therefore, this sample is different from the sample who participated in the Phase 1.

Table 14 Total number of undergraduate students in Kulliyyah of Nursing

Batch	Number of students
Year 1, Sem 2	73
Year 2, Sem 1	20
Year 2, Sem 2	81
Year 3, Sem 1	71
Year 3, Sem 2	59
Year 4	31
TOTAL	335

It is known that the researcher has the full access to reach all undergraduate nursing students in Kulliyyah of Nursing as it was approved by the Kulliyyah of Nursing Postgraduate Research Committee and IIUM Research Ethics Committee. Therefore, the researcher included the total number of active students for calculation of recommended sample size by using a sample size calculator by Raosoft (2019). The sample size calculation was performed by margin error of 5% and 95% of confidence

interval. The estimated population sample size from the setting was made to '335' (see Table 14) and the recommended minimum sample size by the Raosoft calculator was 180.

5.6 DATA COLLECTION

5.6.1 Gaining Access

For primary data collection, the survey is distributed to all IIUM undergraduate nursing students. To maximize survey return the following guide for survey return rates is recommended: 50% = acceptable, 60% = good, and 70% or higher = very good (Babbie, 2007). As IIUM Research Ethics Committee (IREC) gave the approval to launch the study, the researcher contacted each head student of every batch to introduce the purpose of the study.

5.6.2 Instrumentation

The survey approach was used because it enables effective and systematic retrieval of data. Besides, utilizing this approach was also helpful in accessing a larger number of students across year-of-study in the Kulliyyah of Nursing without difficult financial and time boundaries. The researcher included survey topic on 1) demographic details and 2) the characteristics of smartphone usage for learning of the students, to gain better understanding on the respondents' profile (refer Appendix 6) For the latter, the survey was made based on the study from (Rung et al., 2014) and (Biloš et al., 2017). The researcher tried to understand the trend of using smartphones among undergraduate students in learning, for example the types of learning activities and the location of learning using smartphones takes place. Besides, the researcher also tried to understand the level of experience by adapting four different categories as reported by Biloš et al. (2017), which are:

Novice:	I only have a few apps installed. I used smartphone for calls, texting, and emails.
Intermediate:	I occasionally download apps when I have a need, or my friends recommend something new.
Advanced:	I often installed many of the same apps to evaluate the differences and make recommendations to my friends about the best apps.
Expert:	I have developed my own mobile apps.

Meanwhile, the main topic of this survey, which is technology acceptance, was measured to study the behavioural intention of the student to use smartphone applications for SDL of clinical skill. The original UTAUT2, as explained in the previous chapter, is already established, valid and reliable. The number of items for each variable and its source are given in Table 15. All items used a 7-point Likert scale for measuring the responses.

The researcher obtained permission from the original authors of the survey instruments, through emails, and adapted the instruments for the current study. The researcher also obtained permission by Venkatesh (2012) to adapt the instrument that suits the study topic (refer Appendix 3). Besides, the researcher also obtained the permission for the additional construct, which is self-management of learning from Wang, Wu and Wang (2009). Since this instrument was a combination of eight constructs (see Table 15), therefore a total of 28 items were designed to ascertain the topic namely as "*Perceived behavioural intention to use smartphone application for self-directed learning of clinical skill*." All the items employed on a seven-point Likert scale by which *1 = strongly disagree* and 7 = *strongly agree.*

Table 15 Measurement Items and Source

Construct	No of items	Source
Performance Expectancy	3	(Venkatesh, 2012)
Effort Expectancy	4	(Venkatesh, 2012)
Social Influence	3	(Venkatesh, 2012)
Facilitating Condition	4	(Venkatesh, 2012)
Habit	4	(Venkatesh, 2012)
Hedonic Motivation	3	(Venkatesh, 2012)
Self-management of Learning	4	(Wang et al., 2009)
Behavioural Intention	3	(Venkatesh, 2012)

5.7 METHOD OF DATA ANALYSIS

Descriptive and inferential statistics are two main methods of analysing quantitative data obtained from surveys (Saunders et al., 2009). Descriptive statistics summarizes the data collected and allows profound understanding of the students' characteristics. A descriptive analysis was performed using mean (standard deviation: SD). Considering examining the relationship in the research framework, Partial Least Square Structural Equation Modelling (PLS-SEM) was performed. As this phase is mainly focusing on identifying factors influencing behavioural intention (BI) on using smartphone application, PLS-SEM is deemed to be most appropriate. Reliability test using Cronbach's alpha was done to test the reliability of the measures. Value greater or equal to 0.70 indicates that the measure is reliable (Nunnally, 1978).

5.8 PILOT SURVEY

A pilot study was conducted to ensure the ability of the instrument to consistently and systematically retrieve the data required to answer the research question. The pilot study was conducted with two faculties from external universities, Universiti Malaysia Sarawak (UNIMAS) and Universiti Teknologi MARA (UiTM), that offered an accredited bachelor nursing program. They were selected on the basis that they were applying the learning standard provided by the Nursing Board of Malaysia and the Ministry of

Education; besides, they are sharing a similar nursing skill learning environment such as lecturing system, examination system and clinical learning system.

This pilot study was conducted electronically through Google Form service online. The purpose of the pilot study was to ensure the appropriateness of the survey instrument and the acceptability of the wording of the questionnaire in the local cultural context. Another rationale for conducting pilot study is to identify logistic problems which might occur during distributing survey link or communication barriers or understanding of the question. Furthermore, conducting a pilot study prior to the actual study offers an opportunity to pre-test the research plan as well as the analysis of the retrieved data.

The researcher used to determine the minimum sample size specific to the PLS path model for model estimation using 10 times rule of thumb (Hair et al., 2017). 10 times rules offer a rough estimation for minimum sample size requirement by saying that the minimum sample size should be 10 times the maximum number of arrowheads pointing at a latent variable anywhere in the PLS path model. In this study, the number of arrowheads is seven, therefore the minimum number of sample size is 70. However, since the researcher wanted to receive more comments for improvement of survey tool and reliability as close as to the real setting, therefore a bigger sample size was used.

Table 16 Survey part and details for pilot study

Part	Details
Information sheet	Details on the objectives of the study.
Consent form	Enquiring the student to give their consent before they can start to answer the survey questions.
Preliminary part	Acquiring the time students start answering the survey form. It helped the researcher to calculate the time needed for them to complete all survey items.
Part 1	Acquiring respondents' demographic data, including their university, gender, age, year of study, and previous level of education.
Part 2	Acquiring the information on students' usage of smartphone and smartphone applications including level of experience of using smartphone, number of and type of operating system of smartphone used, expertise level of using smartphone apps, and number of apps installed for learning.
Part 3	Acquiring the main topic on "P*erceived behavioural intention to use smartphone application for self-directed learning of clinical skill*" using 28 questions of UTAUT2. All the items of the survey were measured with a seven-point Likert scale.
Final part	Gaining self-explained feedback on the understanding of answering all the survey items given to them.

A phone call to the respective faculty member was made to introduce the purpose of the study, further the permission to conduct the study by the head of department was acquired. The link to the online survey form was provided to respected head of students in each faculty. They were asked to distribute the link to their classmates. The online survey study was divided into several parts, Table 16 above describes all parts of the survey and its details.

The feedback given was important for improvement of the instrument such as to evaluate the format, content, relevance, question structure and wording. There were 191 respondents involved in this survey, in which 89 respondents were from UNIMAS and 102 respondents from UiTM. Table 17 shows the important setting, dates, and total number of respondents in pilot study:

Table 17 Pilot study setting, important dates, and total number of respondents

Setting	Date of permission granted	Date of survey start	Date of survey end	Total number of respondents
UNIMAS	7th March 2019	26th March 2019	28th March 2019	89
UiTM Puncak Alam	7th March 2019	3rd April 2019	5th April 2019	102

As a result of this pilot study, the researcher learned that it took less than 15 minutes to complete a survey of the respondent. Only a few responses reported difficulties in interpreting certain parts of the survey instructions, but the majority indicated no major difficulty in understanding and completing the survey form. Among the problems identified in the pilot study were: 1) difficulties in understanding the instruction of the survey and 2) improper use of word or terminology, as tabulated in Table 18.

Table 18 List of changes to the survey instrument

No	Part	Original	New
1	Title	A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning	A Survey on the Perceived Behavioural Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning among Undergraduate Nursing Students
2	2	How frequent do you access smartphone apps for learning based on these locations?	How frequent do you access learning-related application on your smartphone according to the following locations?
3	3	Part 3: Perceived Behavioral Intention to Use Smartphone Application for Enhancing Self-Directed Clinical Skill Learning	Part 3: Perceived Behavioural Intention to Use Smartphone Application to Enhance Self-Directed Clinical Skill Learning
4	3	I think using a smartphone app to enhance my self-directed clinical skill learning …	I think using a smartphone application for the purpose of enhancing my self-directed clinical skill learning…

Due to these problems, the researcher considered few methodological changes to address the problem. This is important because if the respondents did not understand the scenario correctly, the answers might reflect an incorrect perception of the respondents. First, the researcher assigned four on-site enumerators to meet and brief students on how to respond to the survey instrument. Second, the researcher sent a survey tool for proofreading and editing services. As the changes consisted only of the language element, such as the selection of proper words or phrases, no deletion of the item was made.

In assessment of the level of internal consistency and reliability for the seven continuous variables of the survey items, Cronbach's alphas were calculated. The first result has revealed a good indicator reliability, in which the outer loading of each item of the model is above 0.708. Besides, Cronbach's values are higher than the threshold of 0.7. By referring to Table 19 which summarizes the results of pilot study, it can be concluded that PE, EE, HM, HT, PE, SI and SL demonstrate sufficient level of internal consistency. In assessment of internal consistency, composite reliability which is more than 0.7 is surpassed the value that is relevant for exploratory research.

Table 19 Internal consistency measures for measurement model of pilot study

Factor	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
BI	0.948	0.949	0.967	0.906
EE	0.95	0.957	0.964	0.869
FC	0.901	0.908	0.931	0.772
HM	0.973	0.974	0.983	0.95
HT	0.899	0.904	0.93	0.767
PE	0.902	0.91	0.938	0.835
SI	0.903	0.919	0.939	0.837
SL	0.884	0.898	0.919	0.741

5.9 THE SURVEY

For the actual survey, the population were undergraduate nursing students of Kulliyyah of Nursing, IIUM. The data from each batch of students were collected through online form, therefore Google Form service was utilized because it is free and a secure site for the respondents to join, besides, it can be operated by using both computing, and mobile devices. The advantages of using online survey form are:

1) it is considerably minimal cost to administer as compared to paper based.

2) it allows the respondents to answer while they feel convenience anytime or anywhere.

However, there were some limitations associated with the use of online survey, these include the students may directly ignore the invitation to the study before reading them and the need to send reminders to administer the survey form. The service of enumerators was used to help students in answering the questions, so that it helps the respondents to comprehend the survey requirements better. However, the researcher limits the assistance until the respondents understand the survey instructions and manage to answer the survey independently.

Besides, few assumptions have been determined by the researcher in this study. The researcher assumed that during data collection, the students would answer the survey items truthfully. With the help of the enumerators in explaining the objectives of the survey study and the way how to answer the survey, the respondents probably would be answering honestly. Besides, the researcher also highlighted that anonymity and confidentiality of the respondents would be preserved and that the participants are volunteers who may withdraw from the study at any time and with no ramifications.

In the first place, permission to conduct the study was already approved by the Kulliyyah and University's ethics committee. The updated information sheet and survey instrument which explained the purpose, method of study and survey items were prepared. The organization of the survey page follows this part sequence:

1) Part 1: Title of the study, purpose of study and general information regarding the study.

2) Part 2: Consent to participate in the study.

3) Part 3: Survey questions

    a) Demographic information

    b) Smartphone usage

    c) Perceived behavioural intention to use smartphone application for self-directed learning of clinical skill.

The first page of the online survey included the title of the study, the study purpose, and the information regarding the research. Then, the respondent was asked to indicate their voluntary consent to participate in the survey by selecting the 'Agree' checkbox at the end of the online page. The survey was divided into three parts: demographic information, smartphone usage, and perceived behavioural intention to use smartphone application for self-directed learning of clinical skill. The third part is the main survey with 28 questions adapted from prior studies as discussed in the previous sub-chapter. At the end of the survey, the respondents were given the incentives (a set of stationaries) as an appreciation token for their participation in the study.

5.10 FINDINGS AND DISCUSSION

The surveys commenced on 22nd May 2019 and closed on 27th May 2019. After the students had finished answering the survey online, the data administered in the Google Form worksheet was directly exported into Microsoft Excel 2010 format. The data was transformed into SPSS format before it can be read by *SmartPLS 3* software used by the researcher. The flow of the findings was organized based on this sequence:

1) Demographic details of the respondents
2) Information on smartphone usage
3) Perception on using smartphone application for self-directed learning of clinical skills.

The demographics variables (Part 1) and usage of smartphone (Part 2) details were analysed at nominal level, and the main survey item (Part 3) were analysed at ordinal level.

5.10.1 Response rate

In total, at the time of the survey, KON had 336 undergraduate students. All students were approached to respond to the survey, with a total of 249 students responding successfully to the survey. The resulting sample therefore recorded 74.3 per cent of the

total number of students. The percentage of respondents indicated that it had a very good return rate for the survey.

5.10.2 Part 1: Demographic details

Demographic data were recorded numerically and analysed using the descriptive statistics, including the frequency distribution and percentage. Table 20 summarizes the characteristics of all the undergraduate nursing students who responded to this survey, of whom were undergraduate nursing students that enrolled in bachelor nursing program from 2015 until 2018 at Kulliyyah of Nursing (KON), International Islamic University of Malaysia.

Most of the respondents were female (n = 219, 87.96 %) and 30 were males (12.04 %). The students were also asked to indicate their year-of-study. At the time the survey commenced, there were four batches of students active in the faculty, in which 70 (28.1%) were first year, 82 (33%) were second year, 73 (29.3%) were third year and 24 (9.6%) were fourth year. In assessment of the age of the respondents, the students who were aged ‘20 and less’ were 60 (24.1%), students aged ’21 to 22’ were 131 (52.6%), and students aged ‘23 and above’ were 58 (23.3%).

Table 20 Sample characteristics of quantitative study

Variable	Respondents	
	N	%
Gender		
Male	30	12.04
Female	219	87.96
Year of birth		
20 and below	60	24.1
21	63	25.3
22	68	27.31
23 and above	58	23.3
Year of Study		
Y1	70	28.11
Y2	82	32.9
Y3	73	29.32
Y4	24	9.64
Previous level of education		
Foundation study	220	88.35
Matriculation	2	0.80
Diploma	1	0.4
Malaysia Higher School Certificate	25	10.04
Other	1	0.40

Students were asked to indicate their previous educational background. The survey results showed that majority of the respondents (n = 220, 88.35%) were graduated from IIUM foundation program, 25 students (10.04%) were from Malaysian higher school certificate, two students (0.80%) were graduated from Malaysian Ministry of Education matriculation program and one student was graduated from diploma and foreign certificate.

5.10.3 Part 2: Usage of smartphone and smartphone application

5.10.3.1 Usage of smartphone device

All students who responded to this survey were described as a smartphone user. Table 21 shows that most of the students (n =134, 53.82%) have been using smartphones for more than six years, 37.75% (n = 94) for four to five years, and 8.43% (n = 21) for three years or less. This study showed that many of the students had just one device (n = 222, 74.05%), followed by two devices (n = 26, 10.44%), and three or more devices (n= 1, 0.4%) used at the same time. There was another important finding that needed to be addressed, that more than 74% (n= 194) of the devices owned by the students were based on Android operating system followed by iOS (n= 65, 24.81%) and WinOS (n= 2, 0.76%).

Table 21 Usage of smartphone device

Variable	Respondents	
	N	%
Years of using smartphone		
Less than 1 year	1	0.4
2 to 3 years	20	8.03
4 to 5 years	94	37.75
More Than 6 years	134	53.82
Number of smartphones currently in use		
One smartphone	222	89.16
Two smartphones at the same time	26	10.44
More than two smartphones at the same time	1	0.40
Smartphone OS currently in use		
Android	194	74.05
iOS	65	24.81
WinOS	1	0.38
Others	2	0.76

5.10.3.2 Usage of smartphone application

Level of expertise of using smartphone application

The following Table 22 presents the usage of smartphone applications of the respondents in this study. Students were asked to indicate the level of expertise in the use of smartphone applications, ranging from novice to expert, and the number of learning applications used on their devices at the time of the study.

Finding showed that almost three quarters of smartphone users surveyed in this study perceived themselves as intermediate users (n = 180, 72.29%), in which they occasionally download applications when there is a need or when their friends recommend something new (Biloš et al., 2017). Then, it was followed by advanced users (n = 37, 14.86%) and novice users (n = 32, 12.85%). The respondents were also asked to state the number of learning applications that they use in their smartphone. The findings showed that the highest percentage of respondents were using one to five applications for learning purposes (n = 206, 82.73%). Only 4.42% (n = 11) of the respondents were using six to ten applications for learning. The remaining 12.45% (n = 31) said they have never used any learning-related applications in their smartphone.

Table 22 Level of expertise of using smartphone application

Variable	Respondents	
	N	%
Level of expertise of using smartphone applications		
Novice	32	12.85
Intermediate	180	72.29
Advanced	37	14.86
Expert	0	0
Number of learning applications		
None	31	12.45
Yes: 1 to 5 applications	206	82.73
Yes: 6 to 10 applications	11	4.42
Yes: More than 10 applications	1	0.40

Accessing smartphone apps by location

Furthermore, students were asked to provide information on where they particularly access their smartphone applications. Table 23 shows that the most frequent location of students using smartphone applications was at their university campus (Mean = 5.277, SD = 0.821), followed by home or dormitory (Mean = 5.1, SD = 0.95) and clinical skills centre (Mean = 3.743, SD = 1.248).

Tasks done on smartphone apps

Meanwhile, smartphone features used for their learning purposes were surf web for learning materials (Mean = 5.293, SD = 0.873), followed by reading lecture notes (Mean = 5.068, SD = 0.948) and sharing notes with classmates (Mean = 5.036, SD = 0.975). However, when using smartphone applications, students were very least in making notes (Mean = 3.932, SD = 1.295). Table 23 reports all result of the students accessing smartphone application based on locations and types of tasks done on smartphone application:

Table 23 Accessing smartphone applications by locations and tasks done on smartphone applications

	Mean	Standard deviation
Location of accessing smartphone applications		
Home or dormitory	5.100	0.950
University campus	5.277	0.821
University library	4.129	1.090
In the class	4.233	1.091
In the clinical skills centre	3.743	1.248
On the go (e.g., on the bus and while walking)	4.382	1.149
Tasks done on smartphone applications		
Look up course timetable	4.478	1.239
Look up portal announcements	4.209	1.257
E-mail faculty staff or classmates	4.743	1.111
Read lecture notes	5.068	0.948
Watch lecture videos	4.655	1.087
Watch instructional video	4.639	1.082
Do library or literature searches	4.398	1.097
Surf the web for learning material	5.293	0.873
Share notes with classmates	5.036	0.975
Making note	3.932	1.295
Record learning activities	4.112	1.309

5.10.4 Part 3: Perceived behavioural intention to use smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students

Having explained the demographics and smartphone usage of the questionnaire, the next step was to conduct the analysis of the model. The findings on perceived behavioural intention to use smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students were reported into two types of analysis which are measurement model analysis and structural model analysis.

5.10.4.1 Measurement model analysis

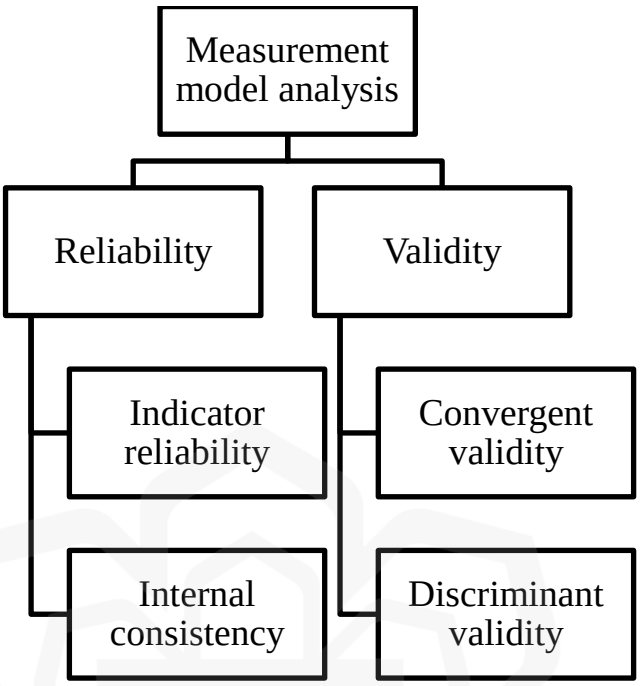


Figure 10 Types of measurement model analysis

It is very important to demonstrate that the data collected is valid and meets statistical standards. The measurement model was validated using reflective measurements that included internal consistency reliability using composite reliability, indicator reliability using indicator loadings, convergent validity using Average Variance Extracted (AVE), and discriminant validity using the Fornell and Larcker methods (1981) (see Figure 10). For this, the data that was imported into *SmartPLS 3* to perform several tests.

5.10.4.1.1 Indicator reliability

Reliability is the first area to consider when analysing a set of data, which is normally the researcher looking for the indicator reliability findings. Value of factor loading above 0.7 indicated that the latent variable could explain at least 50% of the indicator variance (Hair et al., 2017). For a newly developed framework, item loading lower than 0.4 is considered weak, and can be frequently found, therefore removal of the item can be helpful in the reliability of the model. Low loading can occur due to poorly worded questions in a questionnaire (item), an inappropriate item, and improper transfer of an

item from one context to another (Hulland, 1999). By far, in this study there is no item that marked the value less than 0.4.

5.10.4.1.2 Internal consistency

Internal consistency is the degree to which instrument items are homogenous and reflect the same underlying construct. The internal consistency reliability can be tested using Cronbach's Alpha or Composite Reliability. Composite Reliability (CR) considers the different items loading to the factor, as compared to Cronbach's Alpha that assumes that all items or questions are equally reliable. CR indicated where a satisfactory value should be higher than 0.70 (Hair et al., 2017). From Table 25, the overall composite reliability values are greater than 0.7; therefore, this data satisfies the internal consistency reliability test.

5.10.4.1.3 Convergent validity

Convergent validity and discriminant validity are two main important validation measures in PLS-SEM that led to construct validity. Convergent validity is defined as "the degree to which scores on one scale correlate with scores on other scales designed to assess the same construct" (D. R. Cooper & Schindler, 2014). Measures of convergent validity are important to ensure that variations in one indicator are consistent with variations in the other reflective indicators of the same latent construct (Lowry & Gaskin, 2014). Hair et al. (2017) recommended that in order to measure convergent validity average variance extracted (AVE) must be evaluated. The AVE values must be greater than 0.5 for convergent validity to be acceptable. Table 25 shows that all latent constructs were larger than 0.5 and has established a good convergent validity.

5.10.4.1.4 Discriminant Validity

Discriminant validity is defined as the degree to which scores on a scale do not correlate with scores from scores designed to measure different constructs (D. R. Cooper & Schindler, 2014). Discriminant validity indicates the extent to which a given construct

is different to other latent constructs. Discriminant validity was calculated using Fornell & Larcker criterion, in which the square root of each construct, AVE, should be larger than its correlation with other constructs.

Table 24 Fornell-Larcker's Criterion

	BI	EE	FC	HM	HT	PE	SI	SL
BI	0.962							
EE	0.553	0.946						
FC	0.555	0.574	0.896					
HM	0.578	0.651	0.64	0.981				
HT	0.617	0.558	0.616	0.614	0.903			
PE	0.55	0.774	0.571	0.626	0.53	0.922		
SI	0.371	0.49	0.595	0.533	0.583	0.485	0.96	
SL	0.407	0.427	0.479	0.423	0.495	0.363	0.356	0.901

For this model, Table 24 shows that the square root of the AVEs in each construct was greater than the cross-correlation with other constructs. Subsequently, this was measured as having a good discriminant validity value which means the constructs were different from each other. There was also no high association between variables of the model, thus strengthening the validation that there was no multicollinearity in this study.

Table 25 Internal consistency measures for measurement model

Item	Loadings	rho_A	Cronbach's alpha	CR	AVE
BI1	0.953	0.96	0.959	0.974	0.925
BI2	0.963				
BI3	0.968				
EE1	0.954	0.963	0.961	0.972	0.895
EE2	0.951				
EE3	0.956				
EE4	0.924				
FC1	0.888	0.922	0.918	0.942	0.803
FC2	0.927				
FC3	0.928				
FC4	0.838				
HM1	0.984	0.981	0.98	0.987	0.962
HM2	0.983				
HM3	0.976				
HT1	0.899	0.931	0.924	0.946	0.815
HT2	0.896				
HT3	0.926				
HT4	0.888				
PE1	0.888	0.917	0.912	0.945	0.851
PE2	0.945				
PE3	0.933				
SI1	0.943	0.97	0.958	0.973	0.922
SI2	0.973				
SI3	0.964				
SL1	0.841	0.923	0.922	0.945	0.812
SL2	0.925				
SL3	0.934				
SL4	0.902				

5.10.4.1 Structural model analysis

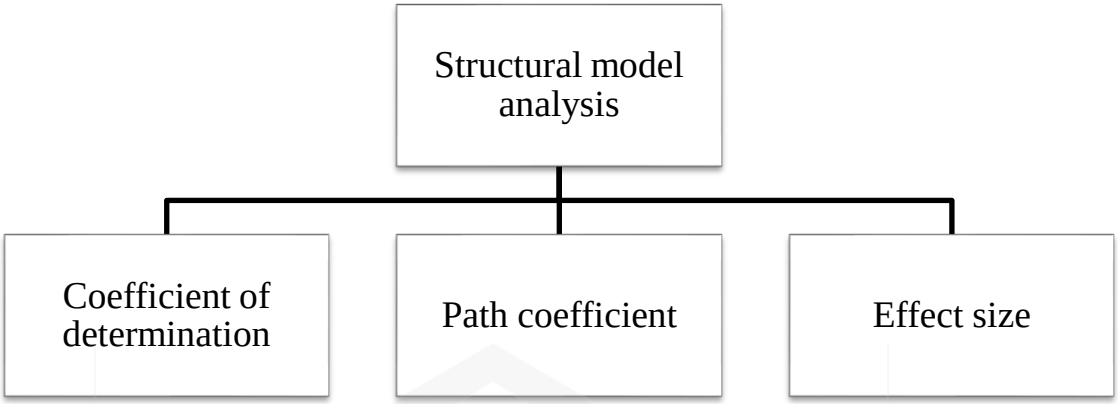


Figure 11: Types of structural model analysis

In order to explain and predict the developed conceptual framework for this research, the methods and suggestions provided by previous PLS literature were used (Henseler et al., 2009), as illustrated in Figure 11. The standardised beta coefficients and the t-values of the hypothesised structural model were examined. Factors such as performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), habit (HT), hedonic motivation (HM) and self-management of learning (SL) were positioned as independent variables, while behavioural intention (BI) was placed as the dependent variable in the model.

SmartPLS 3 was used to run bootstrapping where the t-values illustrated the line linked between the variables. The structural model was assessed based on the sign and path coefficients of each hypothesised path. Bootstrapping was performed to determine the significance of the path. The critical t-value for the two-tailed test is 1.65 that provide a significant level of less than 10% or 0.10; 1.96 provided a significance level of less than 5% or 0.05, and 2.57 provided a significance level of less than 10% or 0.1 (Hair et al., 2017).

5.10.4.1.1 Coefficient of determination

The explanatory power of the structural model was determined alongside its ability to predict the endogenous constructs that were assessed using the coefficient of determination, R^2. Hair et al. (2017) acknowledged the R^2 rule of thumb as 0.75 is substantial, 0.5 is moderate, and 0.25 is weak. This represents the exogenous latent variables' combined effects on the endogenous latent variables.

As in Figure 12, the level of R^2 was 0.499, indicating that all independent variables accumulated for 49.9% of the total variance in students' behavioural intention to use smartphone application for self-directed learning of clinical skill. The results also indicated a moderate model between the combined variables and the empirical data.

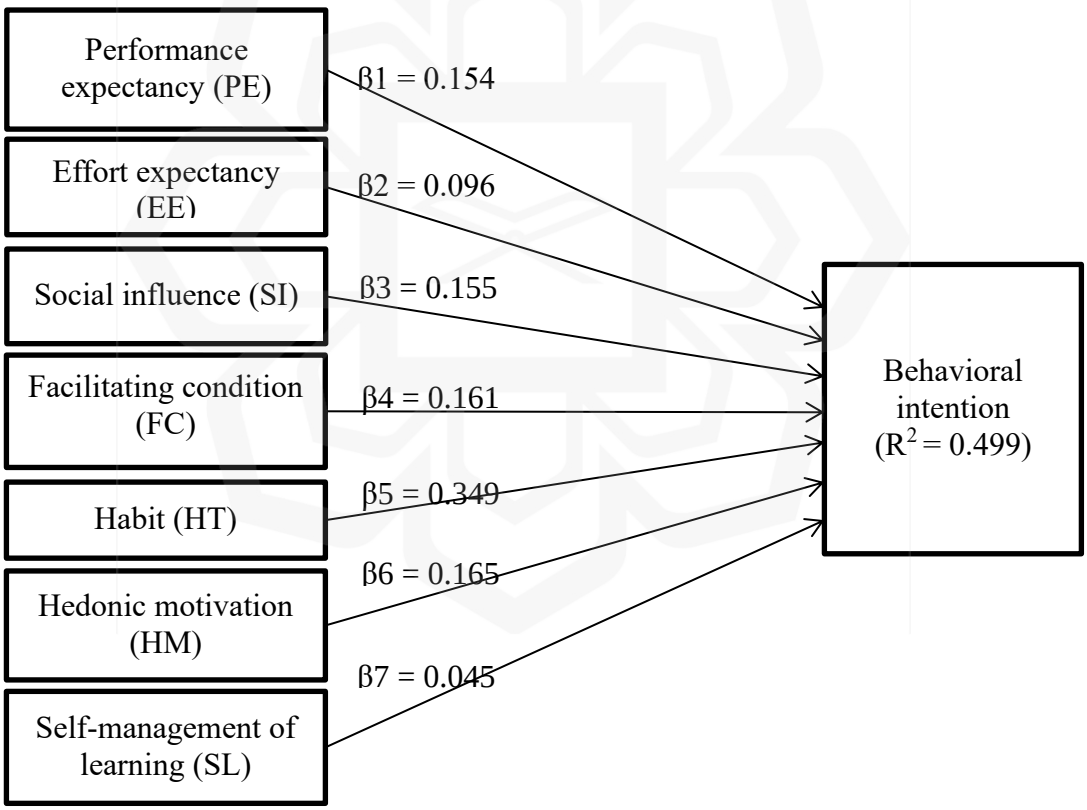


Figure 12 The PLS-SEM structural model results

5.10.4.1.2 Path coefficient

In *SmartPLS 3*, PLS-SEM algorithm is executed to estimate the structural model relationship (path coefficients). The standardized path coefficient value should be between -1 and +1. If the value is approaching +1, a strong positive relationship is hypothesized to be established. In contrast, a path coefficient value of closer to 0 denotes a weak relationship (Hair et al. 2014). In order to determine whether a path coefficient is significant, empirical t value is compared with the critical value. If the t value exceeds the critical value, the path coefficient is said to be significant. In this study, the researcher used critical values for two-tailed test 1.96 (significance level = 5%). Thus, when t value is larger than 1.96 (t > 1.96), the path coefficient is said to be significant. The following Table 26 presents the significance testing results of structural model path coefficients.

Table 26 Relationship between key determinants of behavioural intention

Hypothesis	Path	Original sample (O)	t values	p values	Results
H1	PE -> BI	0.154	1.42	0.156	Not supported
H2	EE -> BI	0.096	0.847	0.397	Not supported
H3	SI -> BI	-0.155	2.355	0.019*	Supported
H4	FC -> BI	0.161	2.14	0.032*	Supported
H5	HT -> BI	0.349	3.997	0**	Supported
H6	HM -> BI	0.165	1.875	0.061	Not supported
H7	SL -> BI	0.045	0.835	0.403	Not supported

* $p < 0.05$, ** $p < 0.01$

Table 26 reveals the findings that PE was not a significant predictor of students' BI to use smartphone application for self-directed learning of clinical skill. It recorded only a higher p value (0.156), $\beta 1 = 0.154$ and t-value of 1.42, hence H1 was not supported. For H2, the analysis of t-value was 0.847 ($\beta 2 = 0.096$, $p > 0.05$) indicating that EE did not significantly affect students' BI, thus H2 was not supported. The analysis of this path unveiled that SI has a significant effect on students' BI with $\beta 3 = -$

0.155 and t-value of 2.355 ($p < 0.05$), thus H3 was supported. Next, H4 tested whether FC can influence the students' BI to use smartphone application for clinical skill self-directed learning. The result showed that FC was a significant contributing predictor of students' BI with $\beta 4 = 0.161$, t-value = 2.14, and $p < 0.05$. Hence, H4 was supported. H5 in this study tested HT for its linkage with students' BI to use smartphone application. HT was shown to be the strongest predictor ($\beta 5 = 0.349$, t-value = 3.997, $p < 0.01$) among all predictors, thus H5 was supported. Meanwhile, H6 examined HM with students' BI to use smartphone application. It exhibits a positive predicting criterion in analysis ($\beta 6 = 0.165$, t-value = 1.875, $p > 0.5$), thus H6 was not supported.

Finally, H7 included the prediction of SL with students' behavioural intention to use smartphone application. SL was apparently not a significant predictor ($\beta 7 = 0.045$, t-value = 0.835, $p > 0.05$), hence H7 was not supported. This summarises the relationship between key determinants of predicting factors with nursing students' BI to use smartphone application for self-directed learning of clinical skill.

5.10.4.1.3 Effect size

In addition to evaluating the R^2 values, the effect size, f^2 was calculated. The effect size is a measure of the impact of a specific predictor construct (PE, EE, SI, FC, HT, HM, SL) on an endogenous construct (BI). It measures the change in R^2 value when a specific predicting construct is omitted from the model. It is used to evaluate whether the omitted predicting construct has a small, medium, or large impact on the R^2 value of the endogenous construct. Table 27 illustrates constructs that provide small effect size to the R^2 of behavioural intention (BI). Habit (HT) provides the largest effect among other constructs in producing R^2 of BI with f^2 value of 0.112. This is followed by small effect size provided by social influence (SI), facilitating condition (FC), and hedonic motivation (HM) with f2 values of 0.026, 0.023, and 0.023, respectively.

Table 27 Effect size

	Path coefficient	Effect size, f^2	
FC	0.161	0.023 (small)	BI (R^2= 0.499)
HM	0.165	0.023 (small)	
HT	0.349	0.112 (small)	
SI	-0.155	0.026 (small)	

5.10.5 Discussion

A greater number of respondents in this study were females because the number of female students is higher than male students in the faculty of nursing. In Malaysia, nursing is considered as a feminine type of profession (Abdollahimohammad et al., 2014), hence female students are favoured to enrol in this course. Students' ages in this study also reflect the typical age of Malaysian college students.

A large proportion of students have been using their smartphones for more than six years, and this means that they are experienced users. On top of that, they are comfortable in owning and using only one device, which demonstrates that the students prefer to perform multiple tasks such as communicating, learning, and playing on a single device. Android is preferable among nursing students compared to iOS, probably because of its user-friendliness and the availability of free applications (Susanto et al., 2016). However, despite prolonged years of experience in using smartphone, only a considerable percentage of students limit themselves to less than five applications for learning. As internet connection is improving, the use of smartphone application for learning might be lessened due to faster and easier content searching using web browsers. It is important to note this relationship as there is a higher percentage of surfing the web for learning material by the students. Besides, the clinical skill centre is the least preferred location for the students to use smartphone application. The clinical skill centre was initially designed to imitate hospital settings, hence the use of smartphone devices in the clinical setting to a certain extent is perceived as unprofessional (Mcnally et al., 2017).

This study also examined the determinants of undergraduate nursing students' perceived behavioural intention to use smartphone application for self-directed learning of clinical skills by adopting the UTAUT2 model of technology acceptance. Results of PLS-SEM analysis demonstrated that the connection between performance expectancy and behavioural intention to use smartphone application was insignificant. Whilst many previous studies reported consistent significant determinants on BI, the outcome of this study however differs. This may mean that it does not appear to the student that the mobile app is appealing because of a system that can enhance learning (such as easy access to a clinical procedure and completing more clinical procedures) but because of uncertainty about the use of the new system, it may give the students a negative affective response (Almaiah & Mulhem, 2018). Therefore, to improve self-directed learning in clinical skills practice, nursing students should be encouraged to use smartphones based on content quality that can meet student needs.

On the other hand, effort expectancy had a negative impact on behavioural intention to use mobile applications for self-directed learning of clinical skills. This finding shared similar results to several past studies (Ahmed et al., 2019; Amantha & Bervell, 2019; Moorthy et al., 2019). The insignificant result proved a critical indication that the students have highly diffused with the smartphone system operation because of high penetration of smartphone among nursing students. Furthermore, earlier results showed a considerable percentage of students using smartphones for more than six years, in which at this point, using a smartphone application is found to be effortless to them. It is perhaps for the students that they would not require a lot of instruction to be able to use the application as they think it will be clear, understandable, and easy to use (Abu-al-aish & Love, 2013). Besides, in building a smartphone application for clinical skills learning, one must consider a clear and understandable interface element in the design. The younger generations are fast learners of technology and highly adaptive despite often having to deal with changes of system. Thus, nursing students are expected to be highly skilled in using smartphone application and it is impartial to include simple yet effective elements in the application. To strengthen these beliefs, developers should develop usable mobile learning services (Wang et al., 2009).

Social influence was found to be a significant determinant for students' behavioural intention in using smartphone application. This finding is consistent with

studies of mobile learning where lecturer, family, and peer support (Badwelan et al., 2016; Alasmari & Zhang, 2019; Moorthy et al., 2019) have impacts for the students in embracing the technology. Therefore, this determinant indicates that lecturers, clinical instructors, and friends have a major role in promoting the use of smartphone application. Likewise, in this study, it is prudent for lecturers and clinical instructors to motivate and declare the importance of using the application. Furthermore, if the application is designed by inserting the elements of virtual profile, chat, and forum, it is highly likely that the students will adopt the application. But the negative value of path coefficient of SI on BI indicated that if there were too much exposure on social interactivity brought into this application, it will reduce the behavioural intention to use the application, thus limiting the build-up of self-directed learning attitude.

Facilitating conditions provides a positive outcome on students' behavioural intention to use smartphone application. This finding is in agreement with Feng, Kong, Zhu, & Yang (2015), Iqbal & Qureshi (2012), and Mohd Suki & Mohd Suki (2017) as the students inclined to adopt the system if there is sufficient amount of resources or infrastructures that can support the use of this application. Nevertheless, although the university has provided the necessary infrastructure such as wireless internet connection within its premises, the findings of this study suggest that the students may have less challenges in adopting the technology. Besides, the students acknowledged that they have the necessary knowledge to use the smartphone application for self-directed learning because they have experienced using several similar types of applications which are available in the application market. In contingency, they are also prepared to find solutions for application problems such as asking help from the authorised people. People with influential character are resourceful for the students and they are easy to gain trust and appreciation especially when dealing with many challenges (Ngafeeson & Sun, 2015). This determinant suggests an important element for system assistance such as virtual help—important for first time users, and helper assistance to whom they can report the problem and receive feedback faster. In a nutshell, the students will adopt the system if resources and technical support are well reinforced.

Meanwhile, habit determinant surprisingly was denoted as the strongest determinant for students' behavioural intention to use smartphone application. This result also resembles the findings of other mobile learning and e-learning studies.

Amantha and Bervell (2019) which discovered habit as the strongest factor affecting BI ($p < 0.001$, $t = 7.311$) indicated that if students can manage to make a habit to use Google classroom, it is enough to show that students can get benefits from using the technology. In a study determining students' adoption of e-learning among the Qatari population by Tarhini (2017), habit is the most influential factor in predicting BI ($p < 0.001$), which how that the students perceive a more active learning process when they spend longer time using e-learning. It is hard for students to give up the use of smartphone application especially when it has the capacity of managing clinical skills learning that involves high cognitive and psychomotor application. Besides, the students also acquired a belief that using smartphone application can be addictive to them, thereby it is potentially for them to enhance their interest to anticipate more in learning and spend more time using the system. On the other hand, students felt that using the application is a must and spontaneous for them. This further will help the student to adopt a smartphone application without being prompted by the instructor.

Next, hedonic motivation is not among the significant predictors for behavioural intention to use smartphone application in this study. In contrast to studies done by Ahmed et al. (2019), Amantha & Bervell (2019), and Moorthy et al. (2019), hedonic motivation has a good linkage with behavioural intention in mobile learning. This informs the lack of enjoyment in using the smartphone application for self-directed learning of clinical skill. It also confounds with the barrier factor showing a low percentage of students using smartphone application in clinical skills laboratory. Besides, it is also an indication that the students appreciate more on the main function of the application (such as procedure checklist) rather than the enjoyment that is ancillary to the application. This is also in line with the problem identified in the earlier study (Phase 1, Part 1: Challenges of SDL of clinical skill) mentioning that the students needed that solution for problems in self-management of learning.

Previous study showed that self-management of learning gives positive outcomes on learning performance (Huang & Yu, 2019). However, from the obtained result, the belief that *self-management of learning* factor may positively determine behavioural intention to use smartphone application for self-directed learning of clinical skills is quite unpopular. Students were not in favour of participating in activities requiring self-discipline (which is a component of autonomous learning), as their

normal learning process could be interrupted. Usually, a student follows the discipline that they impose on themselves. But it is difficult to change to a stricter discipline because it requires willpower that is precipitated by various forms. Gorbunovs et al. (2016) identified the forms of self-discipline may include perseverance, restraint, endurance, thinking before acting, finishing what has been started and being able to make decisions despite facing any discomforts. Self-discipline also means self-control, this approach is not so in favour, more complicated and difficult to achieve success than in the case of a motivational approach. Since clinical skill learning is deemed as unique compared to theory learning, and that psychomotor skills require the application of cognitive movement and orientation skills (Oermann, 1990), the high level of self-discipline is required. In another opinion, self-directed learning can still occur anytime and anywhere even without stronger self-management skill because mobile learning is a form of informal learning that diffuses the characteristics of self-management skill (Aofan et al., 2016).

Finally, this study has its own limitations that must be addressed in future research. First, the study was only conducted at one out of seven public universities in Malaysia that offer bachelor nursing programs, therefore the results cannot be generalized to a broader population. Second, it is also more useful if any research of this kind could apply other moderating factors such as students' academic performance to enhance the arguments and discussions, hence enriching the literature in this field. Third, this study was not able to include actual smartphone application before the students start to answer the questionnaire, hence the responses may have been biased towards the version depicted in the concept and scenario prepared in the survey form. However, a subsequent study on students' perception towards the usage of the application can be conducted to assess the succession of smartphone-based clinical skill self-directed learning after the application is ready.

5.11 SUMMARY

This study examined the undergraduate nursing students' behavioural intention in utilising mobile application for self-directed learning of clinical skill. The results of PLS-SEM analysis confirmed that habit carries the strongest weight as a determinant of nursing students' behavioural intention in using smartphone application, followed by

social influence, and facilitating condition. The overall results have given an extensive inference in terms of research and real practices that must be considered.

Additionally, it is less worrying for the students in adapting with the new technology system of learning because younger people are diffused with such changes. The three significant determinants in this study reflected the factors that are important at the early adoption stage of new technology. On the other hand, this study offers acknowledgement to the body of knowledge, and the findings help to widen the scope of learning from focusing on theory- or cognitive-based learning development, to psychomotor-based learning development as well. It also enlightens the determinants that need to be addressed for self-directed learning of clinical skills which is "self-management of learning".

For students, the worrying factors may be contributed by the uncertainties of using an estranged application because smartphones have always been perceived as a form of disturbance in the learning environment. Other factors such as performance expectancy, effort expectancy, hedonic motivation, and self-management of learning can be put into attention with necessary research and proper development system for future undertakings. In this case, it is the role of user experience designer and instructional designer to provide quality characteristics of the application-based learning system in light of effective and efficient learning experience. The identification of factors affecting the students' behavioural intention to use smartphone application for self-directed learning of clinical skills mark the achievement of the second research objective **(RO2)**. The output from this phase is important to address the design requirements in developing smartphone application prototype in the next phase.

CHAPTER SIX

PHASE 3: DESIGN AND DEVELOPMENT

6.1 STUDY PURPOSE

Following the identification of factors affecting the students' behavioural intention to use smartphone application for self-directed learning of clinical skill, the purpose of this study is to identify relevant features (or design requirements) and to develop smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students. The specific research objectives to be achieved in this study are as the following:

- Specific Research Objective 3a (**RO3a**):
  - To identify relevant features of a smartphone application that facilitate self-directed learning of clinical skills for undergraduate nursing students.
- Specific Research Objective 3b (**RO3b**):
  - To develop a smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

6.2 DATA COLLECTION

In order to identify effective design requirements that could facilitate nursing students for self-directed learning of clinical skill, methodological triangulation approach was applied. Methodological triangulation uses more than one kind of method, either qualitative or quantitative or both to study a particular phenomenon (Casey & Murphy, 2009). The approach has been proven in the literature to generate more comprehensive data, increase data validity, provide confirmation of findings, and enhance understanding of the studied phenomenon. In this thesis, the identification of relevant design requirements was based on triangulation of three different studies using different methods of data collections (Literature Review, Phase 1- interview, Phase 2- survey). Figure 13 illustrates the flow of research activities carried out during the design processes.

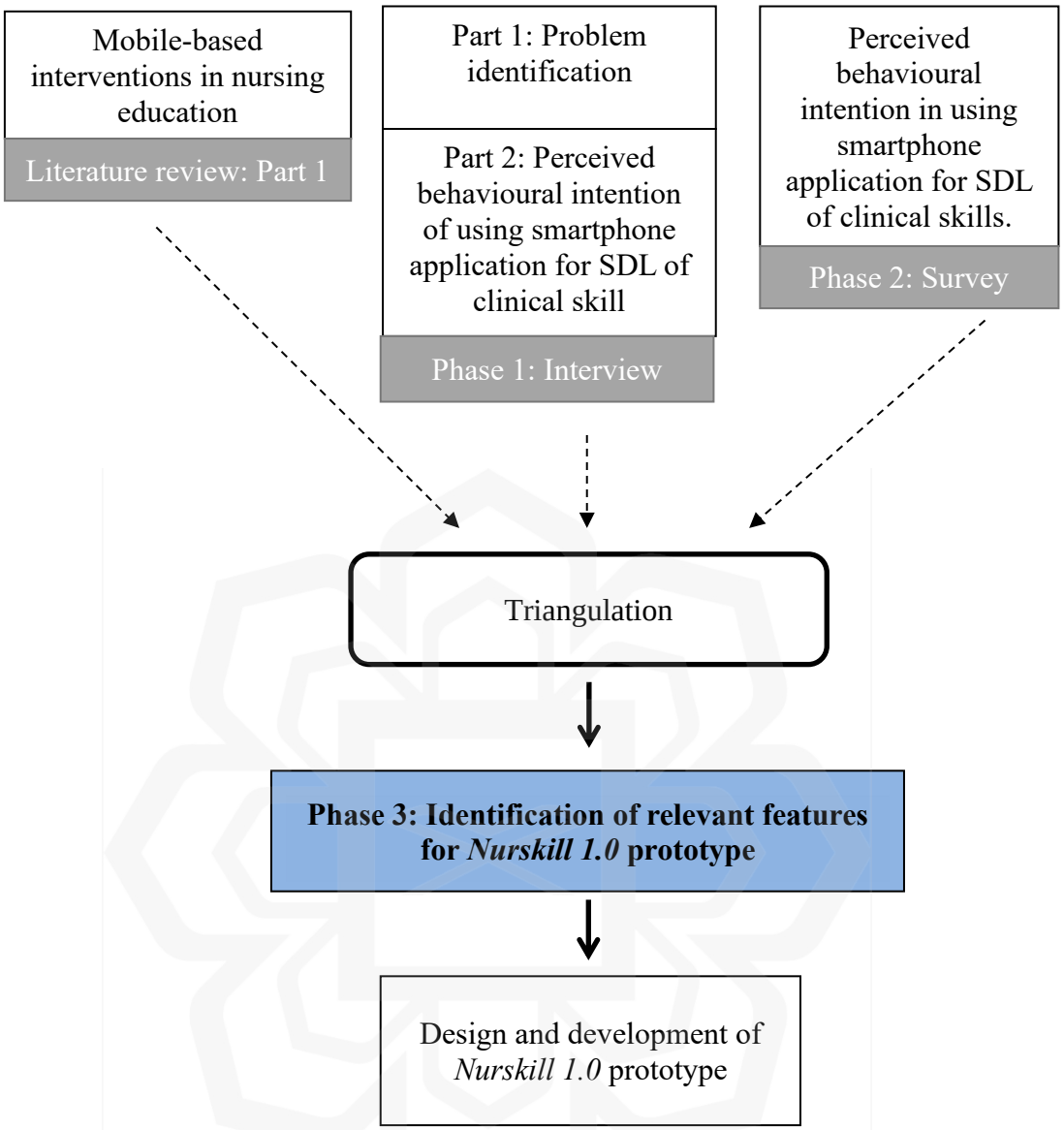


Figure 13 Designing *Nurskill 1.0* prototype using methodological triangulation

A list of requirements was drawn up based on the findings of previous works such as literature review and research objective 1 to identify relevant features of the smartphone application in this study. The requirements listed were compiled and their relevance was carefully examined.

In this study, the researcher gave the meaning of the level of relevance based on which category of behavioural determinant the findings fall, as reported in research objective 2 (refer Table 28). The first category was the 'highly relevant', determined by selecting the determinants which had the highest impact on behavioural intention, this includes habit ($f^2 = 0.112$), facilitating condition ($f^2 = 0.023$) and social influence ($f^2 = 0.026$). For the 'not relevant' category, it is represented by the determinant which was not significant in predicting the behavioural intention of using smartphone application for self-directed learning of clinical skill. In this study, *hedonic motivation* was found to be not relevant because of its lower impact on BI ($f^2 = 0.023$). Meanwhile, the 'relevant' category is represented by *performance expectancy, effort expectancy,* and *self-management of learning.* However, there were few arguments on how the researcher categorized the determinant as 'relevant', which will be discussed in Chapter 6.4. Thus, all requirements under 'not relevant' category were excluded as input for development of *Nurskill 1.0.*

Table 28 Relevancy level of determinant

Relevancy level	Determinant
Highly Relevant	Habit, Facilitating condition, Social influence
Relevant	Performance expectancy, Effort expectancy, Self-management of learning
Not relevant	Hedonic motivation

6.3 PROTOTYPE DEVELOPMENT

In order to present the concept of the application to the participants, *Nurskill 1.0*, a smartphone application prototype designed to facilitate self-directed learning of clinical skills for nursing students, was developed. The prototype is in the form of a high-fidelity prototype developed using Justinmind (www.justinmind.com), an authoring tool for web and mobile prototypes. As the outcome of phase 2 indicates that the smartphone is the device that the nursing students are competent to use and familiar with, the prototype hence was designed in the form of a smartphone application. The development of the prototype was timely reviewed by supervisory team members who are expert in human-computer interaction and usability, and technology instructional in nursing education.

The researcher chose to develop his own prototype in order to reduce biasnes of choosing features based on favoritism. Furthermore the features which were integrated into the application differ from other types of available smartphone application in the market. By developing its own prototype, it will help to cater the issues identified in the earlier work of this study, further to fulfill the research motivation in providing an application which is tailored to the nursing students' needs.

In the first version of prototype, the researcher listed out all requirements and its features representing all seven determinants of the proposed conceptual framework, these included *performance expectancy, effort expectancy, social influence, facilitating condition, habit, hedonic motivation and self-management of learning*. One determinant of this framework -h*edonic motivation,* which suggests 'the enjoyment and entertainment associated with using technology for learning,' however was excluded because it was not significant in determining behavioural intention to use this technology. The researcher also contains the idea that it is not practical to translate enjoyment elements into the design, especially as it is currently staged at infancy level, newly developed and targeted for the users which are first time using the application for learning clinical skill. The argument for this exclusion also lies within the concept of Transtheoretical Model of Behaviour Change (Prochaska et al., 1993), which suggested that individuals in different stages are having a different level of readiness to change. Therefore, by personalizing the strategies based on individual level of readiness, a behaviour change would have a better chance to be successful (Norcross et al., 2011).

Whilst the findings reported that *performance expectancy, effort expectancy and self-management of learning* were not significant (see Figure 12), the researcher argued that the features or design elements rooted from these three factors should not be stopped from being translated into the design of the application. The justification to include EE elements in the design lies within the idea that younger people are actually already competent in using smartphone application. Rad et al. (2017), for example outlined the facts that EE is not significant because the respondents by far have developed awareness on ICT usage. As a result of this, Miloševic et al. (2015) encouraged the institution to solve the issue by training, helping the students to learn the proper way on how to use the system, meanwhile Al-Lozi et al. (2014) suggested interface design and navigation improvement must be made.

Next, PE elements should be included into the design of the application also despite this factor was not statistically influence behavioural intention. The application supports learning performance of the students such as providing faster access to learning material and supports the students to learn more procedures, however it is still limited in terms of quality. The researcher argued in a sense that there is still room for improvement especially in providing credible and quality content of learning material (Mtebe, 2014). Al-Lozi et al. (2014) mentioned that m-learning services must be developed based on students' suggestions, to better meet their performance expectations. Similarly, self-directed learning can still occur anytime and anywhere even without stronger self-management skill because mobile learning is a form of informal learning that diffuses the characteristics of self-management skill (Aofan et al., 2016). Therefore, self-management elements should be included into the design so that it can help to inspire the student's self-control in learning.

Meanwhile, the example of video feature that was incorporated into the *Nurskill 1.0* prototype which is one of the relevant determinant (performance expectancy) of this study is illustrated in Figure 14:

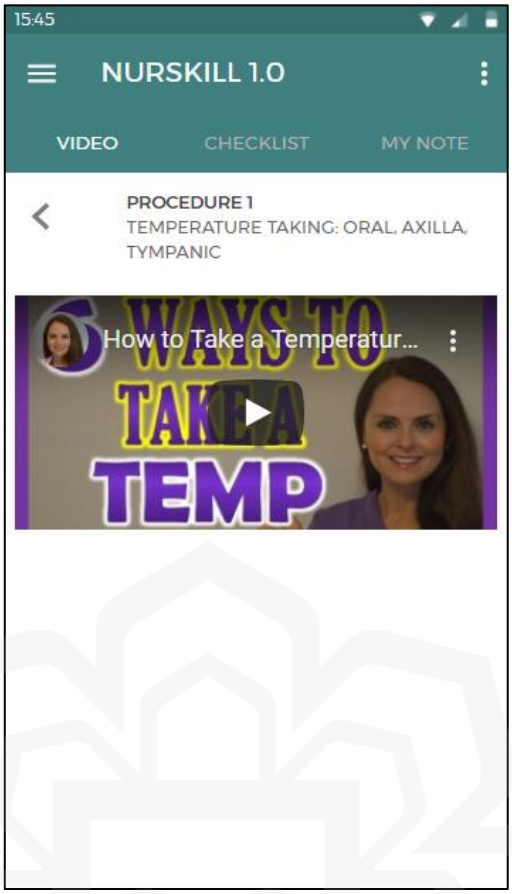


Figure 14 Example of video feature in *Nurskill 1.0* prototype

6.4 FINDINGS AND DISCUSSION

6.4.1 Identification of relevant features of smartphone application for self-directed learning of clinical skill

As a result of identification of requirements from literature review and research objective 1, this study explored other possible features of smartphone application which could be used to fulfil the stipulated requirements. All identified features were then mapped to the relevant determinant (as discussed in Chapter 6.4). For example, the function of 'visualizing the schedule for clinical skill procedure' is closely related to *schedule* feature in smartphone application. Since *schedule* is one of the criteria of time-management, therefore it was grouped under the determinant of "self-management of learning", which is a 'relevant' category of determinant. Table 29 below shows one of the examples on how the requirements taken from Phase 1 -Part 1 (Problem

identification) were listed and further were matched with possible features of smartphone application. A full list of features which have been mapped based on the design requirement and function can be seen in Table 31.

Table 29 Example of possible features related to design requirement/ function based on findings from Phase 1

Source	Requirement/ Function	Possible features
Poor time management	- To visualize the schedule for clinical skill procedure - To visualize the list of clinical procedures based on subjects - To plan for procedures to be performed as accordance to time - To prioritize learning activities as accordance to semester timeline - To monitor the progress of clinical skills procedures to be performed - To remind the clinical skill procedures to be performed	Schedule Procedure listings Appointment Priority label Progress monitoring Reminder

6.4.2 Development of smartphone application prototype for self-directed learning of clinical skills -*Nurskill 1.0*

The development of smartphone application was continued after the identification of relevant features was made. As participants are younger and have experience in using mobile applications, a high-fidelity prototype of a smartphone application integrated with design elements has been developed to act as a trigger material to give the participants a near-to-real feel on how the application would look like so that useful and relevant feedback could be gathered. Table 30 describes in detail the six (6) group of relevant features based on the determinants implemented in the design of the *Nurskill 1.0* prototype.

Table 30 Description and design based on behavioural determinant applied in the *Nurskill 1.0* prototype

Behavioral determinant	Description of behaviour determinant	Relevant features
Performance expectancy	Using the system, the nursing students will improve time completion and task completion in skill learning and skill practice.	Video (streaming, voice narration), Audio play, Documentation, Video recording, Record activity, Procedure checklist
Effort expectancy	Using the system is effortless, easy to use and easy to understand for the nursing students.	Quick tutorial, step-by-step introduction, offline version
Social influence	Using the system will increase social interaction among peers, lecturers and clinical instructors for the sake of clinical skills learning	Feedback, Forum, Expert comment, Social-network, Contact list, Messaging, Announcement, Recognition, Sharing activity
Facilitating condition	Using the system will help to gain important resources and support for the sake of clinical skills learning.	Help section
Habit	Using the system will help to build habit in skill learning and skill practice.	Notification, reminder, last-login status
Self-management of learning	Using the system will help to offer self-discipline behaviour in light of building autonomous learning	View count, screen time Schedule, Progress monitoring, Verification, Appointment, stop watch

First, as informed by the students, the researcher translated the learning and practical content from traditional approach modules such as procedure checklist and logbook into an electronic form of smartphone application. For learning, it is vital to organize a clinical skill *procedure checklist* in accordance with the format practiced in the faculty. The researcher sorted the procedures for every semester of study by following the format designed in the curriculum. By having a list of procedures based on the semester, it is easier to glean through any procedures by a student. Figure 15 illustrates the 'procedure checklist' feature of the app used in the study.

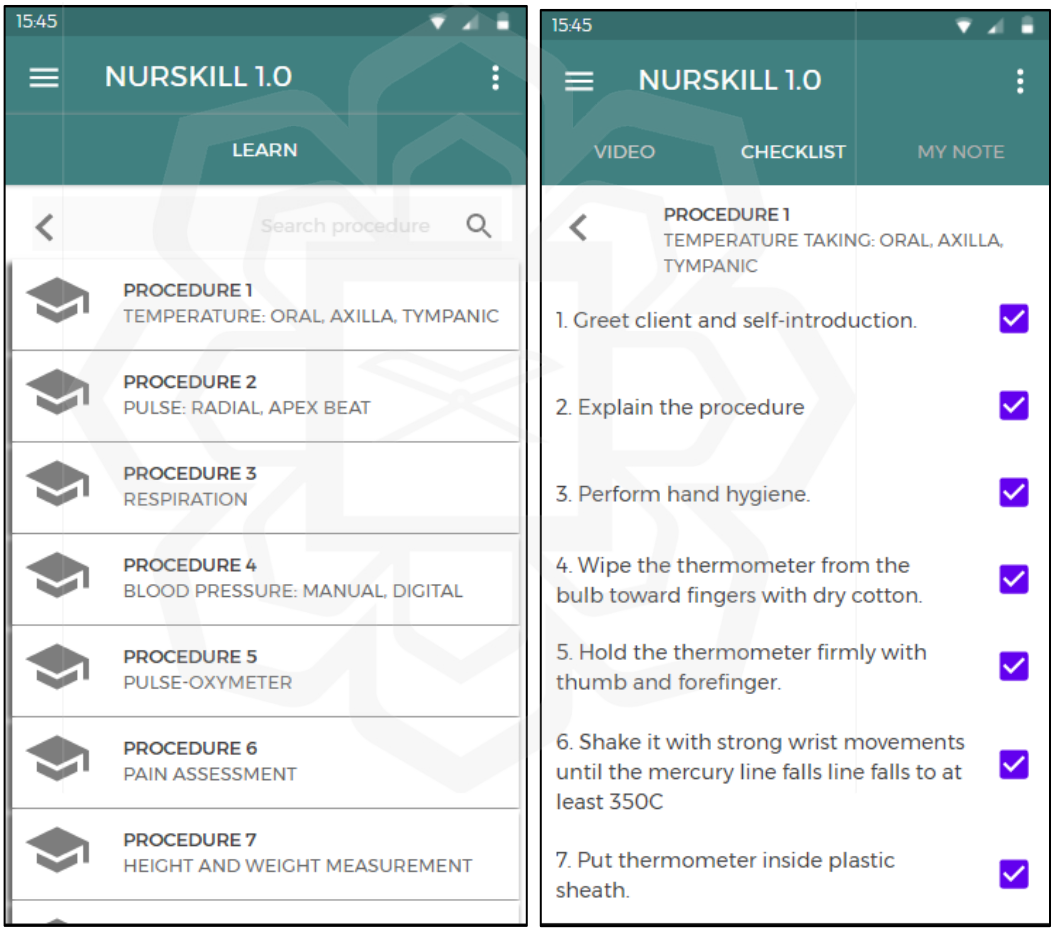


Figure 15 Screenshots of 'procedure checklist' feature in *Nurskill 1.0*

Besides, the researcher also felt that implementing video instruction feature is important because it provides fast and clear visual content about how to perform a clinical skill procedure. Further, some findings have suggested additional features for video instruction such as audio play, voice narration and subtitle and realistic video content to be included. As shown in Figure 16, by having realistic video content, it allows a student to concentrate on essential information of learning.

Figure 16 Screenshot of ‘video’ feature in *Nurskill 1.0*

The researcher also created a *note* feature where a student can record any learning cues or finding because of learning. The *note* will be specifically used for recording and documenting any learning matters perceived by the student directly into the application; thus, the student can refer to it in future. The example of the feature is shown in Figure 17 below:

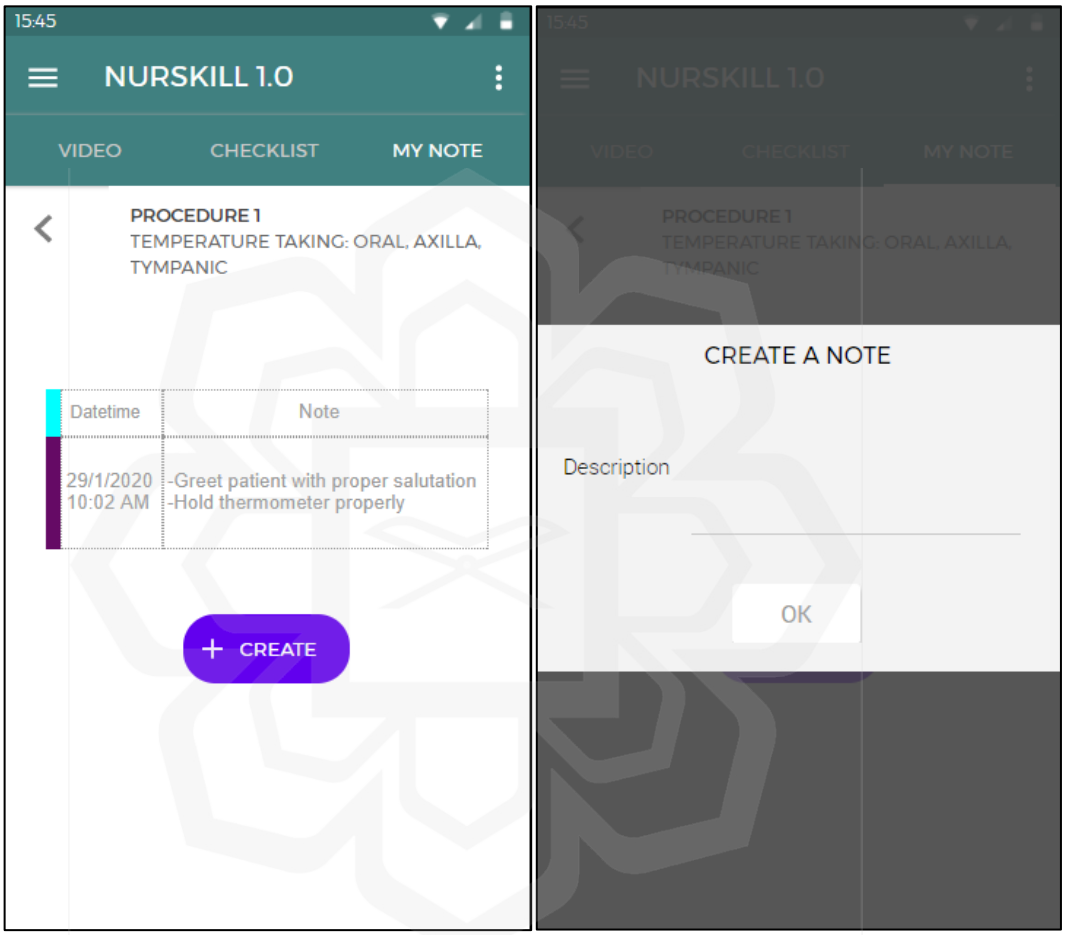


Figure 17 Screenshots of 'note' feature in *Nurskill 1.0*

Meanwhile, for testing students' practical skills competency, an *assessment* module was designed to help the student to get a chance to be assessed by the clinical instructor. In this module, the researcher features the application with a *request* button to prompt the clinical educator to be ready for a clinical assessment. Through this approach, the clinical instructor's assistance can be reached and their response to the request for a skill assessment can be received in the meantime. Figure 18 below shows the example of the assessment feature used in the study:

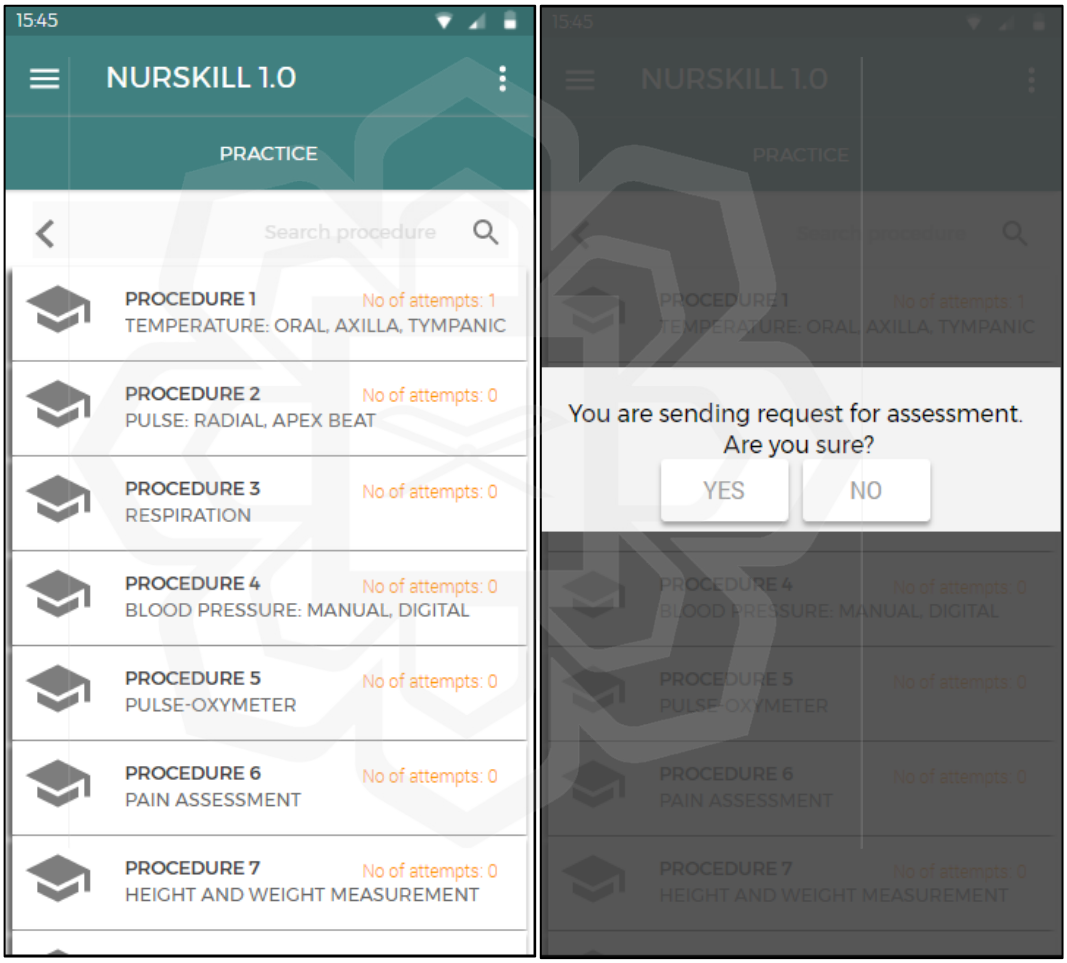


Figure 18 Screenshots of 'assessment' feature in *Nurskill 1.0*

Another feature that can help the student to count in their skill performance is *feedback*. This feature is a precedent process to the assessment module, in which the student can read comments provided by their clinical instructors resulting from practicing the clinical skill. Based on this comment, the student can also make a reflection on their performance and use it to plan for self-improvement in future. Both feedback and reflection feature can be seen in Figure 19 and Figure 20 below:

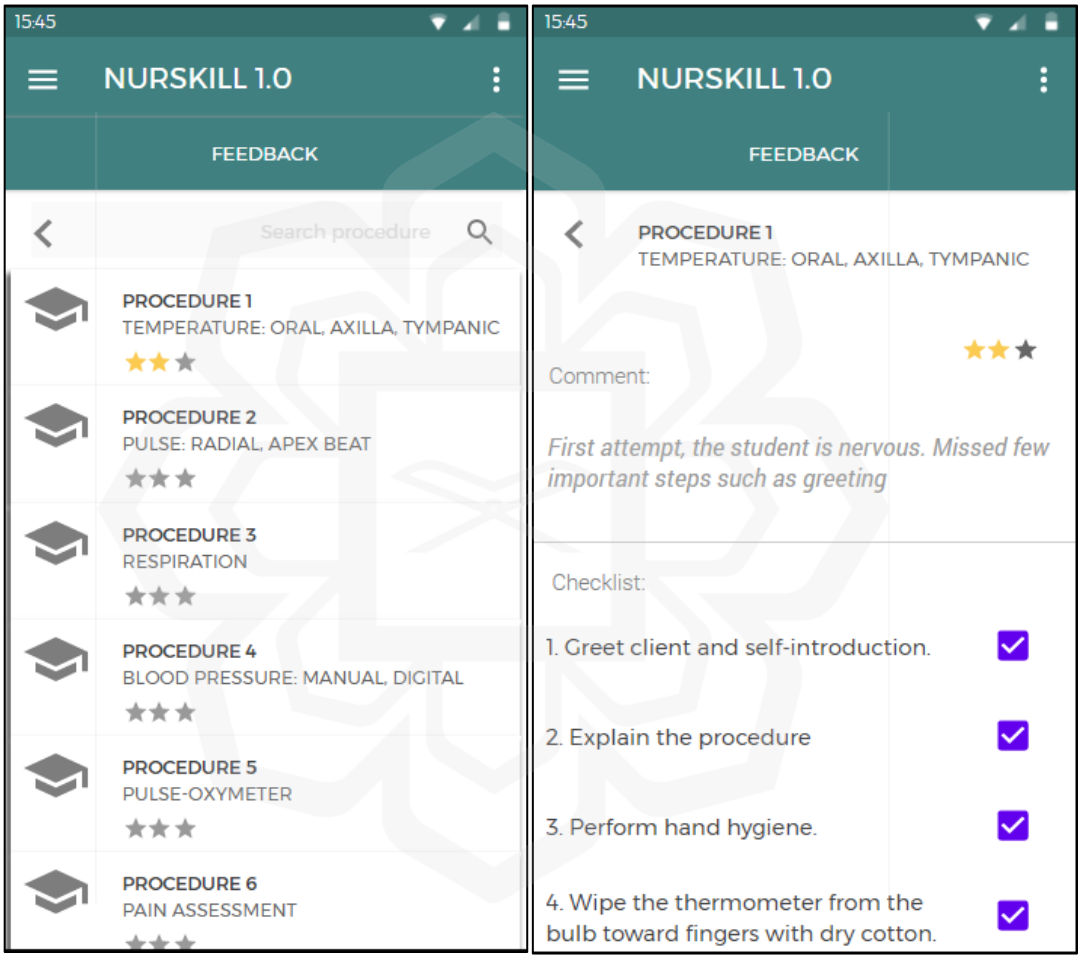


Figure 19 Screenshots of 'feedback' feature in *Nurskill 1.0*

Figure 20 Screenshot of 'reflection' feature used in *Nurskill 1.0*

There are few features which are perceived as important to improve the degree of effort that students imply when using smartphone application for self-directed learning of clinical skills. While many understand that the students have highly diffused with the smartphone system operation, however the students still need to adapt to a new application, therefore a few features were recommended. *Quick tutorial* is important to brief the students on how to utilize the application in introduction of the application. Figure 21 below shows the screenshot of quick tutorial used in the study:

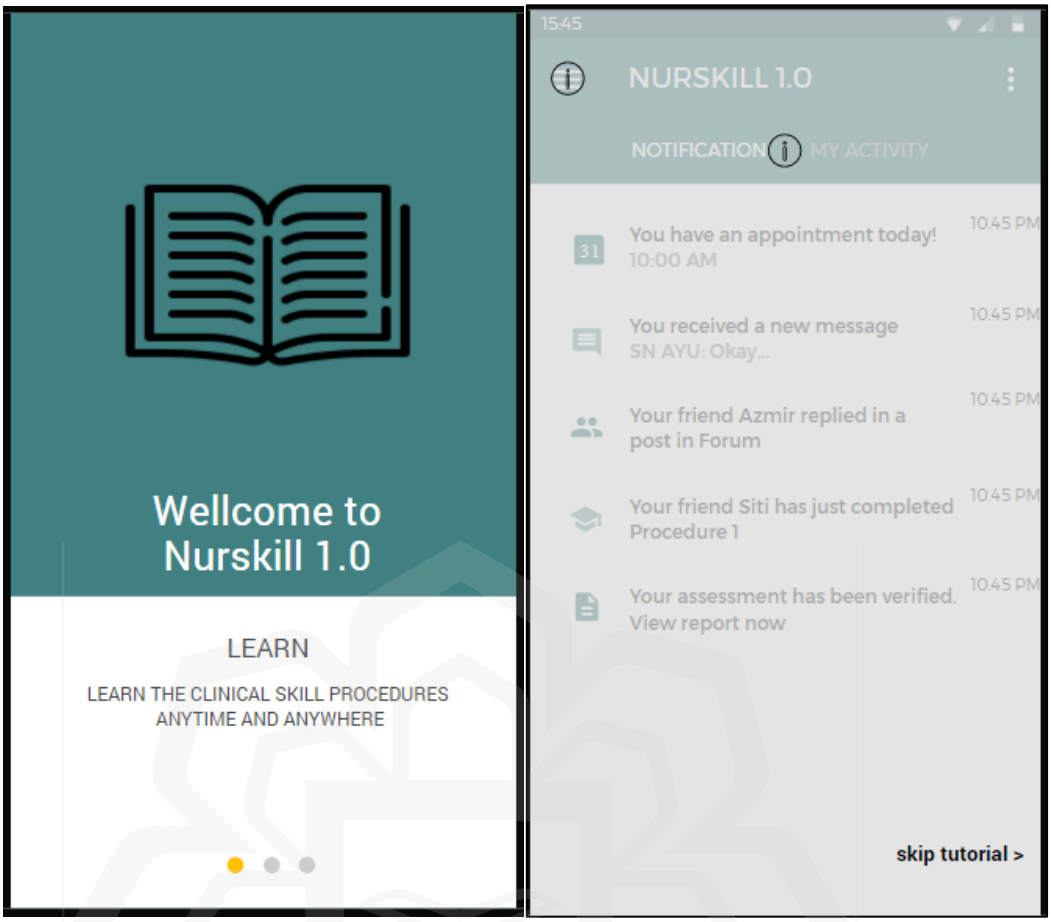


Figure 21 Screenshots of 'quick tutorial' used in *Nurskill 1.0*

Besides, to allow a smooth usage from button to button and from page to page, the application was designed with a *simple interface*. *Slide menu* and *tab menu* button was available in almost every page, so that the student can navigate to another page easily. *Search* button was also inserted to help with searching for the intended item needed. The selection of *font* size, colour and contrast have been considered. It is believed that by mirroring the user interface of other available application in the market, the students may have spent less mental effort to understand how to operate the application. The example of the screenshot is illustrated below:

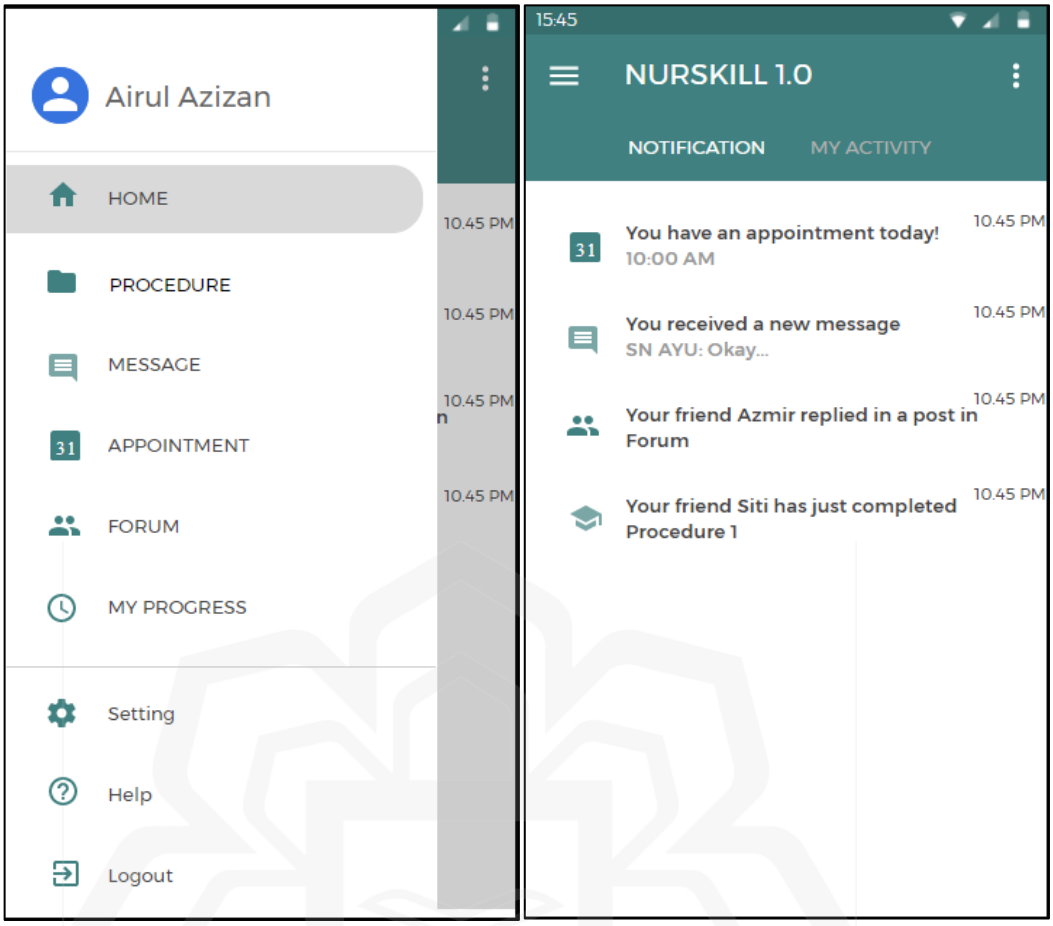


Figure 22 Screenshots of user interface in *Nurskill 1.0*

After that, the researcher leveraged social influence elements by implementing features that would allow *social influence* with friends, clinical instructors, and lecturers. The research embedded this strategy to let the students change ideas, tips, and experience with their friends who already achieve some goals in self-directed learning. By incorporating social influence into *Nurskill 1.0*, the students would be exposed to several styles of learning from their peers, therefore it is helpful for the students to imitate their friends' learning strategy that suits their learning. Some of features incorporated are *social-network platform*, *comment*, *forum*, *expert comment*, *messaging*, *announcement*, and *sharing*. Interacting with these social-network elements in the application could provide immense benefits to the students' learning, it may include interdependence among students, socialization with teachers, interconnected in network, enhanced professional identity, social and cognitive skill (Kakushi et al., 2016). Figure 23, Figure 24 and Figure 25 below shows the example of screenshots for

social media, message/chat and forum features of the app that represent social interaction factor in the study:

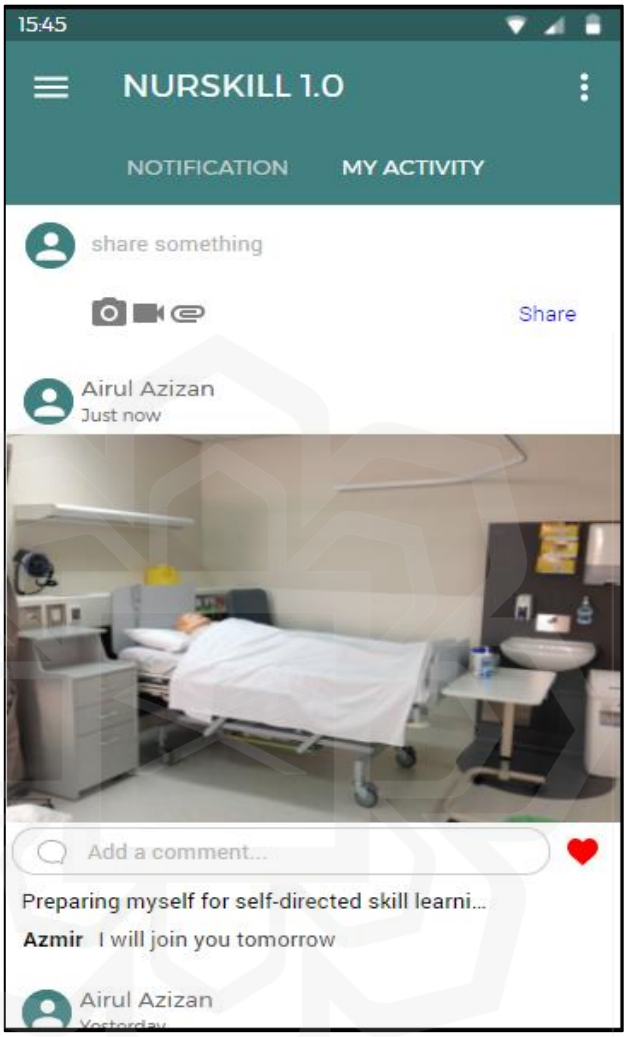


Figure 23 Screenshot of 'social media' in *Nurskill 1.0*

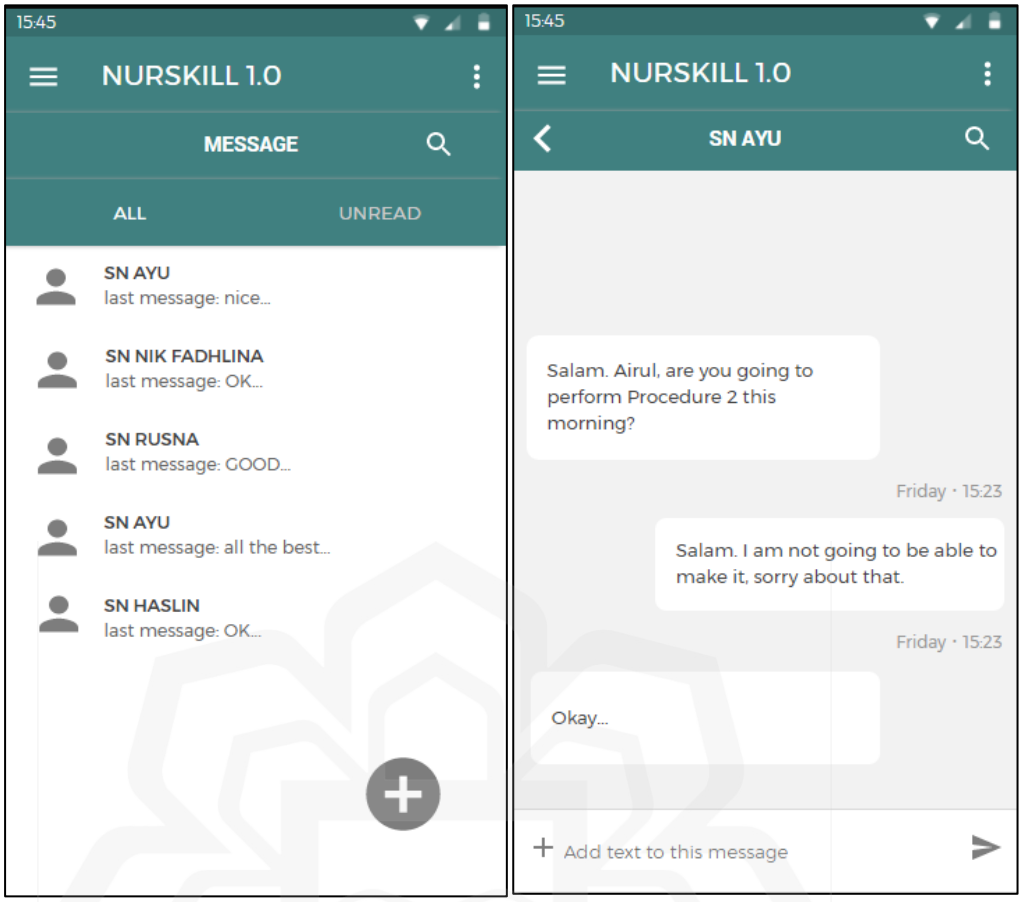


Figure 24 Screenshots of 'Message/ Chat' in *Nurskill 1.0*

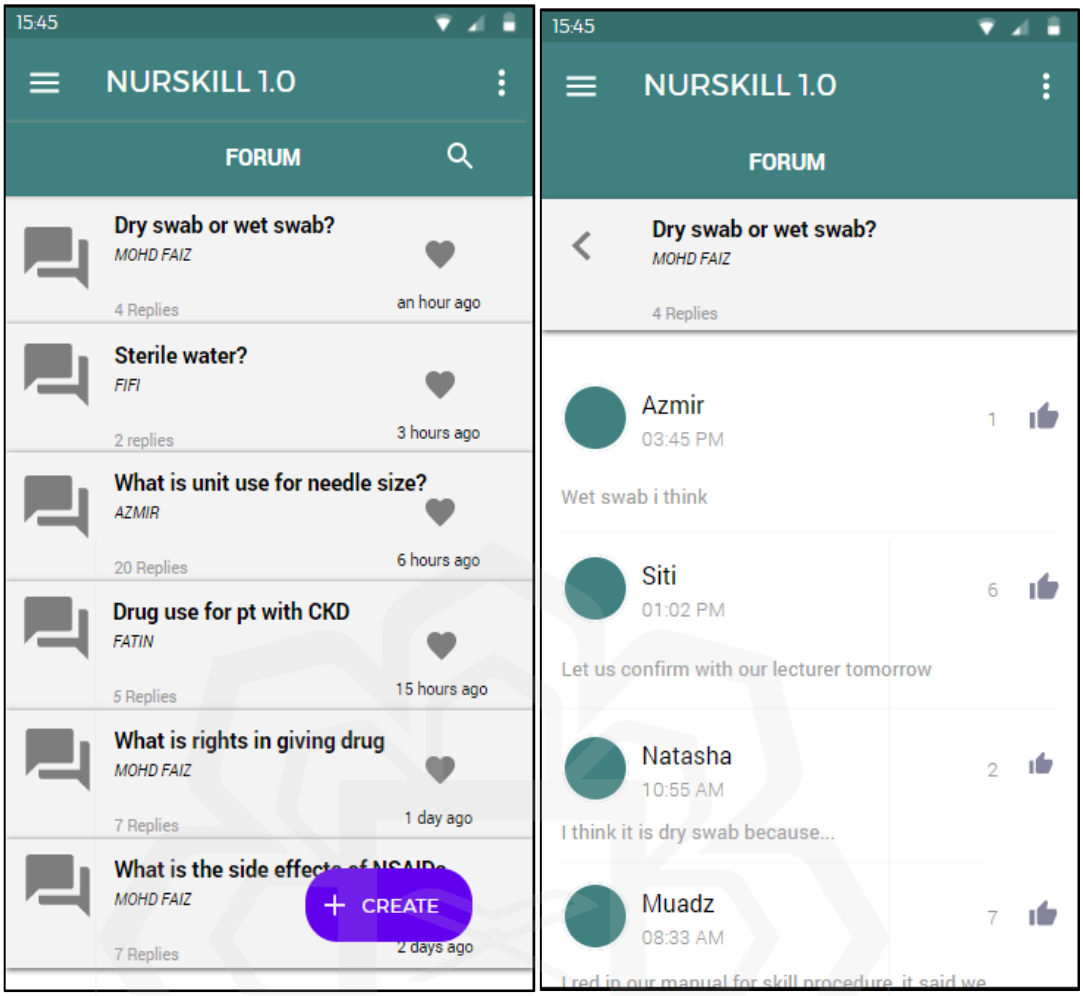


Figure 25 Screenshots of 'forum' in *Nurskill 1.0*

Another element for smartphone application identified in this study was related to the integration of resources and support. It is understood that smartphone technology today is enriched with internet connectivity such as wireless technology, this application also provides content that can be used for *streaming* and surfing online academic content directly. Since the students are still new to using the application, it is expected that there were few errors that might happen at this level, so this app was designed with a *help* section for new users to create a report on the problem they may face. The researcher believed with availability of support; the students would trust the application. Figure 26 shows the screenshot of the *Help* feature used in the study:

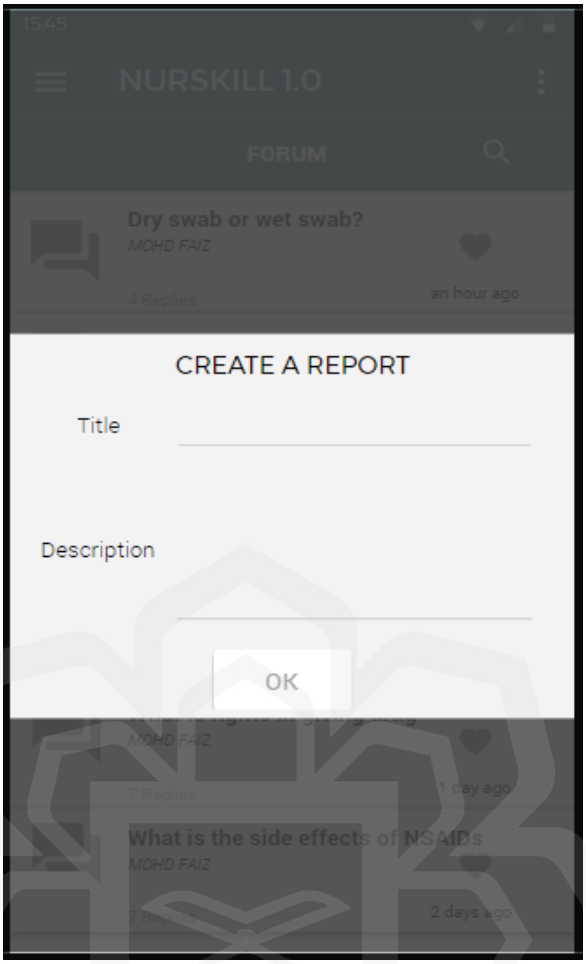


Figure 26 Screenshot of 'report/help' in *Nurskill 1.0*

The habit formation also appeared to be the most important determinant identified from the review and interview session. The use of habit formation such as *reminder* and *notification* are believed to bring users closer and increase logging frequency in the use of the application. The users were able to receive notification, and this became an important instant to display the new observations regarding self-directed learning activities. *Reminder* can be more disruptive; it is an active notification that would ring or vibrate the device in order to get the users' attention (Bentley & Tollmar, 2013). It encourages repetition of behaviour, helps remember to complete a task, and supports the development of a new habit. Figure 27 shows the *notification* feature of *Nurskill 1.0*:

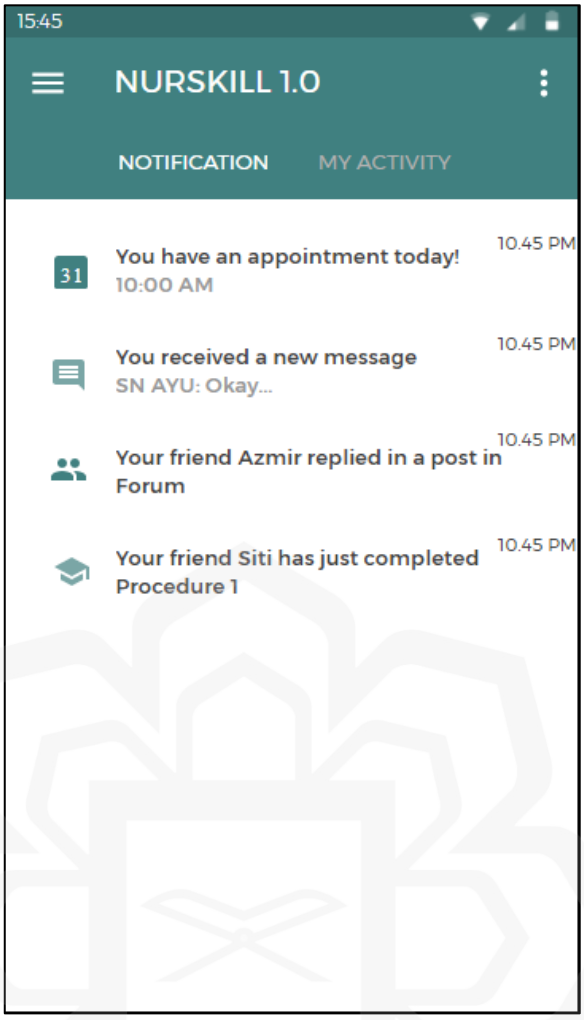


Figure 27 Screenshot of 'notification' in *Nurskill 1.0*

Lastly, another critical feature which has been selected for building this application is related to *self-management of learning* factor. By considering the challenges of nursing students found in Phase 1, the researcher noticed that the students' comment on autonomous in learning was undesirable in terms of time management, communication, planning, motivation, and self-evaluation. Thus, the researcher put more focus on improving the ability for autonomous learning among students. In monitoring overall skill performance, the researcher prepared a feature where the student can monitor the completion progress of procedure based on subject. In this feature, a *progression chart* was created by showing the number of procedures completed per overall number of procedures of the subject. Figure 28 presents the screenshot of *progression chart* used in this study:

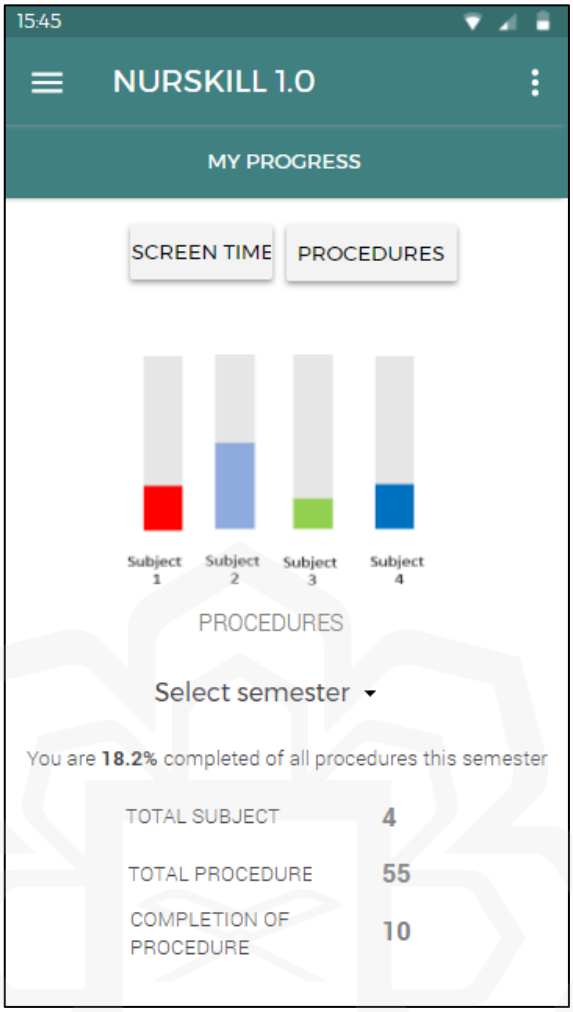


Figure 28 Screenshot of 'progression chart' in *Nurskill 1.0*

For time management, features such as *schedule* and *appointment* are important. The *schedule* was designed by showing available slots for the student to utilize the clinical skill centre. Besides, the student can use the *appointment* feature to book for a slot for clinical skill practice and assessment in the clinical skill centre. Based on the appointment made, the students can manage their time and motivate themselves to perform more procedures. Figure 29 shows the screenshots for *schedule* and *appointment* used in the study:

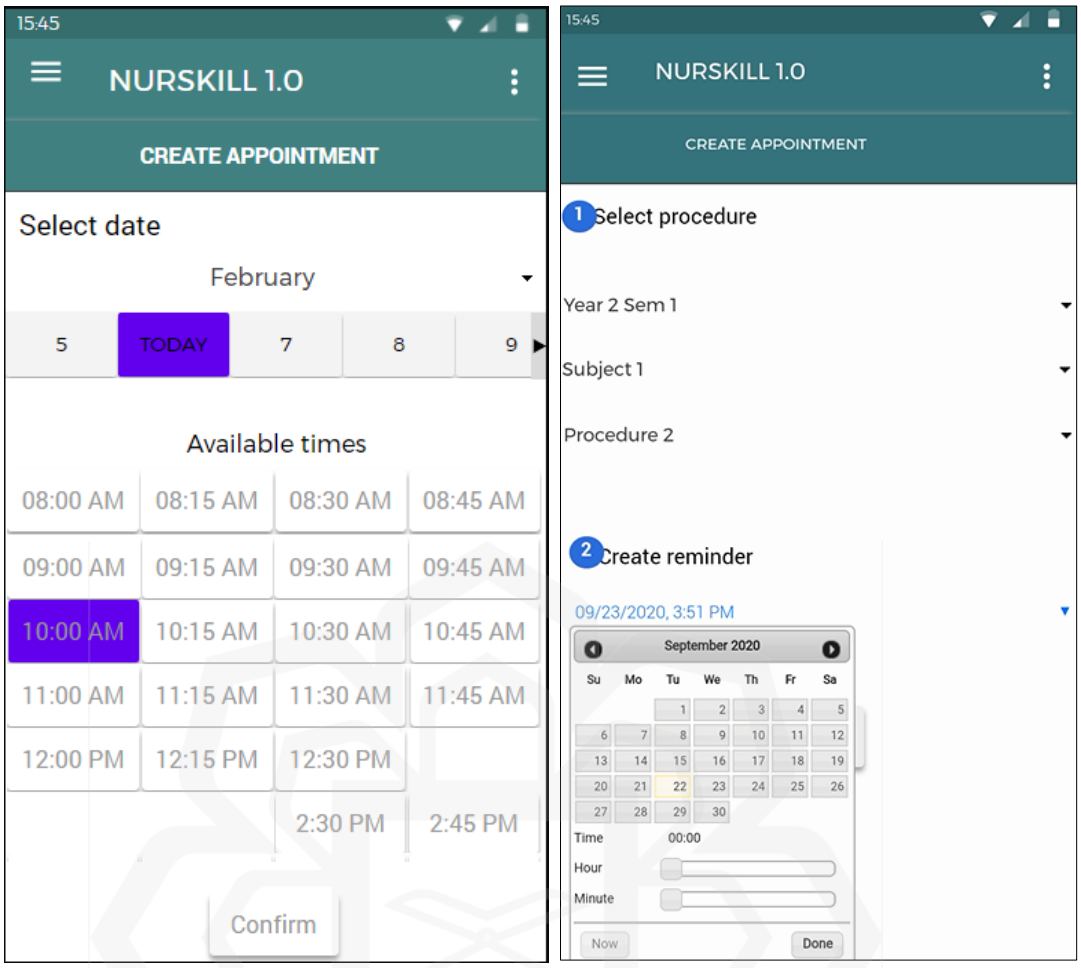


Figure 29 Screenshots of 'schedule' and 'appointment' in *Nurskill 1.0*

Next, *stopwatch* and *verification* of the procedure is another important feature that must be translated into the prototype because it is related to improving the quality of self-evaluation. And lastly, the monitoring of *screen time* will help the student be aware of the time spent on learning using the application. Figure 30 shows the screenshots for *stopwatch* and *screen time* designed in *Nurskill 1.0*:

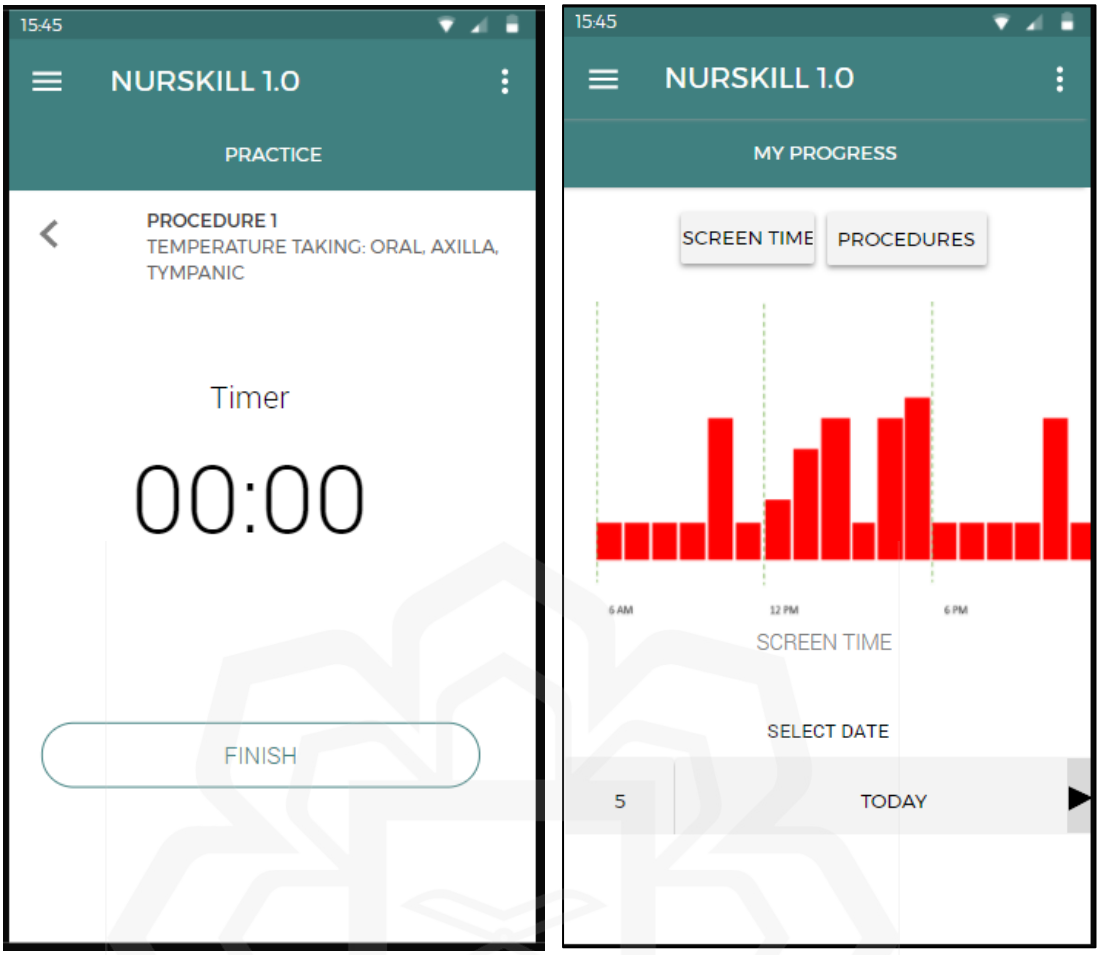


Figure 30 Screenshots of 'stopwatch' and 'screentime' in *Nurskill 1.0*

The production of the design artifact is an iterative process that requires continuous design-demonstrate-evaluate processes. Since this prototype was produced at an early level, some of the features were not suitable to be translated for the time being. Therefore, the researcher has omitted some features found in earlier phases. First, *voice narration*, *subtitles* and *realistic video* require a bigger team member to video cast, edit and produce high quality video. However, the researcher remains the only the video feature in this study by providing the video that can be easily available from the internet such as *YouTube*, thus it saves the researcher's time and cost. This exception is made only to this level of study, which is to understand the perception of using multimedia in the application, however this is not suitable for real tests in later stages.

Besides, the researcher also did not emphasize the specification of types of operating system such as Android or iOS in this prototype since the authoring tool that

the researcher uses (*Justinmind*) can support both. In addition, the researcher also put on-hold for the *offline* and *streaming* features because the researcher believes that these features are too advanced to be conducted for the time being.

6.5 SUMMARY

This study aimed to identify design requirements and its relevant features for developing a smartphone application prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students. The possible features were identified based on the requirements found in literature review and phase 1 findings. In the meantime, each feature was grouped into its related determinant as identified in phase 2. All identified relevant features were rooted from six behavioural determinants which are performance expectancy, effort expectancy, social influence, facilitating condition, habit, and self-management of learning. These findings are useful to inform researchers/designers on design requirements that should be considered in developing learning application for undergraduate nursing students. The completion of this study marked the achievement of the third research objective **(RO3),** which is to identify relevant features for developing smartphone application prototype and development of the prototype that facilitate self-directed learning of clinical skills for undergraduate nursing students.

Table 31 Framework mapping of behavioural determinants and potential relevant features.

No	Author/ Theme/ Sub-themes	Requirements	Features	Determinant
FINDINGS FROM LITERATURE REVIEW PART 1: MOBILE-BASED INTERVENTIONS OF CLINICAL SKILLS LEARNING				
1	Alvarez et al., 2016	To assist student with "help link"	Help section	FC
	N. Lee et al., 2016	To provide video that show clinical procedure demonstration along with voice narration. To make it available for online streaming To record the number of playing time	Video demonstration -Voice narration -Online streaming -Video play frequency count	PE
	S. Kim et al., 2017	To provide video that show clinical procedure demonstration along with instruction on the screen and voice narration	Video demonstration -Instructional content -Voice narration	PE
	T. Wu, 2014	To share and exchange learning activities among peers and teachers To allow the educators to give guidance and feedback on the students' activities	Forum Comment	SI SI
	I.-Y. Yoo & Lee, 2015	To provide audio support in the procedure that need skill on differentiate types of clinical manifestation	Audio play	PE
	M. K. Lee, 2015	To provide discussion and communication To receive and give feedback on students' performance	Comment Feedback	SI SI
	Choi et al., 2018	To document the nursing data found To provide calculation function related to the nursing data	Note Calculation support	PE PE
	H. S. Jeong, 2017	To provide video recording for practicing nursing procedure	Video recording	PE

	Park & Kim, 2018	To offer practical game with score and ranking component are used as scale of performance	Practical game: -Score and ranking	HM
	H. Jeong & Kwon, 2018	To allow uploading students' practice video on Facebook group To invite clinical nurse to comment the nursing practice in the video	Video recording Expert comment	PE SI
	Strandell-Laine et al., 2018	To provide schedule of practicum To create communication among student and educators in social networking-style To allow educator to give feedback to the students' recorded activity.	Schedule Social network-style comment Feedback	SL SI SI
FINDINGS FROM RESEARCH OBJECTIVE 1 PART 1: PROBLEM IDENTIFICATION				
2	Poor time management	To visualize the schedule for clinical skill procedure To visualize the list of clinical procedures based on subjects. To plan for procedures to be performed as accordance to time. To monitor the progress of clinical skills procedures to be performed To remind the clinical skill procedures to be performed	Schedule Procedure listings Appointment Progress monitoring Reminder	SL PE SL SL HT
	Lack of communication with educator	To list the lecturers' and clinical instructors' contact To chat with lecturer or clinical instructor before and after completing a procedure To give and record the feedback for procedures. To send announcement by lecturers or clinical instructors	Contact list Message Feedback Announcement Verification	SI SI SI SI SL

		To verify the completion of procedure		
	Lack of assessment of learning needs	To list out the checklist of equipment for procedure To prepare appointment available time To label the level of difficulty of procedure To create appointment for procedure practice	Procedure checklist Appointment Difficulty label Appointment	PE SL SL SL
	Not open to new ideas	To create topic for discussion for a procedure To create reflective diary throughout practice learning	Forum Reflective diary	SI SL
	Lack of internal motivation	To give recognition for participating in clinical skill activity To give praise for completing procedures To receive advice from the lecturer or clinical instructor To send virtual gift for completing milestone To upload and share recorded practical session with friends. To view the video demonstration or simulation of clinical skills procedure To create appointment for practice in the skill centre.	Recognition Praise Advice Virtual gift Sharing Video demonstration/ simulation Appointment	HT HM HM HM SI PE SL
	Educator-dependent in the search of new information	Student relied heavily on the educator	Reminder	HT
	Lack of awareness on self-evaluation	To remind for self-practice session To provide feedback and verifications to the student To monitor procedure progress	Reminder Feedback Verification Progress summary	HT SI SL SL

FINDINGS FROM RESEARCH OBJECTIVE 1 PART 2: PERCEIVED BEHAVIOURAL INTENTION OF USING SMARTPHONE APPLICATION FOR SDL OF CLINICAL SKILL				
3	Ease of use • Ease of use • Learnability • Simple attribute	To provide offline and online version of application To provide quick tutorial for first time user To arrange for "search button" for easier topic search	Offline version Quick tutorial Search button	EE
	Encouragement • Faculty member influence • Peer influence	To give feedback to the students' skill To give recognition on the students' participation To recognize students' participation in using the app To provide feedback for peer practicing a procedure To share own activity using the app To respond to peer's activity	Feedback Recognition by notification Notification Comment Sharing activity Comment	SI
	Interactivity • Social interactive content • Colourful and animative • Social competitive attribute	To award virtual gift for completing learning goals To provide game such as quiz To praise students for completing procedure To visualize current standing for completion of procedures	Virtual gift Game Praise Current standing	HM
	Habit Formation • Notification as reminder • Notify user login	To notify the student on other friends' activities updates To notify the student the important tips in mastering a skill procedure To remind the activities needed for completion of the goal. To notify the screen time spend on the app.	Notification Reminder Screen time Reminder Last login status	HT

		To notify the last date/time the profile is active or online		
	Learning Performance • Mobility • Perceived convenience • Useful content	To have access to clinical procedure checklist online To have access to progress of performance To provide link to other learning sources such as nursing procedure handbook To have access to clinical procedure checklist To have access to video demonstration and simulation To have link to other popular nursing education website To provide only verified clinical procedure checklist.	Clinical procedure checklist Progress summary External link Clinical procedure checklist Video demonstration and simulation External link Clinical procedure checklist	PE
	Technical and support system • Reporting	To report for any application error	Reporting section	FC
	Self-management of learning • Reflection of learning • Self-monitoring of performance	To provide a reflection note for every procedure. To provide checkbox for clinical procedure checklist To use stopwatch to set a time goal completing a procedure	Note Checkboxes Stopwatch	SL

CHAPTER SEVEN

PHASE 4: EVALUATION

7.1 STUDY PURPOSE

The main objective of this study is to evaluate the prototype of smartphone application-*Nurskill 1.0* in facilitating self-directed learning of clinical skills for undergraduate nursing students. So, the research objective in this phase is to evaluate the usability and perception of using smartphone application prototypes that facilitate self-directed learning of clinical skills for undergraduate nursing students. The two specific research objectives in this study are:

- Specific Research Objective 4a (**RO4a**):
  - To evaluate the usability of smartphone application prototypes that facilitate self-directed learning of clinical skills for undergraduate nursing students.

- Specific Research Objective 4b (**RO4b**):
  - To identify the perception of using smartphone application prototypes that facilitate self-directed learning of clinical skills for undergraduate nursing students.

7.2 RESEARCH METHOD

In order to achieve the first objective which is to evaluate the usability of the application, a think-aloud method, observation, and survey were used. For the second objective, an in-depth interview session was conducted with each participant to evaluate their perception towards the features of the *Nurskill 1.0* application that facilitate SDL of clinical skills.

7.3 RESEARCH SETTING

The research setting for this study is Kulliyyah of Nursing, International Islamic University of Malaysia, Kuantan Pahang.

7.4 RECRUITMENT OF PARTICIPANT

7.4.1 Study Population

This study is targeting undergraduate nursing students who are studying full-time at Kulliyyah of Nursing, International Islamic University of Malaysia.

7.4.2 Inclusion and Exclusion Criteria

Based on the purpose of the study, the inclusion and exclusion criteria for this study were formulated. The inclusion criteria consisted of 1) undergraduate nursing student of Kulliyyah of Nursing, 2) completed at least one semester for clinical skill learning, 3) student status is "active" in the database, 4) own and use a smartphone. Meanwhile, the exclusion criteria include 1) students on study leave 2) have no or less than 1-year experience of using smartphone.

7.5 ESTIMATION OF SAMPLE SIZE

Six students from Year 4 of Bachelor of Nursing program was invited to participate in this study. Year 4 students were the only batch of students who are available on campus during the data collection period, which is the period where the government of Malaysia lifted the MCO. Besides, Year 4 students were the most experienced as compared to the others in terms of learning clinical skills. According to Nielsen (2000), a round of usability testing with as few as five users may identify up to 85% of usability problems in the prototype design.

7.6 SAMPLING METHOD

A critical case sampling was used in this phase, which is the process of selecting a small number of important cases that are likely to yield the most information and have the greatest impact on the development of knowledge (Patton, 2015). Furthermore, Etikan (2016) said the critical criterion for an example is applied based on the statement, "If it happens there, will it happen anywhere?" or "if that group is having problems, then can we be sure all the groups are having problems?" For this reason, in addition to inclusion

and exclusion criteria, the researcher referred to the result in Phase 2 whereby the result reflected that the students were mostly expert in using smartphone, own an Android-based smartphone and have more than 6 years of experience of using smartphone.

7.7 DATA COLLECTION

7.7.1 Gaining Access

To gain access to the participants, an approval by Kulliyyah of Nursing was obtained. The leader in the batch was contacted to address the research objective and was asked to identify any possible classmate to be the participant. Every participant who was willing to participate is personally contacted by *WhatsApp* application. Then, they were personally briefed about the purpose of the study and were informed on how the interview session would be organized in terms of time and procedures. Once the agreement was obtained, an interview session is arranged.

7.7.2 Preparing for the Usability Evaluation and Post-test Interview

Before the interview commenced, the researcher asked the participant to make some preparations. First, the student was asked to download and install supporting applications on their smartphone. The first application is *Justinmind*, an application which is used to simulate the prototype developed by the researcher. The benefit of this application is the participant can view and interact with the *Nurskill 1.0* prototype on their smartphone. The second application is *AZ Screen Recorder*, an application that records the screen activity which is driven by the participant. This is very helpful for the researcher to analyse the usability of the prototype during analysis.

7.7.3 Pilot Interview

This interview guide was piloted with two undergraduate students through an online platform. This pilot interview also helped to improve the familiarization with the interview context and the use of the prototype. This pilot study was conducted during

the movement control order (MCO) initiated by the government of Malaysia as a result of Covid-19 pandemic. As MCO period is unknown when to end, by hook or by crook, online evaluation study had to be performed. However, there were many weaknesses of performing usability study online as compared to face-to-face. First, an interview took more than two hours to finish because of many interruptions such as poor internet connection, and unclear video and audio quality. Second, the participant only had to interact with the application prototype on their laptop, and they were not able to use the prototype on their own smartphone because during the interview the screen is required to be recorded and at the same time the think-aloud method is taken place with the researcher. Therefore, the information from the participant while interacting with the application could not be gauged clearly because the participant did not freely use the application on their smartphone. As a result of these difficulties, the researcher had to wait until the MCO is lifted and the participants can be met face-to-face.

7.7.4 Procedures

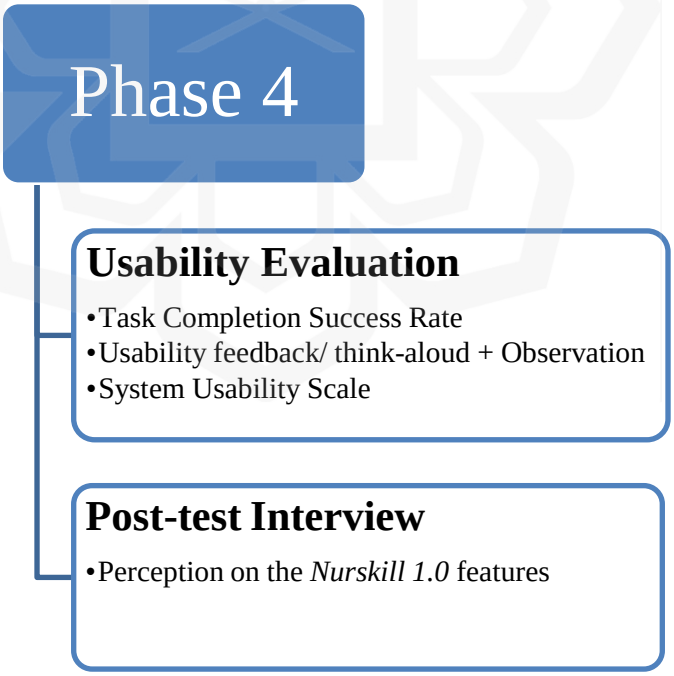


Figure 31 Methods used in evaluation study

In order to help the participant to go through the flow of the usability evaluation process, the participant has been given the information sheet and consent form, informing the general details of the study. There are five sections that the participant is required to follow in the procedure. In the first section, participants were briefed about the objective of the interview followed by fulfilling the consent form. In the second section, the participant was asked to answer a few demographic details encompassing gender, semester and year of study, background of study and experience on using smartphone.

In the third section, a persona and scenario were used in this study to help the participant in answering the task completion test, as persona is one of the variations to guide the heuristic evaluation (Friess, 2015). Persona was formerly used by an American software designer, Allan Cooper, for marketing consultation (A. Cooper, 1999). In this study, a hypothetical archetype of nursing students who are studying in Kulliyyah of Nursing is created with the scenario that reflects their experience in self-directing their clinical skill learning. While the nursing student character is fictional, the detailed information of the persona was generated based on the students' characteristics gathered in Phase 1, where 16 students were interviewed on the challenges in self-directing their learning clinical skill. Based on this persona and scenario, the participant was asked to perform several tasks on the prototype by using their smartphone. Figure 32 shows the persona and scenario used in the study. The development of persona and scenario was reviewed by an expert in human-computer interaction field from Kulliyyah of Information and Communication Technology, International Islamic University Malaysia.

Afterwards, participants were asked to interact with the *Nurskill 1.0* prototype by performing several tasks as instructed by the researchers. While performing the tasks, they were asked to think-aloud, a technique of uttering or voice-out loud of what they were doing (Charters, 2003). If they encountered a problem, or pause for a few seconds, researchers would ask them what they thought the screen was displaying, whether any aspect was unclear, and how they expected it to. There were 14 tasks required to be completed while their screen interaction with the app were recorded for documentation. Figure 33 shows the list of tasks which are needed to be performed by a participant in this study.

The researcher also observes for observed action, verbal, and non-verbal behaviours while the participant interacts with the apps' features. The researcher adapted a coding scheme for this structured video observation developed by Vermeeren (2002) because applying behavioural coding in multimedia product will help to efficiently analyse the user experience. Behavioural coding provides researchers with a lens for studying human interactions in observational videos. Table 32 shows the breakdown of indicators related to this observation.

PERSONA

Mr Azizan is a first-year undergraduate student attending Bachelor of Nursing in Kulliyyah of Nursing, International Islamic University Malaysia. He is 21 years old and currently on second semester of study. In current semester, he is taking an introduction subject for clinical nursing skill named Subject 1. He has to attend lecture sessions by a nursing lecturer followed by hand-on demonstration and practical session in clinical skill laboratory.

SCENARIO

After the demonstration of the procedure, the lecturer asked him and his colleagues to attend the clinical skill laboratory for self-practice in any interval of the academic schedules as prepared by the faculty. Since the session is self-directed, Mr Azizan has to manage his own schedule to get to practice in the clinical skill centre.

In order to assist Mr Azizan, he has been informed to download and install *Nurskill 1.0,* an application in smartphone which is provided by the faculty to facilitate the self-directed learning session. Mr Azizan has registered a profile into the smartphone application, then he started to look out the list of procedures for learning. He chooses Subject 1 and select Procedure 1 which is *'Temperature taking: oral, axilla, tympanic'* for learning. Then, he learned from a tutorial video on performing temperature taking procedure and begin to look for the steps for the procedure in a form of checklist. He feels that learning from video and checklist is easy and set to perform the procedure individually during his free time. He plans to be competent in the procedure in two-week time.

Since the facilities are quite limited to cater a big number of students in one time, *Nurskill 1.0* provide an information for the students to select available time for booking a place for practicing with a clinical instructor. To improve the communication between Mr Aziz and clinical instructor, he used messaging feature to discuss things.

Along this two-week, Mr Azizan managed to look for his progress and shared his activities with other students. Vice versa, he can look for others' friends shared activities as well. Besides, he can create a topic in a forum for discussion with his colleagues. Other than that, he able to monitor the percentage of completion of other procedures for the subjects he took in the semester.

Figure 32 Persona and scenario used in Phase 4

Task 1: Set up your profile
(*You can enter false or real details here*)
Task 2: Walk through the introduction and select quick tutorial that teach you to open the menu
Task 3: Read the third notification at Home page
Task 4: Find Forum at the menu tab
Task 5: Explore *Nurskill 1.0* social network platform (My Activity)

a) Comment 'OK' at the most recent post
b) Create a new post and share.
c) Search a friend named 'Azmir', follow him, and view his profile.

Task 6: **Learn** about a procedure:

a) Learn about temperature taking procedure (Subject 1, Year 1 Semester 2)
b) Watch the video and its checklist.
c) Create a note for yourself to read the thermometer at eye level.

Task 7: **Practice** and being assessed in a procedure:

a) Send a request to practice temperature taking procedure (Subject 1, Year 1 Semester 2)
b) Notify the instructor that you are ready to perform the procedure, and finish the procedure.
c) Create a new reflection note for yourself to document the temperature result.

Task 8: Find and view feedback report from the instructor dated 29/1/2020 10:02 AM
Task 9: Send message to SN Ayu and say 'Thank you' to her.

Task 10: Appointment

a) View list of appointments for today.
b) Create a new appointment on 9th February 2020 at 10:00 AM for Procedure 2, Subject 1, Year 2 Semester 1
c) Create a reminder for this appointment on 8th February 2020.

Task 11: Forum

a) Reply to the comment in the first post.
b) Create a new forum post entitled 'Discussion on medication for febrile patient'

Task 12: Identify your app usage by finding total screen time for today.
Task 13: Identify the progress of your procedures completion progress for Year 2 Semester 1
Task 14: Create a new report to report on an app problem.

Figure 33 List of tasks used in Phase 4

Table 32 Observed action, verbal and non-verbal user behaviour codes on the product adapted from Vermeeren (2002)

Code	**Short description**	**Definition**
…based on observed actions on the product		
ACT	Wrong Action	an action does not belong in the correct sequence of actions an action is omitted from the sequence an action within a sequence is replaced by another action actions within the sequence are performed in reversed order
DISC	Discontinue	user points at function as if to start executing it, but then does not user stops executing action, before it is finished
EXE	Wrong execution	execution of action not done correctly or optimally
REP	Repeated Action	an action is repeated with the same effect
CORR	Corrective Action	an action is corrected with a subsequent action (or sequence of actions) an action is undone
STOP	Stop Action	starts new task, before having successfully finished the current task
…based on verbal utterances or on non-verbal user behaviour		
GOAL	Wrong Goal	user formulates a goal that cannot be achieved with the product or that does not contribute to achieving the task goal
PUZZ	Puzzled	user indicates: not to know how to perform the task or what function is needed for it not to be sure whether a specific action is needed or not
RAND	Random	user indicates:

		that the current action(s) are chosen randomly
SEARCH	Searching	user indicates: not being able to locate a specific function to be searching for a function of which the analyst knows it does not exist
DIFF	Difficult	user indicates: having physical problems in executing an action that executing the action is difficult or uncomfortable
DSF	Doubt, Surprised, or Frustration	user indicates: not to be sure whether an action was executed properly not to understand an action's effect to be surprised by an action's effect the effect of an action was unsatisfactory or frustrated the user
REC	Recognition of error / Sign of Understanding	user indicates: to recognise a preceding error to understand something previously not understood
QUIT	Quit	user indicates: to recognise that the current task was not finished successfully, but continues with a subsequent task

In the fourth section, upon completion of the task, the participants were asked to answer System Usability Scale (SUS) questionnaire. The SUS is a brief instrument, also termed as "quick and dirty", enables designers to measure and evaluate the usability of a computer system quickly and it is cost effective (Bangor et al., 2009; usability.gov, 2021). It comprised of 10-items, and participants could denote their responses towards each of these items based on a five-point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree' (refer Appendix 6). SUS was proven to provide a high reliability result (alpha = 0.91) (Bangor et al., 2009) as compared to other types of usability survey

instrument such as Questionnaire for User Interface Satisfaction (QUIS), Computer System Usability Questionnaire (CSUQ) (Peres et al., 2013). Based on research, a SUS score above 68 would be considered above average, and anything below 68 is below average (usability.gov, 2021).

Next, in the final section, this study conducted a post-test interview which involved the discussion about participant perceptions towards the features implemented in the *Nurskill 1.0* application. They are required to answer the questions regarding the perception of every feature they have interacted with while completing the tasks.

Each interview session would last for about 45 to 60 minutes and their feedback was video or audio recorded. Then, the participants' verbalizations during the interview were transcribed and translated. The transcribed data was coded deductively by using NVivo 11, a qualitative analysis software package released by QSR International. At the end of the interview, the participants were given the incentives (a set of stationaries, cash, and food) as an appreciation token for their contribution in this study.

7.8 METHOD OF DATA ANALYSIS

Participant's interactions and verbalizations were audio-recorded. Besides, participants' screen interaction while using the *Nurskill 1.0* also were being recorded for usability analysis. This study used thematic analysis because it is a flexible and useful research tool which provides a rich and detailed, yet complex account of the data (Braun & Clarke, 2006). Besides, the observation from video recording, user verbal and non-verbal behaviours also helped in determining the user experience in this analysis. Meanwhile, the SUS score will be determined based on the grading score as reported by Bangor et al. (2009).

7.9 RESULT

7.9.1 Participant

Table 33 summarizes the characteristics of all six undergraduate nursing students who participated in this study. The experience of using smartphone among participants was more than six years old indicating they are experienced users.

Table 33 Participants' demographic details

ID	Gender	Year	Study Background	Experience
ID01	M	4/2	CFS	> 6
ID02	F	4/2	STPM	> 6
ID03	F	4/2	CFS	> 6
ID04	F	4/2	STPM	> 6
ID05	F	4/2	STPM	> 6
ID06	M	4/2	STPM	> 6

However, it is important to note that this study only involved students who were willing to participate and indicate their interest and motivation to enhance their self-directed learning in clinical skills using technological interventions. Students with no motivation to enhance their self-direction of learning clinical skill or those with negative attitudes towards the use of technology innovation in improving their learning might have different perspectives towards the design elements being investigated.

7.9.2 Usability

Based on the concurrent think aloud session, the researcher managed to analyse three types of usability findings, which are the task completion success rate, the usability feedback, and the system usability scale.

7.9.2.1 Task Completion Success Rate

All participants successfully completed all tasks except for Task 2 (Introduction and quick tutorial*)* and Task 12 (Screen time monitoring), in which four out of six of the participants (66.7 %) managed to complete the task. However, there was a limitation in Task 12 (monitor app usage) as there was a design malfunction that resulted in the students not being able to perform the task correctly. All participants, except for Participant 01 and Participant 02, have recorded success in performing all tasks. Table 34 shows the list of completion success rate of all tasks given to the participants:

Table 34 Task completion successful rate

	ID01	ID02	ID03	ID04	ID05	ID06	No of Successful task	Completion Rates
Task 1	√	√	√	√	√	√	6/6	100%
Task 2	X	X	√	√	√	√	4/6	66.7%
Task 3	√	√	√	√	√	√	6/6	100%
Task 4	√	√	√	√	√	√	6/6	100%
Task 5	√	√	√	√	√	√	6/6	100%
Task 6	√	√	√	√	√	√	6/6	100%
Task 7	√	√	√	√	√	√	6/6	100%
Task 8	√	√	√	√	√	√	6/6	100%
Task 9	√	√	√	√	√	√	6/6	100%
Task 10	√	√	√	√	√	√	6/6	100%
Task 11	√	√	√	√	√	√	6/6	100%
Task 12	X	X	√	√	√	√	4/6	66.7%
Task 13	√	√	√	√	√	√	6/6	100%
Task 14	√	√	√	√	√	√	6/6	100%

√: completed, X: not completed

7.9.2.2 Usability feedback

While the completion of the tasks is commencing, the participants have to voice out their mind while interacting with the *Nurskill 1.0* app. They gave their feedback whether it is easy or difficult in completing the tasks. There were three themes regarding the usability of this application identified, which includes unclear navigation tree, flow process error, and unclear interface design properties. In support of these themes, the action observed, verbal and non-verbal behaviours were addressed as well. It is tabulated based on the frequency of occurrence of the related codes (Refer Table 35). Meanwhile, the details of the themes identified are as follows:

a) Unclear navigation tree

Many usability issues that preventing or slowing down the task completion time were related to unclear navigation trees. The *Nurskill 1.0* was built to have several pages and sub-pages where a user can click on and explore on the function that it has. In this analysis, the problem is seen prominent when the participants glean through some pages in the application, such as *Learn, Practice* and *Feedback.* It is because these pages possess similar design characteristics for example year of study, semester of study, date, and the procedure name. Somehow, these similarities caused confusion to the participant, thus slowing down the process to complete the task. For example, Participant 03 who wanted to complete the task on 'performing a hand-on practice' was stuck within the '*Learn*' page as she presumed that the page showing the list of procedures (refer Figure 34) could also be used for '*Practice*' purposes. When she found that she was not on the right page, so she has to explore more to correct herself.

b) Flow process error

Besides, there were issues that prevented task completion related to the wrong flow process on the application. During development of the prototype, each page was set up with system input control (such as button) and apps builder components, so that when a user clicks on it, it will lead to another page that represents its label. On analysis of the usability among participants, a few occasions were addressed during task completion activities, where the participants were feeling puzzled while interacting with the buttons and labels. It is because the flow of process after pressing a button unfortunately led them to another unrelated page. This has created frustration as the participant unable to complete the task. For example, Participant 01 who wanted to select the 'screen time' button in order to know the time spent on that application, have found out that he was directed to 'Learn' page, which is unrelated to the task. Because of that, he has to skip and proceed to the next task.

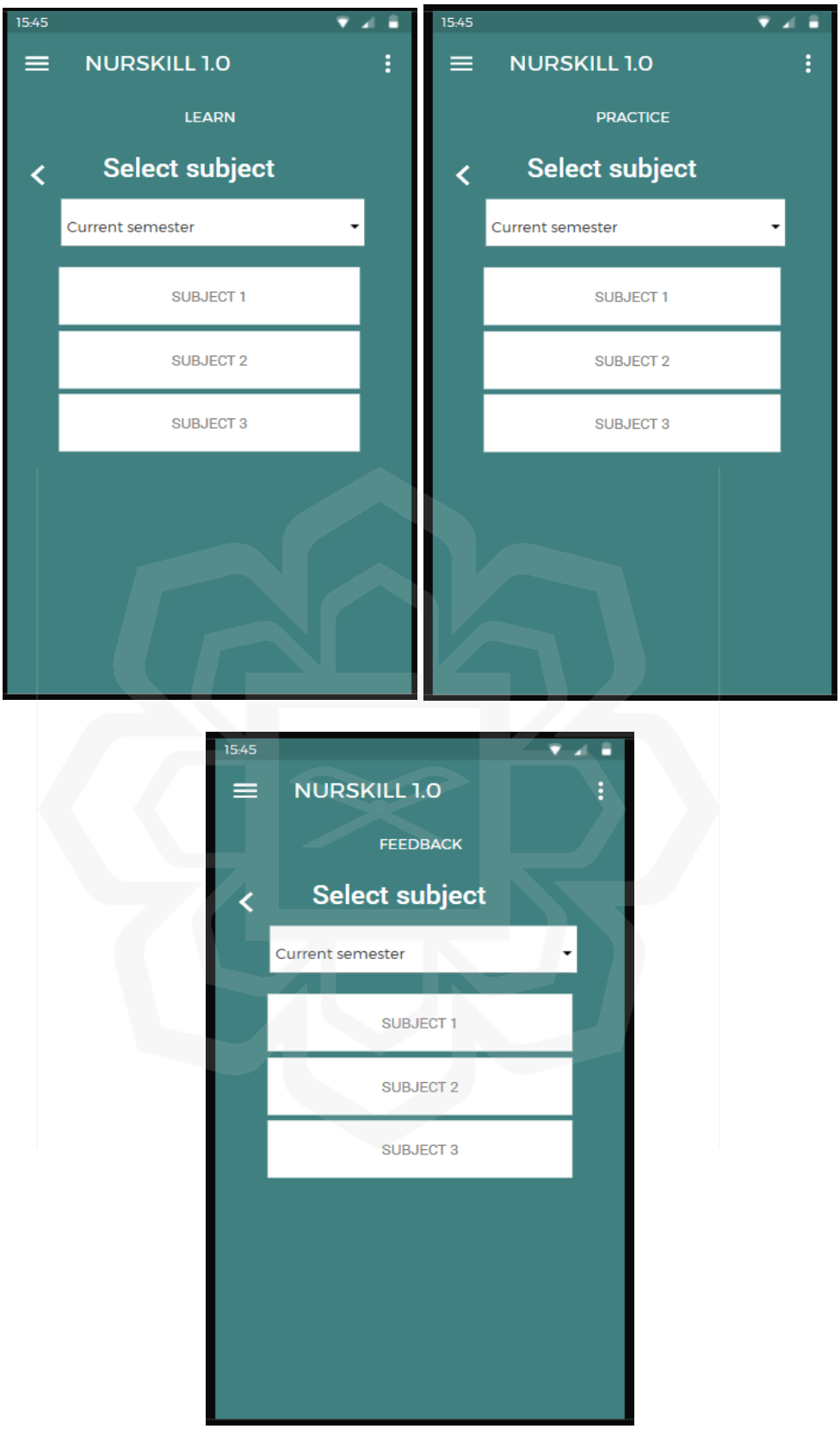


Figure 34 Similar layout in *Learn*, *Practice* and *Feedback* modules

c) Unclear interface design properties

Another usability issue appeared to be prominent found in this study is unclear interface design properties. Firstly, this issue relates with the clarity of design architecture of the application. There were some features designed with a lack of clear instruction to the users, which led the student to spend more effort to explore and understand the function of the features. It forced the participants to behave by repetitively tapping on the screen, indicating an extra effort was used in completing the task. Apart from that, utilizing unsuitable icon has also prevented the participant to explore more about a feature. On analysis of the video, the use of ⓘ sign, which is designed to introduce new users with the description or function of a button, was appeared too hidden in the interface of the application, thus preventing it from being recognized by the participant. For example, Participant 01 used to ignore the ⓘ button, by skipping to the next task showing that there are some weaknesses in the interface design.

Secondly, the problems related to design function arose as the element in the feature did not give any significant value for learning. The participant has expressed confusion while interacting with this element. For example, in the *Learn* section, the checkbox function of the nursing procedure is not really meaningful to the student because the procedure steps are used for viewing and reading only, therefore the checkbox is not really needed. Figure 35 below shows the screenshots of both problems as mentioned by the participants:

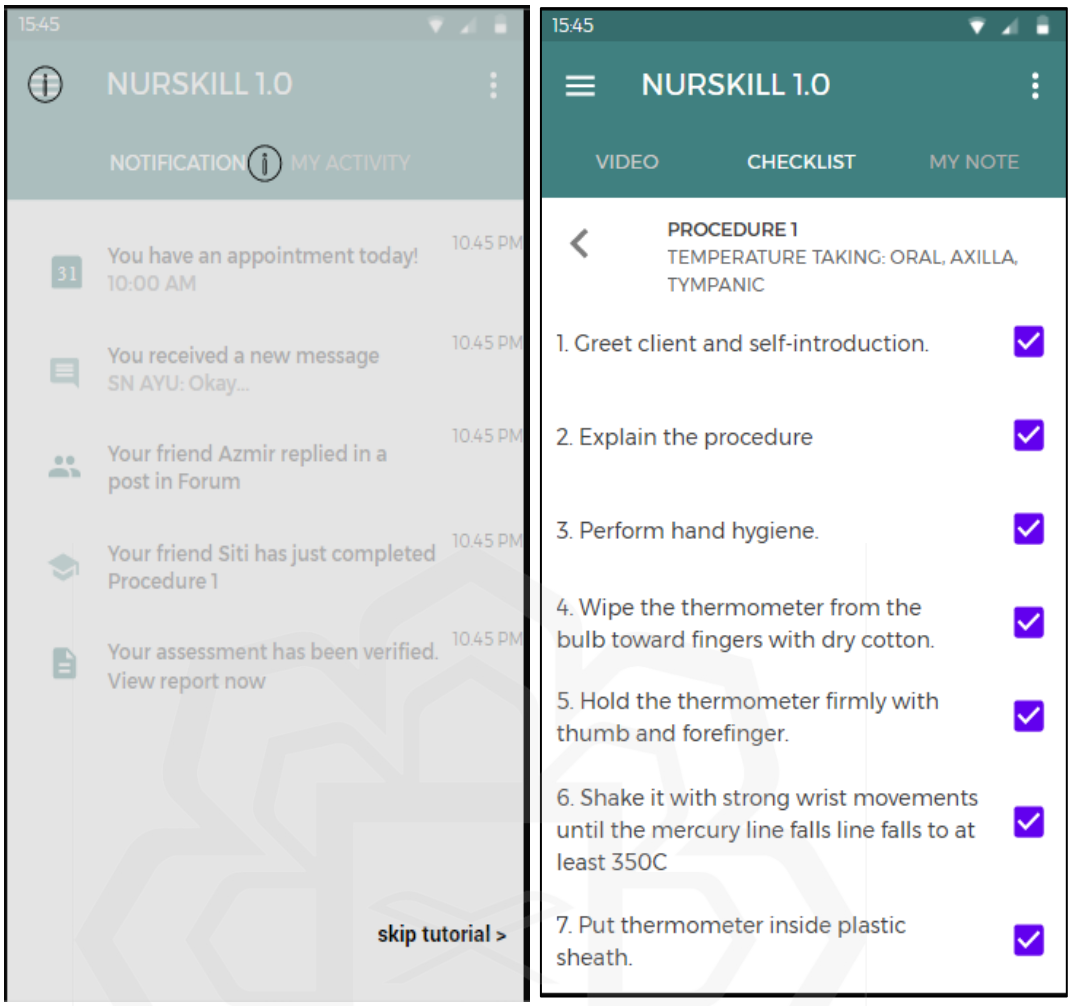


Figure 35 Screenshots showing the ⓘ button is too hidden in the interface (left) and the checkbox function which is not necessary (right) as mentioned by the participant

Table 35 Codes identified based on observation

	Code identified*													
	ACT	DISC	EXE	REP	CORR	STOP	GOAL	PUZZ	RAND	SEARC	DIFF	DSF	REC	QUIT
Task 1												1		
Task 2	2						3	2		1			1	
Task 3	1		2	1	1		1	3	3	1			2	1
Task 4									1				1	
Task 5								1		1	1		2	
Task 6										1		1	1	
Task 7					1							1	3	
Task 8	2			1				2		2	1		2	
Task 9								1		1		1	1	
Task 10											1	1	2	
Task 11								3					3	
Task 12								1						2
Task 13														
Task 14														

*ACT – Wrong Action, DISC – Discontinue, EXE – Wrong execution, REP – Repeated Action, CORR – Corrective Action, STOP – Stop Action, GOAL – Wrong Goal, PUZZ – Puzzled, RAND – Random, SEARCH – Searching, DIFF – Difficult, DSF – Doubt, Surprised, or Frustration, REC – Recognition of error, QUIT – Quit

7.9.2.3 System usability scale

Apart from testing the task completion on the features of *Nurskill 1.0* for usability study, the researcher also asked the participant to evaluate this app through the System Usability Scale (SUS) questionnaire. The following Table 36 presents the average usability score of the application given by each of the undergraduate nursing students:

Table 36 The usability score of *Nurskill 1.0*

Participant	SUS Score
ID01	70
ID02	80
ID03	75
ID04	87.5
ID05	60
ID06	100

The above table shows that, the mean SUS score for *Nurskill 1.0* performed by the participants is 78.75. Based on SUS grading score guidelines published by Bangor et al. (2009) this score indicates that the *Nurskill 1.0* application has a good usability.

7.9.3 End-user perception on features of *Nurskill 1.0*

Besides, a post-test interview involving the discussion about perceptions on the features of the application was analysed. Accordingly, Table 37 presents an example of one participant's excerpt based on the corresponding feature of *Nurskill 1.0.*

Table 37 Participant perceptions on feature of *Nurskill 1.0*

Feature	User perception
Profile	Because like we can see our friend's activity… we will feel motivated to do it also because our friend has a lot of things he has done (ID02, F)
Introduction	Useful… The arrangement is correct, follow (first) we watch the video first, then we (make) an assessment, then we can know the feedback. So it is complete from A to Z. (ID02, F)
Notification	Ok. I think it's ok because the first thing you see when you open social media is when you see the notification first… it is arranged as for an appointment, then the one for the message… The one for the kind of social reply here… I think this is completely ok ... (ID03, F)
Tab menu	It's easy because I think most apps are like this. So it's easy. (ID03, F)

My Activity- Social network	Oh ok. So [we] can post pictures at the same time [we] can comment. So it's kind of nice, it's like social media… he gives motivation like "Oh, he's doing CPR, so ok I need to learn CPR also … I don't want to be left behind." (ID01, M)
Learn- Procedure checklist	So the checklist is .. uniform la.. standardised. During the OSCE, (if we have) the same exact procedure or the checklist with the assessor, so we might not left behind about anything the checklist have been stated. (ID01, M)
Learn- Video	[It] helps, then it kind of standardized. Everyone sees the same video and I do believe that the video posted must be a video that really means [to us]. … [It] is easier [compared to]… if you want to search on YouTube yourself. (ID02, F)
My Note	… I think this thing is helpful… It's easy… If we usually lose our notes, sometimes we forget to bring them ... but [this app] is made for this procedure, we have a specific note… so he makes it easy (ID03, F)
Practice	… [We] can't avoid… CI or lecturer want to know if we really perform or not, they can also look at this history. So if we [tend to] be lazy, we cannot be lazy. (ID02, F) For me, the less time is spent… it means we are really good…. Then we practice again, practice again. So if we target five minutes to complete before this, [then] we can see the progress ... (ID02, F)
Self- reflection	As a reminder too. And it can also be if you want to praise yourself. Today we make it better. So kind of a diary. (ID02, F)
Feedback	So I can take the feedback and I need to improve for that procedure. (ID01, M) It feels ok like that because we can see our trend means we improve by time or not. (ID03, F)
Messaging	… I think ok, it means sometimes certain things we do not like to mix ... [Using] WhatsApp is too personal… (ID03, F)
Appointment	Ah like this, it continues to empty the slot that has been taken. So I feel ok like this. Booking here is easy… So if we are the type of book by place, like by room, then this is helpful. Because sometimes we do not know which room is empty .. (ID03, F)
Forum	So for the forum, it's very helpful because some of the students are very determine and they search something like …should we …use dry swab or wet swab which is some of the student never thought about… [Which] actually there is explanation to that. So in the forum we can discuss something… (ID01, M)
Screen time (app usage)	… This is good… It is practical for today. I think it is motivating. (ID03, F)
Procedure completion	So in this apps it shows how many percent there real progress. …we see, "OK today eighteen percent, so set the aim at least by the end of this year I need to perform at least sixty percent." (ID01, M)

	This is good. So [there] is the graph right, so we can see our performance. Then we must be like reinforced to complete everything. (ID02, F)
App problem reporting	I think it's better because [this] is like a feedback right… So sometimes the bug happens… So maybe the developer will find something to solve the problem. (ID01, M)

Based on the thematic analysis of this study, important issues regarding the perceptions of undergraduate nursing students towards the use of *Nurskill 1.0* for SDL of clinical skills learning were identified. The issues were a) personalization of profile, b) credibility of content, c) complexity of interface design, and d) updates of notification

a) Personalization of profile

All participants were pleased with the profile feature where the user was able to create their own identity in the app and socialize with each other. However, as data was being analysed, there was an emerging trend that highlighted the improvement of features in terms of personalization. The nursing students received a lot of concern with the increasing number of students, citing that the feature was useful. However, there is a need to improve the authenticity of the profile and to improve the social interaction between students and instructors.

> "So if there is student's picture, it's good… students' name is somewhat similar… The picture at least has a kind of description at least to know what year, what semester, because we have several batches [of student]." (ID01, M)

> "Maybe [we] can put picture… one of the medium for us to know each other. Sometimes CI doesn't know us, we also don't even know CI ... Name… Email ... Year..." (ID03, F)

b) Credibility of content

The students were grateful that the application provide a feature that can show all nursing procedure checklists that they learn. This gives an indication that the students can get opportunity to improve their performance in learning clinical skills by shortening the time in accessing all those learning materials. Concerning the academic contents provided in *Nurskill 1.0*, the students raised their concern on the

credibility of the content. The participant did not observe the similarity between the subject on the app with the subject they learn in the faculty. This can be perceived as the content provided in the application is not meaningful to them because it does not reflect the curriculum in the faculty.

> "So it means later it will have the subject's name… The subject name will appear here." (ID02, F)

c) Complexity of interface design

The nursing students also highlighted the importance of having easier and effective interface design of the application. The students understood the use of smartphone application could remove the burden of learning management such as carrying books or keeping notes. However, while providing an alternative to the students, they feel that the interface of the app must be designed in a way that will prevent them from frustration and confusion when using it. From their perspectives, the application would be more acceptable if some of the features can be improved in terms of their usability. This problem has been addressed in earlier of this section. Improvement such as giving proper instruction, providing shortcut buttons, removing unneeded elements, and using correct labelling schemes are really needed.

> "This checklist that I do not understand ... The thing that needs to press (checkbox). What is this function? Maybe [we just let] this empty..." (ID03, F)

d) Updates of notification

The students were really pleased with the notification feature because they loved to receive updates regarding clinical skill activities on the campus. In *Nurskill 1.0*, notification is placed at the 'Home' page of the application, as it was confirmed that this feature represented the factor that contributed the biggest effect size toward the intention to use the smartphone application (Refer Chapter 6). However, the analysis showed the similarities of the student feedback, which is the notification feature, did not count in the number of new notifications based on categories such as message, forum, and appointment. Participants acknowledged that it would be easier for them to monitor new updates if they could compare old and new

notifications or read and unread messages through badges on notification. Badges is an example of low-attention notification that will signify something new on the application since the end user's last interaction. For the participant, it helps them to always keep alert with new updates for learning.

> "If there is such notification that has number on the icon, whether one message, or two messages. If there it is, at least we are alerted... "(ID01, M)

7.10 DISCUSSION

The effort of the student in mastering the use of the application can be seen through the feedback from usability test, system usability system score and the post-test interview findings. As the percentage of completion of tasks is high and the score of SUS is good too, the researcher believed that the user could master the use of the features after several times of attempts. However, in this study, the effort to complete these tasks had been interrupted because of several usability problems such as the unclear navigation tree, flow process error, and unclear interface design properties. This showed that there are few elements that need to be improved in terms of designing into a simpler interface. Hiring user interface and user experience (UI/UX) experts in designing the application would be the best possible answer to deal with the interface design issue.

Out of 14 tasks given to the participants, 12 were managed to get a 100% successful rate for task completion. Students mentioned that the features of the *Nurskill 1.0*, such as the procedure checklist, note, video, practice assessment, were useful and this indicates it plays an important role in facilitating self-directed learning of clinical nursing skills. Access to clinical skill procedures through traditional paper-based checklists does not usually accessible all the time, especially when the students are not actively anticipating learning. Mobile access to *Nurskill 1.0* could help students, especially those in such situations as being away from the academic materials or having lost notes in physical form, to retrieve learning resources anywhere and anytime they needed. This is very much in line with the value of m-learning for learners of this information age, since students can easily and simply access course information, also coherent with the mobile-friendly aspects of life of these students (Hu et al., 2019). This immediate retrieval of material is also in line with past research that illustrates that

efficiency in enhancing teaching and learning as an essential value of information technology is important (Hu et al., 2019).

Following the same line of thought, the interaction among nursing students with the lecturers and clinical instructors rarely took place in the traditional way. This demonstrated a consistency with a previous finding that communication is one of the major challenges among nursing students in learning clinical skills. In the case of the present study, students usually perceived the benefit in communication using *Nurskill 1.0* and it would generally be efficient to speak to the educators via the application, rather than directly give a personal message. Instant messaging apps such as *WhatsApp* were highly popular among Malaysian, and it has shown a positive disposition as an instructional tool. Nevertheless, the use of text messaging in academic settings could give rise to issues on academic integration (Hu et al., 2019; Tindell & Bohlander, 2012). Given the potential of *Nurskill 1.0* in acting as a virtual community, academic-related communication might better remain within the *Nurskill 1.0* system only using its functions such as chat and forum. Also, the features like *forum* and *feedback* in the app will help them to improve their interest in learning and performing hands-on practice.

Meanwhile, nursing students from Kulliyyah of Nursing, IIUM encountered few challenges in developing self-directed learning ability. For realizing the benefits of *Nurskill 1*.0 in supporting learning, the students have a belief that using *Nurskill 1.0* will improve their motivation in learning. In this study, the features that help to improve self-management of learning such as appointment, self-reflection, screen-time monitoring, and procedure completion monitoring were helpful to visualize the need for proper management of learning among their students. Appointment was an important feature used to shorten the time for booking resources for clinical skill practice and assessment, therefore the student can manage their time efficiently and spare more time for learning activities. Self-reflection is a way of assessing their own way of working or learning, this helps the student to think about themselves and focus on achieving their goal in learning. Being able to monitor their own performance is helpful to make themselves self-disciplined when engaging in autonomous learning (Wang et al., 2009).

By far, the students are fairly satisfied with the notification system embedded in the application. The notification system helped the students to get used to the application by prompting the message for the students might receive regarding the

updates on clinical skill learning. The students had spoken about the advantages of having notification, that it will help them to be alert with important tasks to do in learning. However, the important improvements of the notification system also need to be addressed for example categorizing the types of notification (such as *Message* or *Forum*) and the number of updates of the notification. Since it was an early stage of the student to learn about the application, habit is viewed as prior behaviour, meaning experience is a necessary but not sufficient condition for the formation of habit. As students manage to use the real app in future for frequent occasions, the student will tend to perform behaviours automatically because of learning (Limayem et al., 2007).

7.11 SUMMARY

This study has demonstrated the importance of prototype evaluation that includes investigations on both the usability of the application and end-user perceptions, as it is not only useful for ensuring the intention to adopt the application, but it also helps to confirm the features that akin to the user needs and requirements. On evaluation of the usability, the students confirmed that the completion tasks given to them can be done easily, but several design shortcomings need improvement. Besides, in the post-test interview also, the students mentioned several improvements required in the features, so that it can lead to successful adoption of application among undergraduate nursing students. The completion of this study marks the achievement of the fourth research objective **(RO4)**, which is to evaluate the usability of the prototype and to identify the perception of the end-user on the features implemented in the prototype.

CHAPTER EIGHT

DISCUSSION, CONCLUSION AND RECOMMENDATION

8.1 INTRODUCTION

This chapter provides an overall discussion of the research and summary of work conducted for the whole thesis. Specifically, the researcher tried to draw the inferences by integrating the findings from all chapters of study. Besides, the researcher also tried to summarize the works based on the important findings which is perceived as the novelty of the research works, followed by the contributions of the study, limitations of the study and future recommendations that can be made as a result of his study.

8.2 STUDY PURPOSE

This study set out to investigate the factors that influence the behavioural intention of undergraduate nursing students to use smartphone applications and design smartphone applications to facilitate self-directed learning of clinical skill. There appeared to be a potential gap between undergraduate nursing programs' use of mobile technology and their implementation in clinical learning settings. There were five research questions being posed:

RQ1a: What are the challenges on the current implementation of self-directed learning of clinical skills among undergraduate nursing students?

RQ1b: What are the perceptions on using a smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ2: What are the significant predictors on perceived behavioural intention to use smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ3: What are the relevant features of smartphone application to facilitate self-directed learning of clinical skills among undergraduate nursing students?

RQ4: What are the factors influencing usability and perception on using smartphone application prototype to facilitate self-directed learning of clinical skills among undergraduate nursing students?

8.3 INTEGRATION OF FINDINGS

Performance Expectancy

The researcher ratifies that PE would promote the growth of knowledge and skills of the nursing students in learning. Three major factors were perceived by nursing students to use smartphone application which are mobility, perceived convenience, and useful content. The students favour learning mobility by being able to access any learning material and manage learning activities anytime and anywhere. It is also used to help the students to finish tasks in learning more subtly. They perceived the application is useful in reaching academic content where they can always utilize several types of learning materials such as procedure demonstration video, logbook, or procedure checklist, at any time. Besides, the quality of the learning material which is credible and standardized also provides justification for them to always feel that using smartphone application is useful. However, on examining the findings from larger population, the survey findings revealed that performance expectancy was not significant in determining behavioural intention. While numerous previous studies indicated a significant determinant on the BI measure (Ahmed et al., 2019; Aliaño et al., 2019; Amantha & Bervell, 2019), this research however yields a different result. On synthesis of the dissonance of this behavioural finding, the researcher believes there is possibility that the problems were originated from the quality of learning material which is not up to the students' expectation. This means that the faculty should make more efforts in designing application that will assist students in their learning as well as focusing on enhancing the quality of learning opportunities in mobile devices (Mtebe, 2014).

Video(multimedia), note, and *procedure checklist* are all features in relation to performance expectancy components. When evaluating their features, the students achieve a high rate of success in tasks involving video learning and documenting their learning experience. In addition, the students are inspired by learning through the video

in the application, better than searching on *YouTube*. Similarly, the students did not feel that they had trouble keeping their notes or referring to their previous note as they could find it on their device. By taking opportunities to watch video, utilize logbook and procedure checklist on smartphone, this helped the students to cope with some difficulties on their SDL of clinical skill; for example, the restriction to observe and learn during guided practice because of crowded area and the lack of self-evaluation due to abandonment of logbook usage. Students are concerned with reliable sources, but faculty should concentrate on developing learning materials that reflects Malaysian culture. The faculty may use their clinical skill center as a location for video casting, and use clinical instructors, lecturers, and students as their actors. The process of cultural modification and adaptation of the contents and delivery of the application will be helpful in addressing the similarities of viewpoints of the users. The study, on this account, suggested that the mobile application is helpful in strengthening the students' belief that using the system will help them to achieve performance gains.

Effort Expectancy

The researcher points out that EE would encourage the use of mobile applications by nursing students as quick to use and easy to understand. In this study, three important reasons that make the nursing students on this factor include ease of use, learnability, and perceived app attributes. The students favour the degree of ease associated with using smartphone application because operating the application is perceived as easy as operating other similar kinds of applications. They also felt that the application contained features that can help the new users to learn about how to use the application. Then, the app's attributes which are organized and simple also provide justification for them to feel that using the smartphone application is straightforward.

However, the findings from the survey revealed that effort expectancy was not significant in determining behavioural intention. This is in contrast with the result from Momani et al. (2017) which discovered that the effort expectancy of using technology (EE) has significantly influenced the students' BI in using mobile application such as Blackboard. The outcome upholds the findings of Moorthy et al. (2019), who posited that the accomplishment of a mobile learning task does not rely on the effort employed

to use the system. This may be explained by the notion that students have become more accustomed to computers and any mobile platforms. Besides, the students have been using the smartphone application for more than 6 years. As students are more adaptive to new technology, they are well-prepared to accomplish learning tasks which in turn weakens the impact of EE on BI.

The features related to the effort expectation components are the *quick tutorial* and the *step-by-step introduction* of the application. Another essential aspect was the inclusion of this part, the *interface design*. When the features were tested, students did not achieve a maximum rate of success in the tasks involving the *quick tutorial, step-by-step introduction*, and overall interaction with organization of the *interface* components such as tab menu, buttons, and icons. Moreover, there are few design shortcomings in the evaluation which need to be addressed including unclear navigation tree, flow process error, and unclear interface design properties.

There was not much concern with the degree of ease of use and learnability of using the new apps for the students. However, the research posits that the limitations were related to design of the interface. The mobile-based program should not be developed in ad-hoc manner, as also reported in the literature review. Apparently, it should be designed in an iterative process, where the feedbacks from the users can be taken into designing the application. In response to the usability of the smartphone which led to the usability hurdle of the users, there is a need to design interfaces that are simple and easy to navigate. As suggested by Wang et al. (2009), a developer should develop a mobile learning service which are usable to the end users. EE is a factor that instrumental to address the challenges on learning material. The use of the smartphone application could help the student to utilize the learning material anytime, thus it improves efficiency of learning. This study, as a direct result, illuminates that using smartphone application promotes the students' conviction that using the application is easy to use. Still and all, the need to a better interface design is necessary to improve the efficiency of using the application.

Self-management of learning

SL refers to how individuals feel that they are self-disciplined when engaging in autonomous learning; mobile learning provides autonomy for the students to learn informally. Self-management of learning in this study possesses reflection of learning, self-monitoring, and self-recording of learning. The student perceived that reflection of learning will help the student to become aware of their own learning processes. It is also indicated that SL posed an important function for self-monitoring of learning.

The results of the survey showed that SL placed no impact on determining the behavioural intention to use the application, which is consistent with other previous mobile learning studies (Al-adwan et al., 2018; Aliaño et al., 2019; Aofan et al., 2016). The researcher apprehends that the challenges on learning attitude among students are yet to be fully understood. Typically, a student would follow the discipline that they impose on themselves, but to change one's attitude is not an easy job because it requires strong willpower. In this study, upon evaluation of the smartphone application features to reflect learning management behaviour of a student (such as progress monitoring, verification, appointment, and screen time), the students were attracted to all these features and admitted its benefits for learning purposes. The students articulated that they are likely to use the application for learning because they have a capacity to monitor their learning progress with clear learning goals (such as completion rate and time spent on learning clinical skills), which is better than the manual book.

The qualitative findings in Phase 1 have found that students are having certain challenges with traditional methods of SDL of clinical skills in terms of learning management. The students admitted that they did not have better control over time management (prioritizing learning activities), communication with the educator, lack of learning plan, motivation (fear of wrongdoing) and awareness of self-evaluation (verification issue). Under these circumstances, the faculty should make highlight on translating the self-control behaviour and the motivational behaviour into the application design. This is because self-control behaviour deals with the ability to make ones do things that they should even if they do not want to. Meanwhile, motivational behaviour is aimed to induce one's emotions and urge them to do something which they are interested in. This study henceforth show that the mobile application is sensible

towards the belief of the students that using the system would make them feel self-disciplined in learning.

Social Influence

The researcher infers that SI would facilitate social interactions between peers, lecturers, and clinical instructors to encourage students to learn clinical skills. The students insisted that the educator would certainly influence them to use the smartphone application. Aside from that, peer influence would also be a strong foundation for adopting the smartphone application because they share similar interest in the learning.

The survey results showed that SI had impact on the intent to use the application. This finding is consistent with previous studies on mobile learning where lecturer and peer support influence the students in embracing the technology (Badwelan et al., 2016; Alasmari & Zhang, 2019; Moorthy et al., 2019). Therefore, the quantitative result justifies the findings from qualitative study. It is prudent for lecturers and clinical instructors to motivate and declare the importance of using the application to the students. In response of the negative value of path coefficient of SI on BI, the researcher indicated that if there were too much exposure on social interactivity in a smartphone application, it will reduce the intention to use the application, thus limiting the build-up of self-directed learning attitude among the students.

Meanwhile, in assessing the usability and perception of using the features of smartphone application which is built based on this determinant, students have successfully completed all tasks that include social platform, forum, expert comment, messaging and sharing activities. This social communication features provided in the application is meaningful to the students because it provides communication opportunity with their educators, as students felt that it is comparably better than personal meeting. In addition, the students also perceived a higher level of interest in learning clinical skills if the application can guide them with learning seamlessly. This study thus proved that the students would probably use the system if important people around them believe they should use the system.

The qualitative findings in Phase 1 revealed there is few challenges that have been resulted in relation to social interaction among nursing students, these includes

lack of communication with the educator, lack of awareness on self-evaluation, and not open to new ideas. By providing the features of smartphone application that can improve communication such as messaging, the students have equal right to directly message their educators in the system. Besides, the student can get feedback or verification on their performance through feedback feature. In addition, the forum feature may help the students to discuss with their friends, so that they may meet with many opinions from their friends on learning. This study thus proved that students will probably use the system as well if other important people believe they should use the system.

Facilitating Condition

The researcher denotes that FC would help to gain significant resources and support in clinical skills training. There were several factors that have been addressed by the student in the phase 1 of the study which is technical and support system, hardware specification, the speed of internet, and training support. The student claimed that a reporting system is important to create user's trust on the product, hence if there were any failures on the application, the students will not be too frustrated and believe it could be recovered by the authorities. Besides, the students will probably accept to use the application if they are provided with enough training and testing period by the faculty.

The students enjoyed by the provision of learning resources and technology in view of the use of the smartphone application. The results of the survey indicated that FC had an effect on the intention to use the application. This is in coherence with the qualitative result in the earlier phase contemplating that the support in terms of technical and critical resources will help the students to continuously engage with learning. It is important for the faculty to ensure that each student to own a suitable device and internet connection, especially in the faculty premise. Aside from that, providing training on the use of the smartphone application also will be helpful. When evaluating the features, the students are impressed by the technical resources in which they can report an issue and receive feedback from the faculty in the same system. Accordingly, this study provided the view that the mobile application is helpful in enhancing students' belief

that organizational and technical infrastructure is important to support the use of the system.

Habit

The researcher in this study indicated HT would assist in building habit or automation in the learning and the practice of skills. There are two main forms of habit of learning as a result of using smartphone application, which consist of 1) as a reminder of user learning activity and 2) as a user behaviour monitoring. In phase 2, the results of quantitative study indicated that PE had the greatest effect on the intention to use the application. This result also justifies the findings in qualitative study that the students are pleased with the use of the smartphone application because it has characteristics that build habit formation for learning purposes.

When evaluating the features that have been built based on habit factor, students scored a full success rate for the tasks related to *notification* and *reminder*. In addition, the students also were benefited from the notification feature where they would be alerted for any incoming important learning activities. Since, the qualitative findings in Phase 1 entails students were poorly manage their time and lack of awareness on self-evaluation, thus far the reminder and notification features would directly assist the students by providing awareness on any learning updates time management. For example, since there are too many procedures that need to be practiced in a semester, by receiving reminders through smartphone notification, the students can directly make a booking for clinical skill practice. Accordingly, this study provided the view that the mobile application helped to increase people's tendency to perform behaviours automatically because of learning.

8.4 SUMMARY OF WORK

The thesis consists of discussions of five main research works mainly focusing on SDL of clinical skills among undergraduate nursing students, the works comprises: 1) identification of evidence-based component of mobile-based interventions; 2) identification of problems on current implementation of SDL and perspectives on the

use of mobile application for SDL of clinical skill; 3) adaptation and examination of the most significant factors on behavioural intention to use mobile application; 4) identification of most relevant features and development of prototype of mobile application; and 5) usability study and perception on the use of the smartphone application prototype. The work is summarized below.

8.4.1 Identification of evidence-based component of mobile-based interventions

The researcher intended to study the state-of-the-arts on mobile-based interventions among undergraduate nursing. This study is initiated based on the observation of students' experience during the four-year nursing program, which is perceived as burdening in terms of management of learning material, time, motivation, relationship, communication, and attitude. The study on smartphone application is lengthy and costly, requiring more resources as compared to the researcher's capacity during the PhD study period. In this context, a narrative study was conducted with a systematic literature search to understand the success and failures of mobile interventions in nursing education, as described in Chapter 2.

The integration of mobile learning into nursing education could help nursing students to improve their learning. In this study, the researcher identified few literatures in relation to the topics on mobile learning and nursing education for further analysis. After reviewing several identified articles, the researcher considered that there were several application features, that contribute to the success and failures of the interventions, have been implied for nursing students in these mobile-based learning interventions. The researcher summarized that the interventions were embarked too ad-hoc towards nursing students without identifying their learning needs. Thus far, the study suggested that the level of acceptance in implementing new technology in the area of clinical skill learning of nursing should be made. Besides the rigorous works on designing the application should be made as well before a smartphone application can be used in real situation.

8.4.2 Identification of problems and exploration of research motivation

The process of developing an innovative product began by identification of problems experienced by the targeted users, which are nursing students, in implementing SDL of clinical skills. The researcher applied the student development ecology model in the identification of the problems. In addition, the students were also asked to provide feedback on the perception of SDL on clinical skill using smartphone application. Semi-structured interviews were carried out using a pragmatic, general qualitative approach. Chapter 4 describes the working method and the findings. The interviews showed that the difficulties or challenges on the management on SDL of clinical skills among nursing students could offer an opportunity to implement a smartphone application intervention. In the first specific research objective of this study (challenges of SDL) the most obvious areas of concern were 1) lack of self-management skills, 2) lack of desire to learn, 3) lack of self-control of learning. The lack of experience in the implementation of SDL raises question whether SDL on clinical skill is likely not well-monitored. The lack of learning management, interest in learning and discipline in learning experienced by the majority of students further clarified the existence of intrapersonal and interpersonal problems.

At the same time, several perceptions were obtained from the students on the expectations of using smartphone application for SDL of clinical skills. This study's findings are pivotal in providing some desired information for embarking on a larger scale of study. Findings from the second specific research objective (perceived behavioural intention to use smartphone application for SDL of clinical skill) showed that the factors that could facilitate their intention to use smartphone applications for SDL of clinical skills were numerous, they are: 1) learning performance, 2) ease of use, 3) encouragement, 4) interactivity, 5) habit formation, 6) technical and support system, and 7) self-management of learning. The opportunities informed by the students further reinforce the need to use smartphone applications for their learning. It was optimistic for the students after realizing that their learning could be easily managed and monitored by using smartphone applications. Along with it, there is a chance for innovative approach towards managing intrapersonal and interpersonal issues on their learning.

The results of both identification of problems or challenges and behavioural intention to use the smartphone application, have been separately analysed by the

researcher. The findings were further used to inform the development of the survey instrument in Phase 2 and the design requirement for smartphone application in Phase 3. The identification of the challenges and factors influencing the use of clinical skills for SDL smartphone applications marked the achievement of the first research objectives **(RO1)**.

8.4.3 Identification of important factors for behavioral intention

The results of the qualitative study were used to inform the quantitative tool in Kulliyyah of Nursing, IIUM, for a larger population of undergraduate nursing students. It was adapted and modified using a reliable tool based on Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). The adapted items were appropriate to be used in the study context after it was being tested to the other similar study population. The results of the trial study helped the researcher to enhance the survey tools and the data collection process for example acquiring proofreading service and allocating several enumerators for data collection. This could help improve the accessibility and understanding of the survey instructions.

The main objective of this survey study was to identify the most important factors affecting the behavioural intention to use smartphone application in facilitating SDL of clinical skills among undergraduate nursing students. Chapter 5 describes the working method and the findings for this phase of study. The purpose of the analysis was to inculcate the measurement model (reliability and validity) and structural model proposed in the study (determination coefficient, path coefficient, effect size). The findings in this phase showed that habit ($f^2 = 0.112$), social influence ($f^2 = 0.026$), facilitating condition ($f^2 = 0.023$), and hedonic motivation ($f^2 = 0.023$) were the most important factors that could facilitate students' behavioural intention. These results have been used to support the identification of relevant design requirements and prototype development in the next phase. Therefore, after recognizing the significant factors affecting the behavioural intention of undergraduate nursing students to use smartphone applications to facilitate SDL of clinical skills, it marked the achievement of the second research goals **(RO2)**.

8.4.4 Identification of relevant design requirement and development of prototype

Next, in Phase 3, the identified significant factors that influence the use of smartphone application (also referred to as behavioural determinants) were later mapped with several potentially relevant design requirements. To differentiate the level of relevance to the design of the prototype, three types of relevance categories were constructed, which are very relevant, relevant, and not relevant. Chapter 6 describes the complete findings of this phase. Several methodological sources were used for designing purposes, which are from the literature review (Part 1), the qualitative findings in Phase 1 (Part 1 and 2), and the quantitative findings in Phase 2. Each identified design requirement was grouped into its associated UTAUT2 determinant followed by identifying its level of relevance. A framework mapping behavioural determinant with potential relevant mobile features was generated by using methodological triangulation, Later, this framework was used to inform the design of the first prototype-*Nurskill1.0*. To produce a high-fidelity prototype, the investigator used an authoring tool for web and mobile prototypes, *Justinmind*. The identification of the design characteristics and development of the prototype marked the achievement of the third research goal (**RO3**).

8.4.5 Evaluation of prototype

The evaluation of the *Nurskill 1.0* is the last stage of this research. The results of this phase helped the researcher to understand design features, whether the nursing students were to be positively perceived while using it or not. The evaluation consisted of the usability test in using the prototype and the students' post-test interview. First, the respondent was asked to interact with the prototype, followed by to complete the assigned tasks and to fill-in the survey by means of a face-to-face interview. The observation, the successful task completion rate and the usability survey score were used to evaluate the overall usability of the prototype. The usability issues identified in this study include unclear navigation tree, flow process error, and unclear interface design properties. The result of the System Usability Scale score is good and almost all tasks given to them can be completed by the students except for only few tasks.

Second, in the post-test interview, the student was asked to discuss their perception of each feature of the application with the researcher. The list of positive

perceptions was set out in Chapter 7, at the same time some improvements were addressed including a) profile personalization, b) content credibility, c) interface design complexity, and d) updates on notification. These results can be used to enhance a more refined version of the prototype development. Identifying these motivating factors and obstacles marked the achievement of the final objective of research (**RO4**).

8.5 THE CONTRIBUTIONS OF THIS STUDY

1) The identification of problems on current implementation of self-directed learning of clinical skills using developmental ecology among undergraduate nursing students.

The identification of problems on current implementation of self-directed learning of clinical skill, was the first study performed by the researcher. This study employed semi-structured interviews involving 16 nursing students to understand the challenging factors across intrapersonal, interpersonal, and organizational levels. Feedbacks received from the interview were analysed deductively using thematic analysis approach. The factors that could affect students' SDL of clinical skills includes poor time management, lack of communication with educator, lack of assessment of learning needs, not open to new ideas, lack of internal motivation, educator-dependent in the search of new information, and lack of awareness on self-evaluation. Further, these factors were accordingly themed as a) lack of self-management of learning, b) lack of desire to learn, and c) lack of self-control of learning.

2) The identification of perception in the expectation of using smartphone application in facilitating self-directed learning of clinical skills among undergraduate nursing students.

Within the same phase (Phase 1), the researcher managed to identify the perception of the expectation of using smartphone application in facilitating self-directed learning of clinical skills among undergraduate nursing students. Using thematic analysis, findings from this study indicates that factors that could allow the use of smartphone application in facilitating self-directed learning of clinical skills includes learning performance,

ease of use, encouragement, enjoyment, habit formation, technical and support system, and self-management of learning. These identified factors were later used in the subsequent Phase 2 study to identify the significant factors affecting the behavioural intention to use smartphone applications in facilitating SDL of clinical skills of undergraduate nursing students.

3) The identification of significant factors affecting the behavioural intention to use smartphone applications in facilitating SDL of clinical skills of undergraduate nursing students.

Based on the previous phase, self-management of learning was identified as a new factor in this study, therefore a new construct was added into the framework. To identify the significant factors, Phase 2 was conducted, a survey study constructed based on the UTAUT2 model. Response received from the survey was later analysed using the PLS-SEM method. The results indicated that habit (HT), social influence (SI), facilitating condition (FC) has a significant positive relationship with the intention to adopt smartphone application. Performance expectancy, effort expectancy (EE), hedonic motivation (HM), and self-management of learning (SL) however have no significant effect on intention to use.

4) The development of framework mapping behavioural determinants and potentially relevant features.

Next, the researcher managed to develop a framework that linked behavioural determinants (for example significant factors influencing behaviour identified in Phase 2) with several potentially relevant features. All possible features were identified from design requirements based on literature review and factors found in Phase 1 studies. Meanwhile, the significant factors found in Phase 2 serve to categorize the relevant behavioural determinants. Based on this triangulation, a framework that linked behaviour determinants with potential relevant persuasive design principles was produced. This framework was later used to inform the design of our first prototype – *Nurskill 1.0.*

5) The prototype - *Nurskill 1.0*

Thus, in this research, the prototype is the *Nurskill 1.0* application. In comparison of many applications found in the studies, including some that used third party application, the researcher chose to develop his own prototype in order to reduce biases of choosing features based on favoritism. The researcher has started the first round of rigorous design and development based on evidence-based literature, problem identification and related behavioral factors. *Nurskill 1.0* also had been evaluated in terms of usability and perception using observation, think-aloud, task completion, survey, and post-test interview that helped to identify the list of design and behavioral improvement to the application. Thus, the prototype is unique because it is customized with the curriculum and tailored to the problems and needs of the students.

8.6 LIMITATIONS AND FUTURE RECOMMENDATIONS

The study exhibited a number of limitations encountered by the researcher and there are several future recommendations are suggested in this research.

8.6.1 Limitations

All participants in all phases presented in this thesis were undergraduate nursing students, Malaysian nationalities, studying in Kulliyyah of Nursing, International Islamic University Malaysia (IIUM) and living in collectivist culture. Some of the characteristics presented are younger in age, came from the same previous educational background, living in the same campus, similar nationality, cultural and ethnicity. Therefore, generalizing the outcome of this thesis towards undergraduate nursing students from different cultures may not be a feasible idea. Thus, it is recommended for future researchers to replicate with cultural adaptation of this research's detailed processes in designing the application, in order to identify design requirements that are most relevant at facilitating behavioural change among undergraduate nursing students in different populations.

In Phase 1, the researcher has identified that there are various challenging factors on SDL of clinical skills of the undergraduate nursing students, however findings

illustrated that it would be most affected at intrapersonal and interpersonal level only. It is because the self-directed learning concept itself comprises interpersonal level. Meanwhile, the developmental ecology theory suggested the interaction between each level is reciprocal, therefore the organization level is cofactors in addressing the intrapersonal and interpersonal factors.

Similarly, the researcher has identified that there are various influencing factors on using smartphone application in facilitating SDL of clinical skills of the undergraduate nursing students. A new factor, which is self-management of learning, was identified as a new influencing factor and useful to inform the development of quantitative instruments in the next phase of study. However, the researcher only identified the influencing factors only, without identification of the barriers, towards the adoption of smartphone application. It is recommended that future researchers could add the barrier factors in the project. This is useful to identify and compare the kind of design requirements that facilitate or not facilitate the change of behaviour in SDL. Besides, problem identification also can be performed by using several other methods such as survey or observation studies. The qualitative study also can be performed using small-group discussion involving students, clinical instructors, and lecturers.

In the phase 2 study, the researcher has outlined that there are seven possible behavioural determinants in the proposed framework. All determinants are exogenous determinants to an endogenous determinant of behavioural intention to use smartphone application. The study identified three determinants that have an effect on behavioural intention which involves habit, social influence and facilitating condition. However, in this study, the researcher did not include the differences of students' characteristics such as gender such as age, gender, experience, and academic achievement (for example CGPA) into the proposed framework. There is not much debate in the literature for comparing the age, gender, and experience of the population because most of the students are at a similar range of age and have experience in using mobile technology. In future, it is recommended that other researchers could study these moderating variables into the proposed framework and inform the differences of the effectiveness based on the academic achievement of the students.

The identification of design requirements performed in this study are based on the results of few studies made in earlier phases. There are some limitations of the

design requirements or features which are beyond the scope of this research's resources. Therefore, some of the features were put on-hold and the researcher justified that the features would be suitable for use in advanced phases of application design and development. The examples of the features are video demonstration, animation, offline version, streaming, etc. It is recommended that advanced study will focus on these features. Besides, it is also suggested to create a real native application that can be downloaded and used directly by the users, followed by the intervention studies such as pre-post-test or longitudinal test to understand the effectiveness of the application. In addition, it is also important to include the expert consensus and feedback, especially from nursing education and human-computer interaction field, in this study so that the relationship between behavioural determinant and its design requirement can be defined wisely.

8.6.2 Future recommendations

1. Recommendation for the faculty

First, the learning environment is important, and students rely much on the availability of the infrastructure, resources, and system in management of learning, or else the student may be left behind due to having a lack of chance in practicing their skill. The implication of the findings from Phase 1 study (challenges of SDL) is that the faculty should revise how the system works in providing the student with a fair chance to utilize the facilities for practicing skill. There is not much problem for the faculty in terms of infrastructure, because Kulliyyah of Nursing is just moved into a new building, where a lot of space for practicing is prepared. However, there is a need to have a system where they can manage the operation of a clinical skill centre wisely such as a time schedule system, a lab-room and inventory booking system, and an appointment system. Even though the system for these already existed, in paper-based form, the implementation is not fully enforced, besides managing the system is difficult manually.

Second, the faculty must have a monitoring system to ensure all resources and facilities are fully utilized. An electronic system using a web or mobile system will facilitate the management of the clinical skill centre because it is faster and easier. Another version of the application that can be used by clinical instructors, lecturers and

the faculty administrators can be developed in order to manage all data that has been produced from the students' application. The produced data can be retrieved in real time and the information could be generated, beneficial in planning the development of students' activities in the future.

Third, the students should get support in terms of communication with their educators because it is important in guiding the implementation of educational activities. The educators must consider the concerns of the students, for example participants in the interview study voiced their concerns regarding communication problems. The participants were most concerned with the inconsistencies between what was being taught during the practical session and what was being expected in the assessment. Moreover, they were being assessed by another different person. The implication from the finding is that the faculty should provide standardized procedure guidelines of the procedures that will be used in the teaching and assessment, so that if somebody is appointed to assess the student, the same criteria will be used. The students also need to be consistently informed that there are a lot of school of taught in performing a procedure, because the experience from an educator to educator is also different, therefore the students must always prepare to accept new ideas. Again, the use of mobile technology in the form of student and educator versions will help the students and educators communicate easily, and any conflict of ideas can be discussed directly in the forum or messaging application. There are many points of learning that can be intervened by the educator, for example replying to messages from the students, giving comment on the learning discussion posted by the students, and providing feedback after a student completes an assessment.

Fourth, by emphasizing the current pandemic situation, which is unknown when to end, the faculty should provide an innovative way of clinical assessment online. The pandemic has pushed the people to live in a new norm, where people can only meet each other in distance, wearing masks and taking care of the hygiene, for the sake of minimizing the infection. Making clinical assessment cannot be materialized because it needs mass gathering among students and educators. Therefore, several alternatives using technologies can be used to fulfil clinical assessment objectives such as virtual simulation. The faculty should work closely with other faculties such as information

system and education application developers that can provide experts in building such applications.

2. Recommendation for Malaysian nursing authority

Digital skill is one of the focus areas in developing a program. It was indicated that there is a need to develop a specialized support group, especially nursing informatics, to initiate and extend the potentials of information technology in nursing education and services. In the nursing education sector, information system expert is needed to provide a continuous presence in ensuring the faculties in Malaysia receive support for digital skills. Besides, experts in education technologists are also important in giving consultation to improve the delivery of education interventions. Findings from this study indicated that the design of smartphone application is important to improve the learning performance and engagement in learning clinical skills for nursing students. A lot of universities in Malaysia have spent thousands of Ringgits in purchasing learning content from international vendors. There is still a lack of effort in providing learning content which is tailored to Malaysian context. Therefore, NBM can provide the grant in terms of financial and resources, so that the universities can have access to the learning content which are easier to understand and cost effective to subscribe. In brief, there is a need to increase awareness on mobile technology usage in nursing education.

8.7 CONCLUSION

Identifying factors influencing behavioural intention of using smartphone application for self-directed learning of clinical skills and designing applications for undergraduate nursing students is indeed a challenging task for a researcher, largely due to the lack of understanding on the environmental factors affecting the students' learning behaviors such as difficult program, busy schedule, mixed of motivation level, and other soft skill abilities. It is even more challenging for a young researcher to design an application that could facilitate the students' self-directed learning, especially focusing on complex clinical skill learning.

In this thesis, the study's target population is undergraduate nursing students – who share a lot of similar characteristics like other undergraduate students from other programs (such as language, law, education), mostly younger in age. In exception of the others, the nursing students have to learn another set of qualities which requires gross and fine motor skills, critical thinking and problem solving especially in dealing with the safety of the patients. From the researcher's perspective, the challenges of the nursing students have been discussed for a long time, encompassing the struggle between the need to fulfil theoretical learning, the need to be clinically skilful, and the need to mentally and emotionally sound, while maintaining the study-life balance.

The use of developmental ecology theory helped the researcher to confirm that the nursing students were facing several intrapersonal and interpersonal challenges. Besides, using Unified theory of acceptance and use of technology 2, UTAUT2, it helped the researcher to understand the behavioural needs for nursing students to use a smartphone application in facilitating student's learning in the program. The researcher managed to enlist seven behavioural determinants that could be possibly implemented into the design of the application. Based on these determinants, the researcher also managed to understand which factors are significantly important based on larger scale surveys in the undergraduate nursing student population.

Then, in this thesis the process of designing the application prototype also has been demonstrated. The researcher described in detail, how the identification of design requirements and its possible features were conducted and how the outcome of these analyses assists the researcher in finalizing the design of the prototype. The evaluation of the prototype, *Nurskill 1.0*, showed promising results with higher percentage of successful completion tasks, and higher system usability scale score. The researcher also managed to identify several usability problems that need to be addressed in future which includes the design interface and behavioural aspects of design requirements.

REFERENCES

Abdollahimohammad, A., Jaafar, R., & Rahim, A. F. A. (2014). Similarities and differences in cultural values between Iranian and Malaysian nursing students. *Iranian Journal of Nursing and Midwifery Research*, *19*(5), 5–7.

Abu-al-aish, A., & Love, S. (2013). Factors influencing students ' acceptance of m-learning : an investigation in higher education. *International Review of Research in Open and Distance Learning*. https://doi.org/10.19173/irrodl.v14i5.1631

Ahmad, N. (2018). *Nursing Faculty Members ' Perception On Technology Readiness and Comfort level on Implementation Of High Fidelity Simulation Teaching In Undergraduate Nursing Curriculum In Malaysia*. Queen's University of Belfast.

Ahmed, A., Zahid, A., Wajid, H., Muhammad, H. R., & Vighio, S. (2019). Extending UTAUT2 toward acceptance of mobile learning in the context of higher education. *Universal Access in the Information Society*. https://doi.org/10.1007/s10209-019-00685-8

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology*, *94*(3), 545.

Airth-kindree, N., & Vandenbark, R. T. (2014). Mobile applications in nursing education and practice. *Nurse Educator*, *39*(4), 166–169. https://doi.org/10.1097/NNE.0000000000000041

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.

Ajzen, Icek. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Akour, H. (2010). *Determinants of mobile learning acceptance: An empirical investigation in higher education*. ProQuest.

Al-adwan, A. S., Al-Adwan, A., & Berger, H. (2018). Solving the mystery of mobile learning adoption in higher education. *International Journal Mobile Communications*, *16*(1), 24–49.

Al-Lozi, E., Al-Hujran, O., & Al-Debei, M. M. (2014). Get ready to mobile learning : Examining factors affecting college students' behavioral intentions to use m-learning in Saudi Arabia. *Jordan Journal of Business Administration*, *10*(1), 111–128. https://doi.org/10.12816/0026186

Alasmari, T., & Zhang, K. (2019). Mobile learning technology acceptance in Saudi Arabian higher education: An extended framework and a mixed-method study. *Education and Information Technologies*, *24*, 1–18. https://doi.org/https://doi.org/10.1007/s10639-019-09865-8

Aliaño, Á. M., María, A., Hueros, D., Aguaded, I., & Guzmán, M. D. (2019). Mobile learning in university contexts based on the unified theory of acceptance and use of technology (UTAUT). *Journal of New Approaches in Educational Research*, *8*(1), 7–17. https://doi.org/10.7821/naer.2019.1.317

Almaiah, M. A., & Mulhem, A. Al. (2018). Analysis of the essential factors affecting of intention to use of mobile learning applications : A comparison between universities adopters and non-adopters. *Education and Information Technologies*. https://doi.org/https://doi.org/10.1007/s10639-018-9840-1

Alrasheedi, M., & Capretz, L. F. (2015). Determination of critical success factors affecting mobile learning: A meta-analysis approach. *Turkish Online Journal of Educational Technology - TOJET*, *14*(2), 41–51.

Alsswey, A. (2019). M-learning adoption in the Arab gulf countries: A systematic review of factors and challenges. *Education and Information Technologies*.

Althunibat, A. (2015). Determining the factors influencing students ' intention to use m-learning in Jordan higher education. *Computers in Human Behavior*, *52*, 65–71. https://doi.org/10.1016/j.chb.2015.05.046

Alvarez, A. G., Dal Sasso, G. T. M., & Iyengar, M. S. (2016). Persuasive technology in

teaching acute pain assessment in nursing: Results in learning based on pre and post-testing. *Nurse Education Today*, *50*, 109–114. https://doi.org/10.1016/j.nedt.2016.12.019

Amantha, J., & Bervell, B. (2019). Google Classroom for mobile learning in higher education: Modelling the initial perceptions of students. *Education and Information Technologies*, *January*. https://doi.org/https://doi.org/10.1007/s10639-018-09858-z

Anema, M., & McCoy, J. (2009). *Competency based nursing education: guide to achieving outstanding learner outcomes*. Springer Publishing Company.

Aofan, L., Qianqian, C., Zhang, Y., & Chang, T. (2016). Investigating the determinants of mobile learning acceptance in higher education based on UTAUT. *2016 International Computer Symposium*, 651–655. https://doi.org/10.1109/ICS.2016.132

Appana, S. (2008). A review of benefits and limitations of online learning in the context of the student, the instructor, and the tenured faculty. *International Journal of E-Learning*, *7*(1), 5–22.

Arkan, B., Ordin, Y., & Dilek, Y. (2018). Undergraduate nursing students ' experience related to their clinical learning environment and factors affecting to their clinical learning process. *Nurse Education in Practice*, *29*, 127–132. https://doi.org/10.1016/j.nepr.2017.12.005

Arumugam, N., Thayalan, X., Dass, L. C., & Maniam, M. (2014). Unemployment among graduate nurses in Malaysia: A case study. *Asian Social Science*, *10*(9), 227–233. https://doi.org/10.5539/ass.v10n9p227

ASEANUP. (2019). *Southeast Asia digital, social and mobile 2018*. ASEANUP. https://aseanup.com/southeast-asia-digital-social-mobile/

Babbie, E. R. (2007). *The practice of social research*. Thomson Wadsworth.

Badwelan, A., Drew, S., & Bahaddad, A. A. (2016). Towards acceptance m-learning approach in higher education in Saudi Arabia. *International Journal of Business*

and Management, *11*(8), 11–30. https://doi.org/10.5539/ijbm.v11n8p12

Bandura, A. (1986). *Social foundations of thought and action : a social cognitive theory*. Prentice-Hall.

Bangor, A., Kortum, P., & Miller, J. (2009). Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of Usability Studies*, *4*(3), 114–123. https://doi.org/66.39.39.113

Baran, E. (2014). A review of research on mobile learning in teacher education. *Educational Technology & Society*, *17*(4), 17–32.

Baraz, S., Memarian, R., & Vanaki, Z. (2015). Learning challenges of nursing students in clinical environments : A qualitative study in Iran. *Journal of Education and Health Promotion*, *4*, 1–9. https://doi.org/10.4103/2277-9531.162345

Barker, A., Krull, G., & Mallinson, B. (2005). A proposed theoretical model for m-learning adoption in developing countries. *Proceedings of MLearn*, 1–11. http://mlearn.org/mlearn2005/CD/papers/Barker.pdf

Barnett, T., Namasivayam, P., & Narudin, D. A. A. (2010). A critical review of the nursing shortage in Malaysia. *International Nursing Review*, *57*(1), 32–39. https://doi.org/10.1111/j.1466-7657.2009.00784.x

Beauregard, P., Arnaert, A., & Ponzoni, N. (2017). Nursing students' perceptions of using smartphones in the community practicum: A qualitative study. *Nurse Education Today*. https://doi.org/10.1016/j.nedt.2017.03.002

Bentley, F., & Tollmar, K. (2013). The power of mobile notifications to increase wellbeing logging behavior. *Conference on Human Factors in Computing Systems - Proceedings*, 1095–1098. https://doi.org/10.1145/2470654.2466140

Bhave, K., Jain, V., & Roy, S. (2013). Understanding the orientation of Gen Y toward mobile applications and in-app advertising in India. *International Journal of Mobile Marketing*, *8*(1).

Biloš, A., Turkalj, D., & Kelić, I. (2017). Mobile learning usage and preferences of

vocational secondary school students : The cases of Austria , the Czech Republic , and Germany. *Our Economy*, *63*(1), 59–69. https://doi.org/10.1515/ngoe-2017-0006

Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. SAGE.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. SAGE.

Bronfenbrenner, U. (2005). *Making human beings human: Bioecological perspectives on human development*. sage.

Bryan, V. D., Weaver, S., Anderson-johnson, P., & Lindo, J. M. L. (2013). The effect of interpersonal relationships between nursing students and lecturers on learning outcomes at a Jamaican nursing school. *Caribbean Journal of Nursing*, *1*(1), 41–48.

Bulman, C., Lathlean, J., & Gobbi, M. (2012). The concept of reflection in nursing: Qualitative findings on student and teacher perspectives. *Nurse Education Today*, *32*(5), e8–e13. https://doi.org/10.1016/j.nedt.2011.10.007

Camilleri, A. C., & Camilleri, M. A. (2019). Mobile learning via educational apps: An interpretative study. *ACM International Conference Proceeding Series*, 88–92. https://doi.org/10.1145/3337682.3337687

Casey, D., & Murphy, K. (2009). Issues in using methodological triangulation in research. *Nurse Researcher*, *16*(4).

Chang, C., Lai, C., & Hwang, G. (2018). Trends and research issues of mobile learning studies in nursing education : A review of academic publications from 1971 to 2016. *Computers & Education*, *116*, 28–48. https://doi.org/10.1016/j.compedu.2017.09.001

Chang, C. Y., Sung, H. Y., Guo, J. L., Chang, B. Y., & Kuo, F. R. (2019). Effects of spherical video-based virtual reality on nursing students' learning performance in childbirth education training. *Interactive Learning Environments*, 1–17. https://doi.org/10.1080/10494820.2019.1661854

Charters, E. (2003). The use of think-aloud methods in qualitative research an introduction to think-aloud methods. *Brock Education: A Journal of Educational Research and Practice*, *12*(2).

Cheng, Y. (2015). Towards an understanding of the factors affecting m-learning acceptance : Roles of technological characteristics and compatibility. *Asia Pacific Management Review*, 1–11. https://doi.org/10.1016/j.apmrv.2014.12.011

Choi, M., Lee, H. S., & Park, J. H. (2018). Effects of using mobile device-based academic electronic medical records for clinical practicum by undergraduate nursing students: A quasi-experimental study. *Nurse Education Today*, *61*, 112–119. https://doi.org/10.1016/j.nedt.2017.11.018

Chuang, Y. H., Lai, F. C., Chang, C. C., & Wan, H. T. (2018). Effects of a skill demonstration video delivered by smartphone on facilitating nursing students' skill competencies and self-confidence: A randomized controlled trial study. *Nurse Education Today*, *66*, 63–68. https://doi.org/10.1016/j.nedt.2018.03.027

Clark, V. L. P., & Creswell, J. W. (2015). *Understanding Research: A Consumer's Guide*. Pearson Education.

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology : A longitudinal study. *MIS Quarterly*, *23*(2), 145–158.

Compeau, D. R., & Meister, D. (2002). Infusion of innovation adoption: An individual perspective. *Proeedings of the ASAC, Winnipeg, Manitoba*, 23–33.

Cooper, A. (1999). The inmates are running the asylum. Indianapolis, IA: SAMS. *Macmillan*.

Cooper, D. R., & Schindler, P. S. (2014). *Business research methods*. McGraw-Hil.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. SAGE Publications.

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). SAGE Publications,.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research*. Thousand Oaks, California : SAGE.

Davies, M. (2014). Using the Apple iPad to facilitate student-led group work and seminar presentation. *Nurse Education in Practice*, 1–5. https://doi.org/10.1016/j.nepr.2014.01.006

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology : A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, *22*(14), 1111–1132.

Decman, M. (2015). Modeling the acceptance of e-learning in mandatory environments of higher education: The influence of previous education and gender. *Computers in Human Behavior*, *49*, 272–281. https://doi.org/10.1016/j.chb.2015.03.022

Donaldson, R. (2011). *Student acceptance of mobile learning* [The Florida State University]. https://doi.org/10.1016/j.sbspro.2011.10.483

Doyle, G. J., Garrett, B., & Currie, L. M. (2014). Integrating mobile devices into nursing curricula : Opportunities for implementation using Rogers ' Diffusion of Innovation model. *Nurse Education Today*, *34*(5), 775–782. https://doi.org/10.1016/j.nedt.2013.10.021

Eisner, S. (2005). Managing Generation Y. *S.A.M. Advanced Management Journal*, *70*(4). https://doi.org/10.1109/EMR.2011.5876168

El-Masri, M., & Tarhini, A. (2017). Factors affecting the adoption of e-learning systems in Qatar and USA: Extending the unified theory of acceptance and use of technology 2 (UTAUT2). *Educational Technology Research and Development*. https://doi.org/10.1007/s11423-016-9508-8

El, N., Sofar, S. M., Ali, J., & Al-battawi, I. (2017). Self-directed learning readiness among nursing students at King Abdulaziz University, Saudi Arabia . *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, *6*(6), 14–24. https://doi.org/10.9790/1959-0606031424

Etikan, I. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1–4. https://doi.org/10.11648/j.ajtas.20160501.11

Ewertsson, M., Allvin, R., Holmström, I. K., & Blomberg, K. (2015). Walking the bridge: Nursing students' learning in clinical skill laboratories. *Nurse Education in Practice*, *15*(4), 277–283. https://doi.org/10.1016/j.nepr.2015.03.006

Fan, J. Y., Wang, Y. H., Chao, L. F., Jane, S. W., & Hsu, L. L. (2015). Performance evaluation of nursing students following competency-based education. *Nurse Education Today*, *35*(1), 97–103. https://doi.org/10.1016/j.nedt.2014.07.002

Feng, L., Kong, X., Zhu, S., & Yang, H. H. (2015). An investigation of factors influencing college students' mobile learning behavior. *In International Conference on Hybrid Learning and Continuing Education, July*, 323–333. https://doi.org/10.1007/978-3-319-20621-9

Ferrari, R. (2015). Writing narrative style literature reviews. *Medical Writing*, *24*(4), 230–235.

Fisher, M., King, J., & Tague, G. (2001). Development of a self-directed learning readiness scale for nursing education. *Nurse Education Today*, *21*(7), 516–525. https://doi.org/10.1054/nedt.2001.0589

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*,

18(1), 39–50.

Friess, E. (2015). Personas in heuristic evaluation: an exploratory study. *IEEE Transactions on Professional Communication*, *58*(2), 176–191.

Froneman, K., du Plessis, E., & Koen, M. P. (2016). Effective educator–student relationships in nursing education to strengthen nursing students' resilience. *Curationis*, *39*(1). https://curationis.org.za/index.php/curationis/article/view/1595

Gemuhay, H. M., Kalolo, A., Mirisho, R., Chipwaza, B., & Nyangena, E. (2019). Factors affecting performance in clinical practice among preservice diploma nursing students in Northern Tanzania. *Nursing Research and Practice, 2019*. https://doi.org/https://doi.org/10.1155/2019/3453085 Research

George, T. P., DeCristofaro, C., Murphy, P. F., & Sims, A. (2017). Student perceptions and acceptance of mobile technology in an undergraduate nursing program. *Healthcare*, *5*(3), 35. https://doi.org/10.3390/healthcare5030035

Ghiasvand, A. M., Naderi, M., Tafreshi, M. Z., Ahmadi, F., & Hosseini, M. (2017). Relationship between time management skills and anxiety and academic motivation of nursing students in Tehran. *Electronic Physician*, *9*(1), 3678–3684. https://doi.org/10.19082/3678

Gokcearslan, S. (2017). Perspectives of students on acceptance of tablets and self-directed learning with technology. *Contemporary Educational Technology*, *8*(1), 40–55.

Golden, S. D., & Earp, J. A. L. (2012). Social ecological approaches to individuals and their contexts : Twenty years of health education & behavior health promotion interventions. *Health Education & Behavior*, *39*(3), 364 –372. https://doi.org/10.1177/1090198111418634

Gorbunovs, A., Kapenieks, A., & Cakula, S. (2016). Self-discipline as a key indicator to improve learning outcomes in e-learning environment. *Procedia - Social and Behavioral Sciences*, *231*(May), 256–262.

https://doi.org/10.1016/j.sbspro.2016.09.100

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)*. SAGE Publications,.

Haraldseid, C., Friberg, F., & Aase, K. (2015). Nursing students' perceptions of factors influencing their learning environment in a clinical skills laboratory: A qualitative study. *Nurse Education Today*, *35*(9), e1–e6. https://doi.org/10.1016/j.nedt.2015.03.015

Haraldseid, C., Friberg, F., & Aase, K. (2016). How can students contribute? A qualitative study of active student involvement in development of technological learning material for clinical skills training. *BMC Nursing*, *15*, 2. https://doi.org/10.1186/s12912-016-0125-y

Hay, B., Carr, P. J., Dawe, L., & Clark-burg, K. (2017). " iM Ready to Learn ": Undergraduate Nursing Students' Knowledge, Preferences, and Practice of Mobile Technology and Social Media. *Computers, Informatics, Nursing*, *January*, 8–17.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In *New challenges to international marketing*. Emerald Group Publishing Limited.

Hew, J., Lee, V., & Wei, J. (2015). What catalyses mobile apps usage intention : An empirical analysis. *Industrial Management & Data Systems*, *115*(7), 1269–1291. https://doi.org/10.1108/IMDS-01-2015-0028

Hiemstra, R., & Agyekum, S. K. (1994). *Self-directed learning*.

Hirschman, E. C. (1980). Innovativeness, novelty seeking, and consumer creativity. *Journal of Consumer Research*, *7*(3), 283–295.

Holland, A., Smith, F., Mccrossan, G., Adamson, E., Watt, S., & Penny, K. (2013). Online video in clinical skills education of oral medication administration for undergraduate student nurses : A mixed methods , prospective cohort study. *Nurse Education Today*, *33*(6), 663–670.

https://doi.org/10.1016/j.nedt.2012.01.006

Houghton, C. E., Casey, D., Shaw, D., & Murphy, K. (2012). Staff and students' perceptions and experiences of teaching and assessment in clinical skills laboratories : Interview findings from a multiple case study. *Nurse Education Today*, *32*(6), e29–e34. https://doi.org/10.1016/j.nedt.2011.10.005

Hsieh, H., & Hsieh, H. (2019). Undergraduates' out-of-class learning: Exploring EFL students' autonomous learning behaviors and their usage of resources. *Education Sciences*, *9*(159), 1–15.

Hu, X., Ng, J., Tsang, K. K. Y., & Chu, S. K. W. (2019). Integrating mobile learning to learning management system in community college. *Community College Journal of Research and Practice*, *44*(10–12), 722–737. https://doi.org/10.1080/10668926.2019.1640146

Huang, R., & Yu, C.-L. (2019). Exploring the impact of self-management of learning and personal learning initiative on mobile language learning : A moderated mediation model. *Australasian Journal of Educational Technology*, *35*(3), 118–131.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*(2), 195–204.

International Islamic University Malaysia. (2021). *iMaluum Student Portal*. https://imaluum.iium.edu.my/

Iqbal, S., & Qureshi, I. A. (2012). M-learning adoption : A perspective from a developing country. *The International Review of Research in Open and Distance Learning*, *13*(3), 147–164.

Ismail, R., Chong, M. C., W. Zulkafli, W. M. A., Zani, H., & Mohd Shafie, Z. (2020). The effectiveness of using a mobile messenger as an educational supporting tool among nursing students. *Asian Journal of Medicine and Biomedicine*, *4*(1), 67–77. https://doi.org/10.37231/ajmb.2020.4.1.333

Jairak, K., Praneetpolgrang, P., & Mekhabunchakij, K. (2009). *An Acceptance of*

Mobile Learning for Higher Education Students in Thailand.

Jamshidi, N., Molazem, Z., Sharif, F., Torabizadeh, C., & Kalyani, M. N. (2016). The challenges of nursing students in the Clinical Learning Environment : A qualitative study. *The Scientific World Journal*, *2016*, 1–7.

Jayatilleke, B. G., Ranawaka, G. R., Wijesekera, C., & Kumarasinha, M. C. B. (2018). Development of mobile application through design-based. *Asian Association of Open Universities Journal*, *13*(2), 145–168. https://doi.org/10.1108/AAOUJ-02-2018-0013

Jeong, H., & Kwon, H. (2018). Effect of learning core fundamental nursing skill with Social Network Service (SNS) for nursing students in South Korea. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(10), 1–10.

Jeong, H. S. (2017). Effects of nursing students' practices using smartphone videos on fundamental nursing skills, self-efficacy, and learning satisfaction in South Korea. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(6), 2351–2365. https://doi.org/10.12973/eurasia.2017.01229a

Jung, H.-J. (2014). Ubiquitous learning: Determinants impacting learners' satisfaction and performance with smartphones. *Language Learning & Technology*, *18*(3), 97–119. https://doi.org/10.21614/chirurgia.111.5.379

Kakushi, L. E., Dora, Y., & Évora, M. (2016). Social networking in nursing education: Integrative literature review. *Revista Latino-Americana de Enfermagem*, *24*(e2709). https://doi.org/10.1590/1518-8345.1055.2709

Karimi, S. (2016). Do learners' characteristics matter? An exploration of mobile-learning adoption in self-directed learning. *Computers in Human Behavior*, *63*, 769–776. https://doi.org/10.1016/j.chb.2016.06.014

Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for Social Work research. *Social Sciences*, *8*(9). https://doi.org/10.3390/socsci8090255

Kenny, R. F., Neste-Kenny, J. M. C. Van, Burton, P. A., & Meiers, J. (2009). Using

mobile learning to enhance the quality of nursing practice education. In *Mobile learning: Transforming the Delivery of Education and Training.* (pp. 75–98). Athabasca University Press.

Khaliq, J., Hussain, M., Afzal, M., Syed, P., & Gilani, A. (2019). Exploring the factors affecting academic performance of undergraduate nursing students. *Merit Research Journal of Medicine and Medical Sciences*, *7*(12), 540–551.

Khoza, L. B. (2015). Nursing students' perception of clinical learning experiences. *Journal of Human Ecology*, *51*(1–2), 103–110. https://doi.org/10.1080/09709274.2015.11906900

Kim-Soon, N., Ibrahim, M. A., Ahmad, A. R., & Sirisa, N. M. X. (2015). Factors influencing intention to use mobile technologies for learning among technical universities students. *Innovation and Sustainable Economic Competitive Advantage: From Regional Development to Global Growth Factors*, *2010*, 2046–2057.

Kim, J. H., & Park, H. (2019). Effects of Smartphone-Based Mobile Learning in Nursing Education: A Systematic Review and Meta-analysis. *Asian Nursing Research*, *13*(1), 20–29. https://doi.org/10.1016/j.anr.2019.01.005

Kim, S., Shin, H., Lee, J., Kang, S., & Bartlett, R. (2017). A smartphone application to educate undergraduate nursing students about providing care for infant airway obstruction. *Nurse Education Today*, *48*, 145–152. https://doi.org/10.1016/j.nedt.2016.10.006

Knowles, M. (1973). *The Adult Learner: A Neglected Species.* Gulf Publishing Company, P.O. Box 2608, Houston, TX 77001 ($7.95).

Knowles, M. (1975). *Self-regulated Learning: A guide for learners and teachers.* The Adult Education Co.

Knowles, M. (1980). *The modern practice of adult education : From pedagogy to andragogy.* Association Press ; Chicago : Follett Pub. Co., c1980.

Krull, G., & Duart, J. M. (2017). Research trends in mobile learning in higher education:

A systematic review of articles (2011-2015). *The International Review of Research in Open and Distributed Learning*, *18*(7).

Kuiper, R., Murdock, N., & Grant, N. (2010). Thinking strategies of baccalaureate nursing students prompted by self-regulated learning strategies. *Journal of Nursing Education ·*, *49*(8), 429–436. https://doi.org/10.3928/01484834-20100430-01

Kumar, B. A., & Chand, S. S. (2019). Mobile learning adoption: A systematic review. *Education and Information Technologies*, *24*(1), 471–487. https://doi.org/10.1007/s10639-018-9783-6

Lahti, M., Hätönen, H., & Välimäki, M. (2014). Impact of e-learning on nurses' and student nurses knowledge, skills, and satisfaction: A systematic review and meta-analysis. *International Journal of Nursing Studies*, *51*(1), 136–149. https://doi.org/10.1016/j.ijnurstu.2012.12.017

Lee, C., Seeshing, A., & Ip, T. (2017). University english language learners ' readiness to use computer technology for self-directed learning. *System*.

Lee, H., Min, H., Oh, S. M., & Shim, K. (2018). Mobile technology in undergraduate nursing education: A systematic review. *Healthcare Informatics Research*, *24*(2), 97–108. https://doi.org/10.4258/hir.2018.24.2.97

Lee, M. K. (2015). Effects of mobile phone-based app learning compared to computer-based web learning on nursing students: Pilot randomized controlled trial. *Healthcare Informatics Research*, *21*(2), 125–133. https://doi.org/10.4258/hir.2015.21.2.125

Lee, N., Chae, S., Kim, H., Lee, J., Min, H. J., & Park, D. (2016). Mobile based video learning in clinical nursing: A Randomized Controlled Trial. *Computers, Informatics, Nursing*, *34*(1), 8–16.

Limayem, M., Hirt, S. G., & Cheung, C. M. K. (2007). How habit limits the predictive power of intention: The case of information systems continuance. *MIS Quarterly*, 705–737.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic Inquiry. In *Sage Publications, Inc*. https://doi.org/10.1007/s00396-002-0735-7

Longworth, N. (1999). *Making lifelong learning work: Learning cities for a learning century*. Kogan Page.

Lowenthal, J. N. (2010). Using mobile learning: Determinates impacting behavioral intention. *American Journal of Distance Education, 24*(4), 195–206. https://doi.org/10.1080/08923647.2010.519947

Lowry, P. B., & Gaskin, J. (2014). Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE Transactions on Professional Communication, 57*(2), 123–146.

Mahn, H., John-steiner, V., & John-Steiner, V. (2012). Vygotsky and sociocultural approaches to teaching and learning. *Handbook of Psychology, Second Edition, 7*.

Malaysian Communications and Multimedia Commission. (2018). *Internet Users Survey 2018*. https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/Internet-Users-Survey-2018.pdf

Malaysian Nursing Board / Malaysian Midwives Board. (2018a). *Standard Criteria for Approval/Accreditation of Nursing Programmes 2018: Section 1*. https://nursing.moh.gov.my/acts-guidelines/

Malaysian Nursing Board / Malaysian Midwives Board. (2018b). *Standard Criteria for Approval/Accreditation of Nursing Programmes 2018*.

Mao, E., & Palvia, P. (2008). Exploring the effects of direct experience on IT use An organizational field study. *Information & Management*, *45*(4), 249–256.

Mason, M. (2010). *Sample size and saturation in PhD studies using qualitative interviews*. Forum: Qualitative Social Research. https://www.qualitative-research.net/index.php/fqs/article/view/1428/3027

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the Theory of Planned Behavior. *Information Systems Research*, *2*(July), 173–191. https://doi.org/10.1287/isre.2.3.173

McCallum, J. (2007). The debate in favour of using simulation education in pre-registration adult nursing. *Nurse Education Today*, *27*(8), 825–831. https://doi.org/10.1016/j.nedt.2006.10.014

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282.

Mcleroy, K., Bibeau, D. L., Stecker, A., & Glanz, K. (1988). An ecology perspective on health promotion programs. *Health Education Quarterly*, *15*(4), 351–377. https://doi.org/10.1177/109019818801500401

Mcnally, G., Frey, R., & Crossan, M. (2017). Nurse manager and student nurse perceptions of the use of personal smartphones or tablets and the adjunct applications as an educational tool in clinical settings. *Nurse Education in Practice*, *23*, 1–7. https://doi.org/10.1016/j.nepr.2016.12.004

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*. http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

Meichenbaum, D. (1985). Teaching thinking: A cognitive-behavioral perspective. *Thinking and Learning Skills*, *2*, 407–426.

Mertler, C. A. (2016). *Introduction to educational research*. SAGE Publications,.

Midgley, D. F., & Dowling, G. R. (1978). Innovativeness: The concept and its measurement. *Journal of Consumer Research*, *4*(4), 229–242.

Mikkonen, K. (2017). *Clinical learning environment and mentoring of culturally and linguistically diverse nursing students*.

Miloševic, I., Zivkovic´, D., Manasijevic´, D., & Nikolic, D. (2015). The effects of the

intended behavior of students in the use of M-learning. *Computers in Human Behavior*, *51*, 207–215. https://doi.org/10.1016/j.chb.2015.04.041

Ministry of Higher Education. (2010). *Development of Nursing Education in Malaysia : Towards the Year 2020*.

Mohd Said, N., Rogayah, J., & Hafizah, A. (2009). A study of learning environments in the Kulliyyah (Faculty) of Nursing, International Islamic University Malaysia. *Malaysian Journal of Medical Sciences*, *16*(4), 15–24.

Mohd Suki, N., & Mohd Suki, N. (2017). Determining students ' behavioural intention to use animation and storytelling applying the UTAUT model : The moderating roles of gender and experience level. *The International Journal of Management Education*, *15*(3), 528–538. https://doi.org/10.1016/j.ijme.2017.10.002

Momani, F. M., Hamzah, A. K., & Shuwandy, M. (2017). Determining factors that influence students' intention to adopt mobile Blackboard: A case study at Petra University, Jordan. *The International Journal of Multimedia & Its Applications (IJMA)*, *9(4-6)*(December). https://doi.org/10.5121/ijma.2017.9608

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*. https://doi.org/10.1287/isre.2.3.192

Moorthy, K., Yee, T. T., T'ing, L. C., & Kumaran, V. V. (2019). Habit and hedonic motivation are the strongest influences in mobile learning behaviours among higher education students in Malaysia. *Australasian Journal of Educational Technology*, *35*(4), 174–191. https://doi.org/https://doi.org/10.14742/ajet.4432 191

Mosa, A. S. M., Yoo, I., & Sheets, L. (2012). A systematic review of healthcare applications for smartphones. *BMC Medical Informatics and Decision Making*, *12*(67). https://doi.org/10.1186/1472-6947-12-67

Moule, P., Aveyard, H., & Goodman, M. (2016). *Nursing research: An introduction*. Sage.

MQA. (2017). *Malaysian Qualifications Framework (MQF) Second Edition*.

MQA. (2019). *Guidelines of Curriculum : Foundation*. 1–117. www.mqa.gov.my

Mtebe, J. S. (2014). *Investigating students ' behavioural intention to adopt and use mobile learning in higher education in East Africa Investigating students ' behavioural intention to adopt and use mobile learning in higher education in East Africa University of Dar es Sala*. *December 2015*.

Murad, M. H., Coto-Yglesias, F., Varkey, P., Prokop, L. J., & Murad, A. L. (2010). The effectiveness of self-directed learning in health professions education: a systematic review. *Medical Education*, *44*(11), 1057–1068.

Nassuora, A. B. (2013). Students Acceptance of Mobile Learning for Higher Education in Saudi Arabia. *International Journal of Learning Management Systems*, *9*(1), 1–9.

Ngafeeson, M. N., & Sun, J. (2015). The effects of technology innovativeness and system exposure on student acceptance of e-textbooks. *Journal of Information Technology Education: Research*, *14*, 55–71.

Nielsen, J. (2000). *Why You Only Need to Test with 5 Users*. Nielsen Norman Group. https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/

Nolan, J., & Nolan, M. (1997). Self-directed and student-centred learning in nurse education. *British Journal of Nursing*, *6*(2), 103–107.

Norcross, J. C., Krebs, P. M., & Prochaska, J. O. (2011). Stages of change. *Journal of Clinical Psychology*, *67*(2), 143–154.

Nunnally, J. . (1978). *Psychometric Theory*. Mc-Graw Hill. https://doi.org/10.1017/CBO9781107415324.004

Nuutila, K., Tapola, A., Tuominen, H., Kupiainen, S., Pásztor, A., & Niemivirta, M. (2020). Reciprocal predictions between interest, self-efficacy, and performance during a task. *Frontiers in Education*, *5*, 36.

O'Connor, S., & Andrews, T. (2015). Mobile technology and its use in clinical nursing

education: A literature review. *Journal of Nursing Education*, *54*(3), 137–144. https://doi.org/10.3928/01484834-20150218-01

O'Connor, S., & Andrews, T. (2016). Nursing students' opinion on the use of smartphone applications (apps) in clinical education and training: A study protocol. *Studies in Health Technology and Informatics*, *225*(0), 1024–1025. https://doi.org/10.3233/978-1-61499-658-3-1024

O'Mara, L., Mcdonald, J., Gillespie, M., Brown, H., & Miles, L. (2014). Challenging clinical learning environments : Experiences of undergraduate nursing students. *Nurse Education in Practice*, *14*(2), 208–213. https://doi.org/10.1016/j.nepr.2013.08.012

Oermann, M. H. (1990). Psychomotor skill development. *Journal of Continuing Education in Nursing*, *21*(5), 202–204.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, *42*(5), 533–544.

Park, K. Y., & Kim, M. S. (2018). Outcomes of a drug dosage calculation training smartphone app on learning achievement, metacognition, and flow state according to prior knowledge. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 2867–2876. https://doi.org/10.29333/ejmste/90984

Patton, M. Q. (2002). *Qualitative research and evaluation methods.* Sage.

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage.

Pedro, L. F. M. G., Barbosa, C. M. M. de O., Santos, C. M. das N., Francisco, L., Gabriel, M., Marina, C., Oliveira, M. De, & Manuel, C. (2018). A critical review of mobile learning integration in formal educational contexts. *International Journal of Educational Technology in Higher Education*, *15*(1), 10.

https://doi.org/10.1186/s41239-018-0091-4

Peres, S. C., Pham, T., & Phillips, R. (2013). Validation of the system usability scale (SUS) SUS in the wild. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *57*(1), 192–196.

Pham, X. L., Nguyen, T. H., Hwang, W. Y., & Chen, G. D. (2016). Effects of push notifications on learner engagement in a mobile learning app. *Proceedings - IEEE 16th International Conference on Advanced Learning Technologies, ICALT 2016*, 90–94. https://doi.org/10.1109/ICALT.2016.50

Phillippi, J. C., & Wyatt, T. H. (2011). Smartphones in nursing education. *Computers Informatics Nursing*, *29*(8), 449–454. https://doi.org/10.1097/NCN.0b013e3181fc411f

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1993). In search of how people change: Applications to addictive behaviors. *Addictions Nursing Network*, *5*(1), 2–16.

Qamata-Mtshali, N. A. (2013). *Problem based learning vs traditional curricula : a comparative study of nursing students' self-directed learning readiness* [University of the Witwatersrand]. http://hdl.handle.net/10539/12656

Rad, M. S., Nilashi, M., Dahlan, H. M., & Ibrahim, O. (2017). *Academic researchers' behavioural intention to use academic social networking sites : A case of Malaysian research universities*. https://doi.org/10.1177/0266666917741923

Raman, J. (2015). Mobile technology in nursing education: WHERE do we go from here? A review of the literature. *Nurse Education Today*, *35*(5), 663–672. https://doi.org/10.1016/j.nedt.2015.01.018

Ramos-Morcillo, A. J., Leal-Costa, C., Moral-García, J. E., & Ruzafa-Martínez, M. (2020). Experiences of nursing students during the abrupt change from face-to-face to e-learning education during the first month of confinement due to COVID-19 in Spain. *International Journal of Environmental Research and Public Health*, *17*(15), 1–15. https://doi.org/10.3390/ijerph17155519

Raosoft. (2019). *Raosoft sample size calculator*. Raosoft, Inc. http://www.raosoft.com/samplesize.html

Renn, K. A., & Arnold, K. D. (2003). Reconceptualizing Research on College Student Peer Culture. *The Journal of Higher Education*, *74*(3), 261–291.

Rensburg, G. H. Van, & Botma, Y. (2015). Bridging the gap between self-directed learning of nurse educators and effective student support. *Curationis*, *38*(2), 1–7. https://doi.org/10.4102/curationis.v38i2.1503

Rogers, E. M. (2003). *Diffusion of Innovation* (3rd Editio). Macmillan Publishing.

Rung, A., Warnke, F., Mattheos, N., & Perio, M. (2014). *Investigating the Use of Smartphones for Learning Purposes by Australian Dental Students*. *April*. https://doi.org/10.2196/mhealth.3120

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, *25*, 54–67. https://doi.org/10.1006/ceps.1999.1020

Safari, K., Haghighib, A. S., Rastegara, A., & Jamshidi, A. (2011). The relationship between psychological empowerment and organizational learning. *Procedia - Social and Behavioral Sciences 30*, 851–866. https://doi.org/10.1002/jcop.21578

Salameh, B., Ewais, A., & Salameh, O. (2020). Integrating M-learning in teaching ECG reading and arrhythmia management for undergraduate nursing students. *International Journal of Interactive Mobile Technologies*, *14*(1), 82–95. https://doi.org/10.3991/ijim.v14i01.11417

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Pearson education.

Schreurs, J., & Dumbraveanu, R. (2014). A shift from teacher centered to learner centered approach. *International Journal of Engineering Pedagogy*, *4*(3), 36–41.

Serçekus, P., & Bas, H. (2016). Nursing students' perceptions about clinical learning environment in Turkey. *Nurse Education in Practice*, *17*, 134–138. https://doi.org/10.1016/j.nepr.2015.12.008

Setia, M. S. (2017). Methodology Series Module 10: Qualitative Health Research. *Indian Journal of Dermatology*, *62*(4), 367–370. https://doi.org/10.4103/ijd.IJD_290_17

Sha, L., Looi, C. K., Chen, W., Seow, P., & Wong, L. H. (2012). Recognizing and measuring self-regulated learning in a mobile learning environment. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2011.11.019

Singh, L., Thomas, T. D., Gaffar, K. O., & Renville, D. (2016). Mobile learning among students and lecturers in the developing world: Perceptions using the UTAUT model. *Handbook of Research on Mobile Devices and Applications in Higher Education Settings*, 402–431. https://doi.org/10.4018/978-1-5225-0256-2.ch017

Sönmez, A., Göçmez, L., Uygun, D., & Ataizi, M. (2018). A review of current studies of mobile learning. *Journal of Educational Technology & Online Learning*, *1*(1), 13–27. http://dergipark.gov.tr/jetol

Stone, R., Cooper, S., & Cant, R. (2013). The value of peer learning in undergraduate nursing education: A systematic review. *ISRN Nursing*. https://doi.org/10.1155/2013/930901

Strandell-Laine, C., Saarikoski, M., Löyttyniemi, E., Meretoja, R., Salminen, L., & Leino-Kilpi, H. (2018). Effectiveness of mobile cooperation intervention on students' clinical learning outcomes: A randomized controlled trial. *Journal of Advanced Nursing*, *74*(6), 1319–1331. https://doi.org/10.1111/jan.13542

Strandell-laine, C., Stolt, M., Leino-kilpi, H., & Saarikoski, M. (2014). Use of mobile devices in nursing student – nurse teacher cooperation during the clinical practicum : An integrative review. *Nurse Education Today*. https://doi.org/10.1016/j.nedt.2014.10.007

Su-Fen, C., Chien-Lin, K., Lin, K.-C., & Jane, L.-H. (2010). Developing online

continuing education content for enhancing caring among Taiwan nurses. *International Journal of Nursing Studies*, *47*(9), 1152–1158. https://doi.org/10.3928/00220124-20130301-26

Sulosaari, V., Huupponen, R., Hupli, M., Puukka, P., Torniainen, K., & Leino-kilpi, H. (2015). Factors associated with nursing students ' medication competence at the beginning and end of their education. *BMC Medical Education*, *15*(223), 1–11. https://doi.org/10.1186/s12909-015-0513-0

Susanto, H., Almunawar, M. N., & Leu, F.-Y. (2016). Android vs iOS or others? SMD-OS security issues: Generation Y perception. *International Journal of Technology Diffusion*, *7*(2), 1–18. https://doi.org/10.4018/IJTD.2016040101

Tan, K., Chong, M. C., Subramaniam, P., & Wong, L. P. (2018). The effectiveness of outcome based education on the competencies of nursing students: A systematic review. *Nurse Education Today*, *64*, 180–189. https://doi.org/10.1016/j.nedt.2017.12.030

Tarhini, A., Masa'deh, R., Al-Busaidi, K., Mohammed, A. B., & Maqableh, M. (2016). Factors influencing students ' adoption of e-learning : A structural equation modeling approach. *Journal of International Education in Business*. https://doi.org/https:// doi.org/10.1108/JIEB-09-2016-0032

Tashakkori, A., Teddlie, C., & Teddlie, C. B. (1998). *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). Sage.

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144–176.

Terry, V. R., Moloney, C., Bowtell, L., & Terry, P. C. (2016). Online intravenous pump emulator: As effective as face-to-face simulation for training nursing students. *Nurse Education Today*, *40*, 198–203. https://doi.org/10.1016/j.nedt.2016.03.004

Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana.

International Journal of Education and Development Using Information and Communication Technology (IJEDICT), *9*(3), 71–85.

Thompson, B. R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing : Toward a conceptual model of utilization. *MIS Quarterly*, *15(1)*(1991), 125–143.

Tindell, D. R., & Bohlander, R. W. (2012). The use and abuse of cell phones and text messaging in the classroom: A survey of college students. *College Teaching*, *60*(1), 1–9.

usability.gov. (2021). *System Usability Scale (SUS)*. https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html

Vagrani, A., Kumar, N., & Ilavarasan, P. V. (2017). Decline in mobile application life cycle. *Procedia Computer Science*, *122*, 957–964. https://doi.org/10.1016/j.procs.2017.11.460

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, *15*, 398–405. https://doi.org/10.1111/nhs.12048

Venkatesh, V. (2012). Consumer acceptance and use of information technology: Extending the unified theory. *MIS Quarterly*, *36*(1), 157–178.

Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46(2)*(October 2018), 185–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Vermeeren, A. P. O. S. (2002). DEVAN: A tool for detailed video analysis of user test data. *Behaviour and Information Technology*, *21*(6), 403–423. https://doi.org/10.1080/0144929021000051714

Vicdan, A. K. (2019). The effect of mobile application on acquiring the blood pressure measurement skill of nursing students. *EAS Journal of Nursing and Midwifery*, *1*(5), 168–177. https://doi.org/10.36349/EASJNM.2019.v01i05.004

Vicdan, A. K. (2020). Assessment of the effect of mobile-assisted education regarding intramuscular injection by using the Instagram app. *Nursing Practice Today*, *7*(4), 245–254.

Waard, D. (2017). *Self-Directed Learning of Experienced Adult Online Learners Enrolled in FutureLearn MOOCs*.

Wang, Y., Wu, M., & Wang, H. (2009). Differences in the acceptance of mobile learning. *British Journal of Educational Technology*, *40*(1), 92–118. https://doi.org/10.1111/j.1467-8535.2007.00809.x

Wiley, K. (1983). Effects of a self-directed learning project and preference for structure on self-directed learning readiness. *Nursing Research*, *32*(3).

Wu, P. F. (2012). A mixed methods approach to technology acceptance research. *Journal of the Association of Information Systems*, *13*(3), 172–187. https://doi.org/10.17705/1jais.00287

Wu, T. (2014). The use of a mobile assistant learning system for health education based on project-based learning. *Computers, Informatics, Nursing*, *32*(10), 497–503. https://doi.org/10.1097/CIN.0000000000000089

Xie, W., Zhao, Y., & Xie, W. (2013). The effects of interface design of hand-held devices on mobile advertising effectiveness among college students in China. *International Journal of Mobile Marketing*, *8*(1), 46–61.

Yoo, I.-Y., & Lee, Y.-M. (2015). The effects of mobile applications in cardiopulmonary assessment education. *Nurse Education Today*, *35*(2), e19–e23. https://doi.org/10.1016/j.nedt.2014.12.002

Zhang, J., & Cui, Q. (2018). Collaborative Learning in Higher Nursing Education: A Systematic Review. *Journal of Professional Nursing*, *34*(5), 378–388. https://doi.org/10.1016/j.profnurs.2018.07.007

Appendix I: Information Sheet and Consent Form for Qualitative Study (In-Depth Interview)

This informed consent form is for nursing students of Kulliyyah of Nursing, IIUM who have experienced practicing their clinical skill in clinical skill centre.

Airul Azizan Zainudin
Kulliyyah of Nursing, International Islamic University Malaysia
Name of Project and Version: Experience on Clinical Skill Learning in Clinical Skill Laboratory and Expectation on Using Smartphone Application to Support Skill Self-assessment among Undergraduates Nursing Students.

This Informed Consent Form has two parts:
- **Information Sheet**
- **Certificate of Consent**

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction
I am Airul Azizan Zainudin, postgraduate nursing student from International Islamic University Malaysia. I am exploring undergraduate nursing students' learning experience in clinical skill laboratory in their faculty and their expectation on using smartphone application to support skill self-assessment. I am going to give you information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research. This consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. You also can ask me about the research if you have questions later.

Purpose of the research

Clinical skill training is essential in nursing education because it combines theoretical and practical learning experience which allows the student to combine their sensory, motor and cognitive learning processes. It also helps to gain knowledge, skills and attitude for providing nursing care. Even though the university always emphasized the important of patient-centredness and evidence-based practice, without proper training and early authentic clinical exposure, a nursing student whom on a clinical practicum duty may compromise the safety of patient. For that reason, we would like to know nursing students' experience on clinical skill learning in clinical skill laboratory and the expectation on using smartphone application to support clinical skill self-assessment.

Type of Research Intervention
This research will involve your participation for in-depth interview that will take about forty-five minutes. The interview session will be audio recorded.

Participant Selection
You are being invited to take part in this research because we feel that your experience can contribute much to our understanding and knowledge of clinical skill laboratory learning.

Voluntary Participation
Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate all the services you receive at this university will continue and nothing

will change.

Procedures
We are inviting you to take part in this interview because of your valuable experience in clinical skill laboratory learning. The interview session will be guided by me. We can also answer questions about the research that you might have. Then we will ask you questions about clinical skill learning and give you time to share your knowledge and experience.

The questions will be about the experience of clinical skill laboratory learning as well as your expectation in using smartphone application to support clinical self-assessment of clinical skill learning. If you do not wish to answer any of the questions during the interview, you may say so and the interviewer will move on to the next question.

The appointment for interview session will be set according to your preference. No one else but the interviewer will be present unless you would like someone else to be there. The entire interview session will be audio-recorded, but no one will be identified by name on the tape. Each participant will be identified by number. The interview session then will be transcribed and translated into English language. The audio recorder and file will be coded by number and it is anonymous.

The tape will be kept by me in Kulliyyah of Nursing. The information recorded is confidential, and no one else except the research team will have access to the tapes. The tapes will be destroyed once the project completed.

Duration
The interview session will be held once and will take about forty-five minutes.

Risks
There is a risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for this to happen. You do not have to answer any question or take part in the interview if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

Benefits
There will be indirect benefit to you, your participation is likely to help us find out more about how to improve clinical skill learning.

Reimbursements
You will not be provided any incentive to take part in the research. However, we will give you Ringgit Malaysia Ten (RM 10) for your time.

Confidentiality
We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone.

Sharing the Results
Nothing that you tell us today will be shared with anybody outside the research team, and nothing will be attributed to you by name. Following the meetings, we will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw
You do not have to take part in this research if you do not wish to do so. If you choose not to participate all the services you receive at this Kulliyyah will continue and nothing will change. You may stop participating in the interview at any time that you wish. I will give you an opportunity at the end of the interview to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

Who to Contact
If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following:

Assist. Prof. Dr. Norfadzilah Ahmad
Kulliyyah of Nursing,
International Islamic University Malaysia,
Jalan Hospital,
25150 Kuantan, Pahang.
Phone number: 09-570 7269
Email: fadzilah_hmd@iium.edu.my

Airul Azizan Zainudin
Kulliyyah of Nursing,
International Islamic University Malaysia,
Jalan Hospital,
25150 Kuantan, Pahang.
Phone number: 013-9678320
Email: azizanzainudin@gmail.com

Part II: Certificate of Consent

I have been invited to participate in research about experience in clinical skill laboratory and expectation on using smartphone application to support clinical skill self-assessment among undergraduate nursing students.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Name of Participant:

_____

Signature of Participant:

_____

IC No:

_____

Date: _____
Day/month/year

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

Interview session.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Signature of Researcher /person taking the consent

_____

Date

_____
Day/month/year

Appendix II: In-depth Interview Guide

Version 1

Respondent Code: _____

Section A: Demographic Information Instructions:

Kindly, take few more minutes to provide the following demographic information. This section is seeking information about your background. Please choose the answer that applies to you.

1. What is your gender?	□ Male □ Female
2. What is your year of study?	□ 2 □ 3 □ 4
3. What is your background of study?	□ Centre of Foundation Study, IIUM □ STPM □ Diploma □ Others (Please state) _____
4. Experience on using smartphone?	□ Less than a year □ 1-3 years □ 4-6 years □ More than 6 years

Page 1 of 5

Section B: Experience of learning clinical skill

Topic	Main Question	Probing Question
General experience	What is clinical skill learning?	Where do you think clinical skill learning always takes place?
	What types of learning activities you are doing in the clinical skill center?	
Physical	What is your view with the facilities in the clinical skill centre? (eg lab room, material equipment)	-Do you think the lab room/ material equipment always available when you need it? -How about their quality? -Do you think the quality of the equipment affect your learning? How?
	Can you share with me about the standard procedure guideline used in the skill lab?	-in form of what? -what version of guidelines you are using -who prepare the procedure checklist
Psychosocial	What is the expectation of the faculty on you? (for practicing)	-Do you think the objectives of the practical session is clear for you? If Yes, how? If No, why? -how the expectation affects your feeling? -how about their expectation during practical exam?
	How do you see the need of feedback during practicing your skill?	-who are giving you the feedback? Who are other persons giving you the feedback? -how feedback is given? -Did the feedback given in timely appropriate? -how do you learn from it?
	Can you share with us how do you communicate with the faculty members such as clinical instructor and lecturer with regards to skill practice?	-how do you usually communicate? -for what purpose? -how they response to you? -timely response?
Organization	Based on your experience, how is the quality of teaching delivered to you?	-How do you look at the preparation of the faculty members to teach skill to the students? For example the staffs' knowledge and skill -What about the accessibility to meet the faculty members?
Self-Regulated Learning	How do you self-reflect on the changes in skill performance effectiveness?	How do you personally set goals to learn clinical skill? How do you relate your personal goal with your strategy you use in learning the skill?

		-How do you evaluate your own skill performance? Tell me the example (peer evaluation, self-evaluation) -What were the steps taken to check whether your skill was improved? -Mode of monitoring? (journaling, video-recording, logbook)
		-Can u tell me what will you do if you're being told that you will be assessed on a particular procedure?
		-Can you tell me what will you do after you have been completed a procedure in front of the others? -What will you do if you are having difficulties in understanding certain skill or procedure? -What did you do after you are given the marks or grade after completing the procedure or task in CSC?
		-Do you have any particular method to complete the procedures before a particular test or exam? -Can you tell me how do you prepare for routine clinical skill practice in CSC?

Section C: Expectation of using smartphone application for clinical skill learning

The next section you will be shown with the concept of smartphone application which is designed to support the clinical skill self-assessment among undergraduate nursing students.

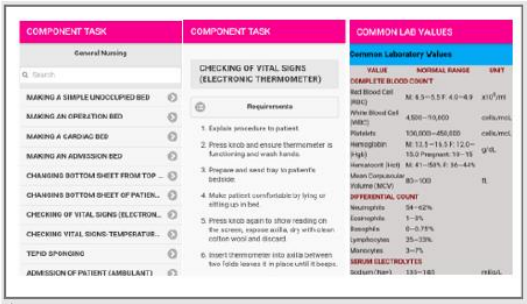
You are expected to tell us your idea on the use of smartphone application for clinical skill self-assessment.

***showing the concept of nursing clinical skill mobile application (refer Trigger)

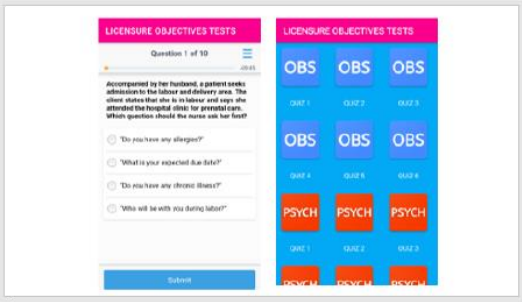
Topic	Main Question	Probing Question
Technology acceptance	Based on the concept of smartphone application, how do you think this app would effect/ influence your clinical skills learning performance?	How do you think this app would change the way you currently learning your clinical skills? How do you see the use of the smartphone application will help you to set goal before practice in CSC? How do you see the use of smartphone application can help you make your own strategic planning before practicing? How do you see the smartphone application help you to keep track of your motivation? How do you know that the smartphone app can help you to understand you personal capability to learn?
	Based on the concept of smartphone application, do you think you would had any difficulties of using this application?	Shall you experienced any difficulties when using this application, what would you do? How do you think the app should be designed to make sure that is easy to learn and easy to use for nursing students?
	Is significant people around you could potentially influence your likelihood of using this clinical skills mobile application? Why or why not they influence?	-lecturer -classmates -family members
	Based on your previous experience of using other mobile apps, what are the critical resources that you would need to have when you want to install and use this clinical skills application?	Do you think the platform of smartphone (Android vs iOS) is important to be considered? Why? Do you think wireless support is necessary for you to use this app? Do you think you will consider the specs of smartphone before using this clinical skill app

		(eg storage, battery lifespan, speed processor)? Why?
	What kinds of resources, infrastructure and support by the university would you think necessary to support the use of this clinical skills app?	
	Do you think it's important for this clinical skills app to be fun and pleasurable when using this clinical skill practice app?	If no, why do you say it is not important? If Yes, how do you think to make this clinical skills app fun and pleasurable?"
	In your opinion, what do you think would make you use this application regularly?	
Closing	Which other factors would you consider to be one of the reasons for you to use smartphone to support self-assessment? Please explain Thank you very much for you time and support.	

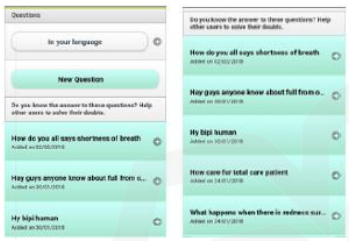
TRIGGER



1



2



3

BEHAVIOR MONITORING

4

TEACHING GUIDE

5

PROGRESS SHOWING

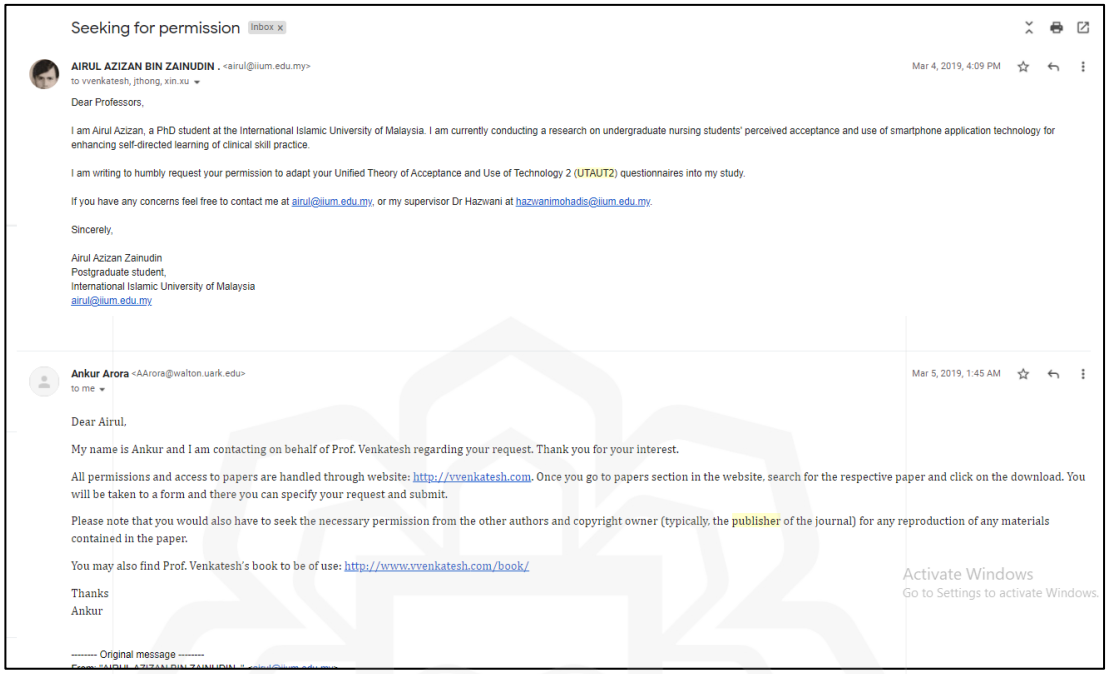
6

Reminder

7

Appendix III: Approval to Adopt Questionnaire

1. Approval from The Author -Prof Venkatesh



Seeking for permission Inbox ×

AIRUL AZIZAN BIN ZAINUDIN , <airul@iium.edu.my> Mar 4, 2019, 4:09 PM
to vvenkatesh, jthong, xin.xu

Dear Professors,

I am Airul Azizan, a PhD student at the International Islamic University of Malaysia. I am currently conducting a research on undergraduate nursing students' perceived acceptance and use of smartphone application technology for enhancing self-directed learning of clinical skill practice.

I am writing to humbly request your permission to adapt your Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) questionnaires into my study.

If you have any concerns feel free to contact me at airul@iium.edu.my, or my supervisor Dr Hazwani at hazwanimohadis@iium.edu.my.

Sincerely,

Airul Azizan Zainudin
Postgraduate student,
International Islamic University of Malaysia
airul@iium.edu.my

Ankur Arora <AArora@walton.uark.edu> Mar 5, 2019, 1:45 AM
to me

Dear Airul,

My name is Ankur and I am contacting on behalf of Prof. Venkatesh regarding your request. Thank you for your interest.

All permissions and access to papers are handled through website: http://vvenkatesh.com. Once you go to papers section in the website, search for the respective paper and click on the download. You will be taken to a form and there you can specify your request and submit.

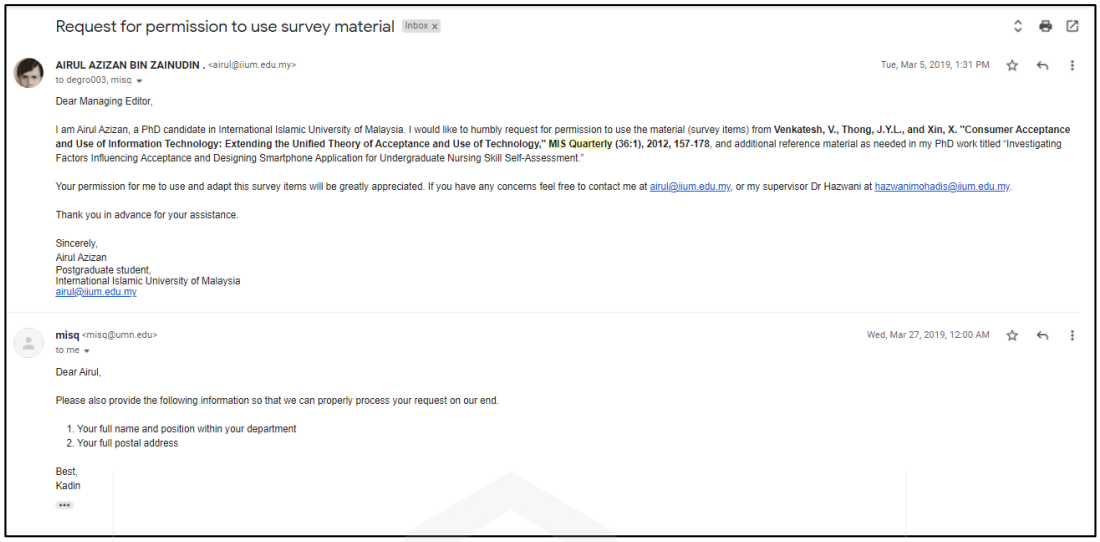
Please note that you would also have to seek the necessary permission from the other authors and copyright owner (typically, the publisher of the journal) for any reproduction of any materials contained in the paper.

You may also find Prof. Venkatesh's book to be of use: http://www.vvenkatesh.com/book/

Thanks
Ankur

-------- Original message --------

2. Approval from The Publisher -MISQ



Request for permission to use survey material Inbox ×

AIRUL AZIZAN BIN ZAINUDIN . <airul@iium.edu.my> Tue, Mar 5, 2019, 1:31 PM
to degro003, misq

Dear Managing Editor,

I am Airul Azizan, a PhD candidate in International Islamic University of Malaysia. I would like to humbly request for permission to use the material (survey items) from **Venkatesh, V., Thong, J.Y.L., and Xin, X. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology," MIS Quarterly (36:1), 2012, 157-178**, and additional reference material as needed in my PhD work titled "Investigating Factors Influencing Acceptance and Designing Smartphone Application for Undergraduate Nursing Skill Self-Assessment."

Your permission for me to use and adapt this survey items will be greatly appreciated. If you have any concerns feel free to contact me at airul@iium.edu.my, or my supervisor Dr Hazwani at hazwanimohadis@iium.edu.my.

Thank you in advance for your assistance.

Sincerely,
Airul Azizan
Postgraduate student,
International Islamic University of Malaysia
airul@iium.edu.my

misq <misq@umn.edu> Wed, Mar 27, 2019, 12:00 AM
to me

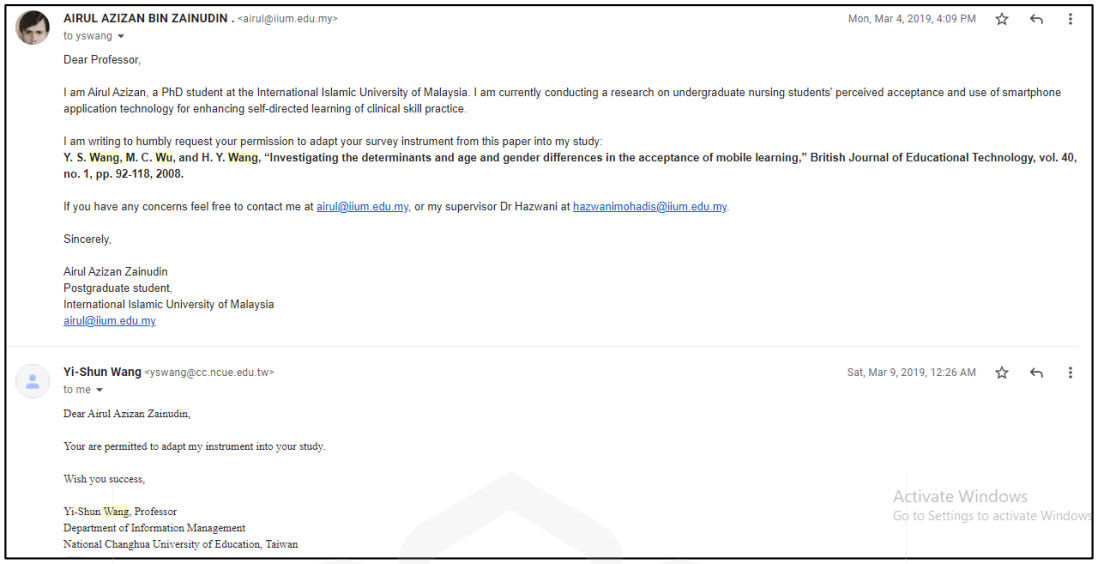
Dear Airul,

Please also provide the following information so that we can properly process your request on our end.

1. Your full name and position within your department
2. Your full postal address

Best,
Kadin

3. Approval from The Author -Prof Wang



AIRUL AZIZAN BIN ZAINUDIN . <airul@iium.edu.my> Mon, Mar 4, 2019, 4:09 PM

to yswang

Dear Professor,

I am Airul Azizan, a PhD student at the International Islamic University of Malaysia. I am currently conducting a research on undergraduate nursing students' perceived acceptance and use of smartphone application technology for enhancing self-directed learning of clinical skill practice.

I am writing to humbly request your permission to adapt your survey instrument from this paper into my study:
Y. S. Wang, M. C. Wu, and H. Y. Wang, "Investigating the determinants and age and gender differences in the acceptance of mobile learning," British Journal of Educational Technology, vol. 40, no. 1, pp. 92-118, 2008.

If you have any concerns feel free to contact me at airul@iium.edu.my, or my supervisor Dr Hazwani at hazwanimohadis@iium.edu.my.

Sincerely,

Airul Azizan Zainudin
Postgraduate student,
International Islamic University of Malaysia
airul@iium.edu.my

Yi-Shun Wang <yswang@cc.ncue.edu.tw> Sat, Mar 9, 2019, 12:26 AM

to me

Dear Airul Azizan Zainudin,

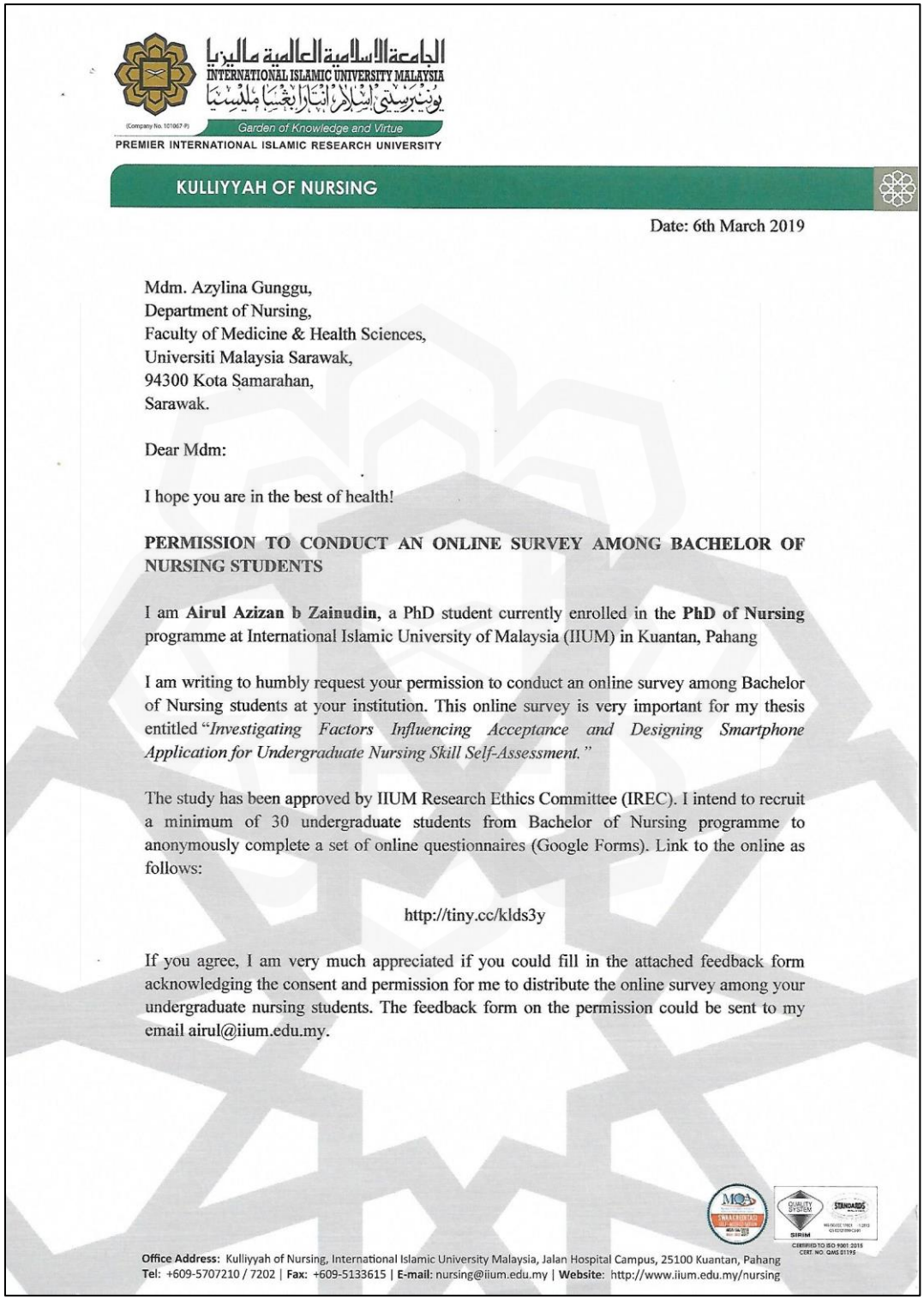
Your are permitted to adapt my instrument into your study.

Wish you success,

Yi-Shun Wang, Professor
Department of Information Management
National Changhua University of Education, Taiwan

Appendix IV: Pilot Study of Quantitative Study (Survey)

1. Permission To Conduct Online Survey/ Feedback Form UNIMAS



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
(Company No. 101067-P)
Garden of Knowledge and Virtue
PREMIER INTERNATIONAL ISLAMIC RESEARCH UNIVERSITY

KULLIYYAH OF NURSING

Date: 6th March 2019

Mdm. Azylina Gunggu,
Department of Nursing,
Faculty of Medicine & Health Sciences,
Universiti Malaysia Sarawak,
94300 Kota Samarahan,
Sarawak.

Dear Mdm:

I hope you are in the best of health!

PERMISSION TO CONDUCT AN ONLINE SURVEY AMONG BACHELOR OF NURSING STUDENTS

I am **Airul Azizan b Zainudin**, a PhD student currently enrolled in the **PhD of Nursing** programme at International Islamic University of Malaysia (IIUM) in Kuantan, Pahang

I am writing to humbly request your permission to conduct an online survey among Bachelor of Nursing students at your institution. This online survey is very important for my thesis entitled "*Investigating Factors Influencing Acceptance and Designing Smartphone Application for Undergraduate Nursing Skill Self-Assessment.*"

The study has been approved by IIUM Research Ethics Committee (IREC). I intend to recruit a minimum of 30 undergraduate students from Bachelor of Nursing programme to anonymously complete a set of online questionnaires (Google Forms). Link to the online as follows:

http://tiny.cc/klds3y

If you agree, I am very much appreciated if you could fill in the attached feedback form acknowledging the consent and permission for me to distribute the online survey among your undergraduate nursing students. The feedback form on the permission could be sent to my email airul@iium.edu.my.

CERTIFIED TO ISO 9001:2015
CERT. NO: QMS 01195

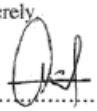
Office Address: Kulliyyah of Nursing, International Islamic University Malaysia, Jalan Hospital Campus, 25100 Kuantan, Pahang
Tel: +609-5707210 / 7202 | **Fax:** +609-5133615 | **E-mail:** nursing@iium.edu.my | **Website:** http://www.iium.edu.my/nursing

Attached herewith is:

1. Feedback Form (Appendix 1)
2. IREC Study Approval Letter (Appendix 2).

Your approval to conduct this online survey will be greatly appreciated. Thank you in advance for your assistance.

Sincerely,



.....

Airul Azizan b Zainudin
Postgraduate student,
Kulliyyah of Nursing,
International Islamic University Malaysia
airul@iium.edu.my

Supervised by:

Dr. Hazwani binti Mohd Mohadis
Assistant Professor
Department of Information System
Kulliyyah of Information and
Communication Technology
International Islamic University Malaysia
Gombak, Selangor
hazwanimohadis@iium.edu.my
Phone No: 03-6196 5680 (Office)

Dr. Norfadzilah Ahmad
Assistant Professor
Department of Professional Nursing Studies
Kulliyyah of Nursing
International Islamic University Malaysia,
Jalan Hospital, 25150
Kuantan, Pahang.
fadzilah_hmd@iium.edu.my
Phone No: 09-570 7317 (Office)

APPENDIX 1

FEEDBACK ON PERMISSION TO CONDUCT ONLINE SURVEY IN DEPARTMENT OF NURSING, FACULTY OF MEDICINE AND HEALTH SCIENCES, UNIMAS

Survey Topic: A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning

Our department/faculty/school:

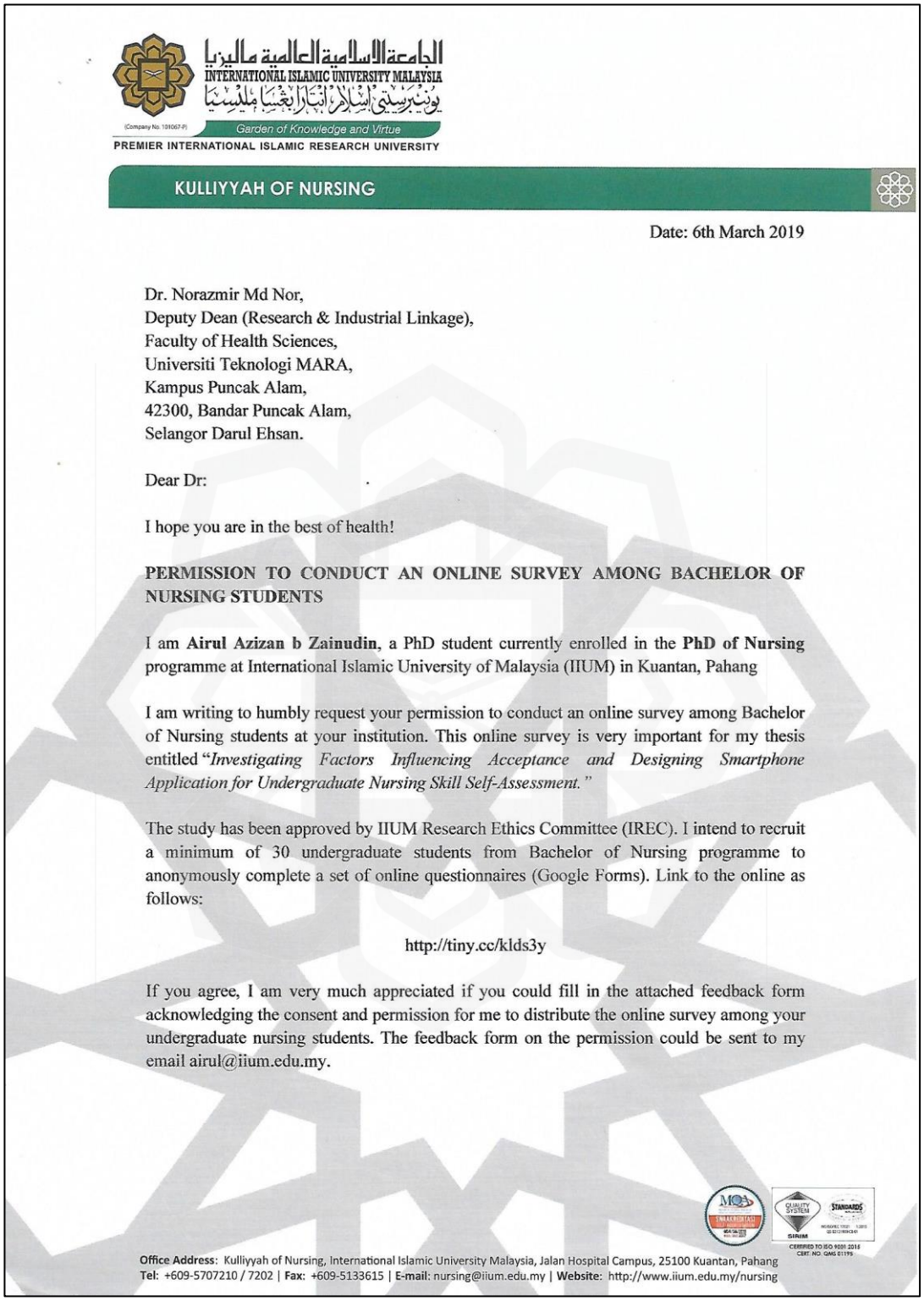
☑ Allow the student to do the online survey

☐ Not allow the student to do the online survey

.....

Mdm. Azylina Gunggu,
Department of Nursing,
Faculty of Medicine & Health Sciences,
Universiti Malaysia Sarawak.

2. Permission To Conduct Online Survey/ Feedback Form UiTM Puncak Alam



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملايسيا
(Company No. 101067-P) Garden of Knowledge and Virtue
PREMIER INTERNATIONAL ISLAMIC RESEARCH UNIVERSITY

KULLIYYAH OF NURSING

Date: 6th March 2019

Dr. Norazmir Md Nor,
Deputy Dean (Research & Industrial Linkage),
Faculty of Health Sciences,
Universiti Teknologi MARA,
Kampus Puncak Alam,
42300, Bandar Puncak Alam,
Selangor Darul Ehsan.

Dear Dr:

I hope you are in the best of health!

PERMISSION TO CONDUCT AN ONLINE SURVEY AMONG BACHELOR OF NURSING STUDENTS

I am **Airul Azizan b Zainudin**, a PhD student currently enrolled in the **PhD of Nursing** programme at International Islamic University of Malaysia (IIUM) in Kuantan, Pahang

I am writing to humbly request your permission to conduct an online survey among Bachelor of Nursing students at your institution. This online survey is very important for my thesis entitled "*Investigating Factors Influencing Acceptance and Designing Smartphone Application for Undergraduate Nursing Skill Self-Assessment.*"

The study has been approved by IIUM Research Ethics Committee (IREC). I intend to recruit a minimum of 30 undergraduate students from Bachelor of Nursing programme to anonymously complete a set of online questionnaires (Google Forms). Link to the online as follows:

http://tiny.cc/klds3y

If you agree, I am very much appreciated if you could fill in the attached feedback form acknowledging the consent and permission for me to distribute the online survey among your undergraduate nursing students. The feedback form on the permission could be sent to my email airul@iium.edu.my.

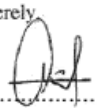
Office Address: Kulliyyah of Nursing, International Islamic University Malaysia, Jalan Hospital Campus, 25100 Kuantan, Pahang
Tel: +609-5707210 / 7202 | **Fax**: +609-5133615 | **E-mail**: nursing@iium.edu.my | **Website**: http://www.iium.edu.my/nursing

Attached herewith is:

1. Feedback Form (Appendix 1)
2. IREC Study Approval Letter (Appendix 2).

Your approval to conduct this online survey will be greatly appreciated. Thank you in advance for your assistance.

Sincerely,



.....

Airul Azizan b Zainudin
Postgraduate student,
Kulliyyah of Nursing,
International Islamic University Malaysia
airul@iium.edu.my

Supervised by:

Dr. Hazwani binti Mohd Mohadis
Assistant Professor
Department of Information System
Kulliyyah of Information and
Communication Technology
International Islamic University Malaysia
Gombak, Selangor
hazwanimohadis@iium.edu.my
Phone No: 03-6196 5680 (Office)

Dr. Norfadzilah Ahmad
Assistant Professor
Department of Professional Nursing Studies
Kulliyyah of Nursing
International Islamic University Malaysia,
Jalan Hospital, 25150
Kuantan, Pahang.
fadzilah_hmd@iium.edu.my
Phone No: 09-570 7317 (Office)

APPENDIX 1

FEEDBACK ON PERMISSION TO CONDUCT ONLINE SURVEY IN CENTER OF NURSING, FACULTY OF HEALTH SCIENCES, UNIVERSITI TEKNOLOGI MARA

Survey Topic: A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning

Our department/faculty/school:

☑ Allow the student to do the online survey

☐ Not allow the student to do the online survey

.....

Dr. Norazmir Md Nor,
Deputy Dean (Research & Industrial Linkage)
Faculty of Health Sciences,
Universiti Teknologi MARA.

DR. NORAZMIR MD NOR
Deputy Dean Research & Industrial Linkages
Faculty of Health Sciences
Universiti Teknologi MARA
42300 Puncak Alam, Selangor

Appendix V: Information Sheet and Consent Form for Quantitative Study (Survey)

Version 1, dated 1st May 2019

This informed consent form is for undergraduate nursing students of Kulliyyah of Nursing, IIUM.

Airul Azizan Zainudin
Kulliyyah of Nursing, International Islamic University Malaysia
Name of Project: A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning -version 1

This Informed Consent Form has two parts:

- **Information Sheet**
- **Certificate of Consent**

Part 1: Information sheet

Introduction

I am Airul Azizan Zainudin, postgraduate student from International Islamic University Malaysia. I am exploring undergraduate nursing students' acceptance to use smartphone application to enhance self-directed clinical skill learning. I am going to give you information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research. You also can ask me about the research if you have questions later.

Purpose of the research

Self-directed learner takes control and accepts the freedom to learn what they view as important for themselves. Nursing students are expected to engage in self-directed learning through identifying their own learning needs, setting goals, choosing learning strategies, identifying human and material resources and evaluating outcomes of their learning process. With the proliferation of mobile computing technology, learning can be delivered to students anytime and anywhere through the use of wireless Internet and mobile devices, especially smartphone application. The acceptance of smartphone application by individuals is critical to the successful implementation of self-directed learning. For that reason, I would like to invite you to participate in an online survey on perceived behavioral intention to use smartphone application for enhancing self-directed clinical skill learning among undergraduate nursing students.

Type of Research Intervention

This research will involve your participation for survey that will take about less than fifteen minutes.

Participant Selection

You are being invited to take part in this research because we feel that your experience can contribute much to our understanding and knowledge of clinical skill self-directed learning. Based on the purpose of the study, the inclusion and exclusion criteria for this study were formulated. They include that: 1) undergraduate nursing student of Kulliyyah of Nursing, 2) had experience learning clinical skill, 3) student status is "active" in the database, 4) own and use smartphone.

Voluntary Participation
Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate all the services you receive at this university will continue and nothing will change.

Procedures
We are inviting you to take part in this survey because of your valuable experience in clinical skill self-directed learning. The survey session will be guided by me or my assistants. We can also answer questions about the research that you might have.

There are three parts in the survey. Part 1 will ask about the demographic data of the participants. Part 2 will ask about the usage of smartphone and smartphone apps for purpose of learning. Lastly, Part 3 will ask about the perceived behavioral intention to use smartphone application for the purpose of enhancing clinical skill self-directed learning.

Duration
The survey session will be held once and will take less than fifteen minutes.

Risks
There is almost no risk in participating in this survey because there are no personal details regarding your identity asked in the questions.

Benefits
There will be indirect benefit to you, your participation is likely to help us find out more about how to recognize important factors of acceptance for using smartphone application to enhance clinical skill self-directed learning.

Reimbursements
You will be provided with a souvenir as a thank you remark for answering the survey.

Sharing the Results
We will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw
You do not have to take part in this research if you do not wish to do so. If you choose not to participate all the services you receive at this Kulliyyah will continue and nothing will change.

Who to Contact
If you have any questions, you may contact any of the following:

Airul Azizan Zainudin	Dr. Hazwani binti Mohd Mohadis	Dr. Norfadzilah Ahmad
Postgraduate student, Kulliyyah of Nursing, International Islamic University Malaysia, Jalan Hospital, 25150 Kuantan, Pahang. Phone number: 013-9678320 Email: azizanzainudin@gmail.com	Assistant Professor, Dept. of Information System, Kulliyyah of Information and Communication Technology, International Islamic University Malaysia, Gombak, Selangor	Assistant Professor, Dept. Professional Nursing Studies, Kulliyyah of Nursing, International Islamic University Malaysia, Jalan Hospital, 25150 Kuantan, Pahang.

Part 2: Consent Form

Clicking on the "agree" button below indicates that:

- you have agreed with the above information
- you voluntarily agree to participate

***Confirmation**
□ Agree

Appendix VI: The Online Survey Form

A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning

Part 1: Information sheet

Introduction
I am Airul Azizan Zainudin, postgraduate student from International Islamic University Malaysia. I am exploring undergraduate nursing students' acceptance to use smartphone application to enhance self-directed clinical skill learning. I am going to give you information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research. You also can ask me about the research if you have questions later.

Purpose of the research
Self-directed learner takes control and accepts the freedom to learn what they view as important for themselves. Nursing students are expected to engage in self-directed learning through identifying their own learning needs, setting goals, choosing learning strategies, identifying human and material resources and evaluating outcomes of their learning process. With the proliferation of mobile computing technology, learning can be delivered to students anytime and anywhere through the use of wireless Internet and mobile devices, especially smartphone application. The acceptance of smartphone application by individuals is critical to the successful implementation of self-directed learning. For that reason, I would like to invite you to participate in an online survey on perceived behavioral intention to use smartphone application for enhancing self-directed clinical skill learning among undergraduate nursing students.

Type of Research Intervention
This research will involve your participation for survey that will take about less than fifteen minutes.

Participant Selection
You are being invited to take part in this research because we feel that your experience can contribute much to our understanding and knowledge of clinical skill self-directed learning. Based on the purpose of the study, the inclusion and exclusion criteria for this study were formulated. They include that: 1) undergraduate nursing student of Kulliyyah of Nursing, 2) had experience learning clinical skill, 3) student status is "active" in the database, 4) own

and use smartphone.

Voluntary Participation
Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate all the services you receive at this university will continue and nothing will change.

Procedures

We are inviting you to take part in this survey because of your valuable experience in clinical skill self-directed learning. The survey session will be guided by me or my assistants. We can also answer questions about the research that you might have.

There are three parts in the survey. Part 1 will ask about the demographic data of the participants. Part 2 will ask about the usage of smartphone and smartphone apps for purpose of learning. Lastly, Part 3 will ask about the perceived behavioral intention to use smartphone application for the purpose of enhancing clinical skill self-directed learning.

Duration
The survey session will be held once and will take less than fifteen minutes.

Risks
There is almost no risk in participating in this survey because there are no personal details regarding your identity asked in the questions.

Benefits
There will be indirect benefit to you, your participation is likely to help us find out more about how to recognize important factors of acceptance for using smartphone application to enhance clinical skill self-directed learning.

Reimbursements
You will be provided with a souvenir as a thank you remark for answering the survey.

Sharing the Results
We will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw
You do not have to take part in this research if you do not wish to do so. If you choose not to participate all the services you receive at this Kulliyyah will continue and nothing will change.

Who to Contact
If you have any questions, you may contact any of the following:

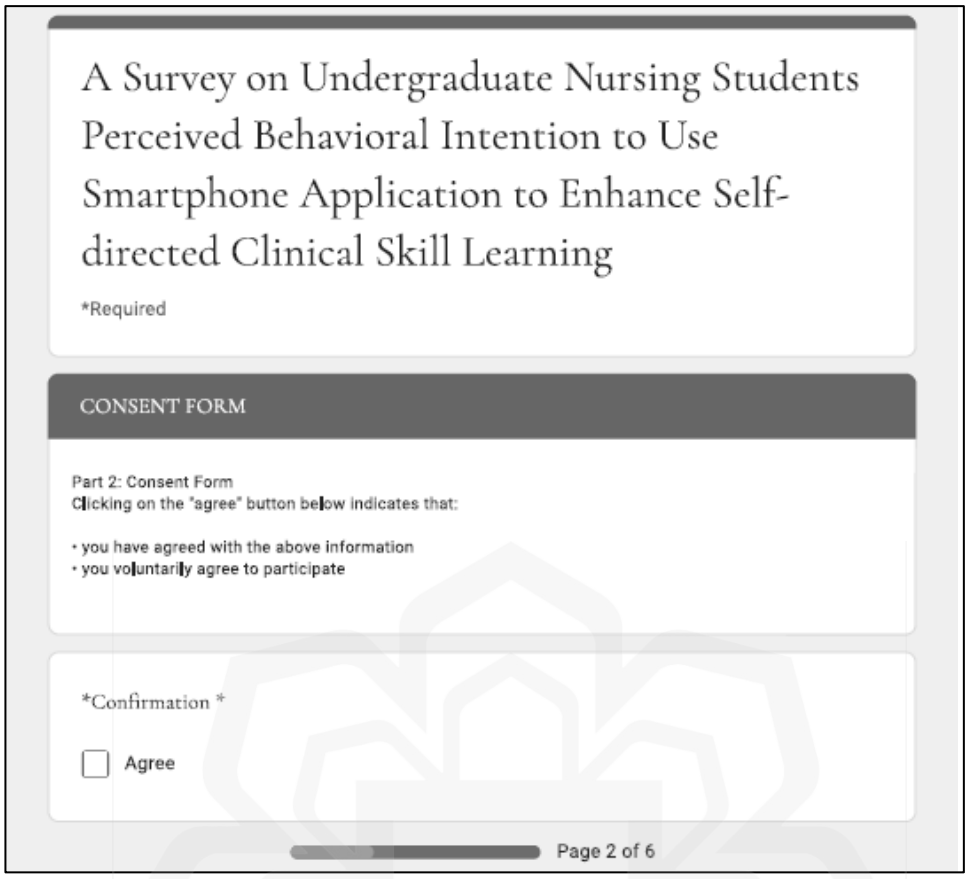
Airul Azizan Zainudin
Postgraduate student,
Kulliyyah of Nursing,
International Islamic University Malaysia,
Jalan Hospital, 25150
Kuantan, Pahang.
Phone number: 013-9678320
Email: azizanzainudin@gmail.com

Dr. Hazwani binti Mohd Mohadis
Assistant Professor,
Dept. of Information System,
Kulliyyah of Information and Communication Technology,
International Islamic University Malaysia,
Gombak, Selangor

Dr. Norfadzilah Ahmad
Assistant Professor,
Dept. Professional Nursing Studies,
Kulliyyah of Nursing,
International Islamic University Malaysia,
Jalan Hospital, 25150
Kuantan, Pahang.

Page 1 of 6

Next



A Survey on Undergraduate Nursing Students Perceived Behavioral Intention to Use Smartphone Application to Enhance Self-directed Clinical Skill Learning

*Required

CONSENT FORM

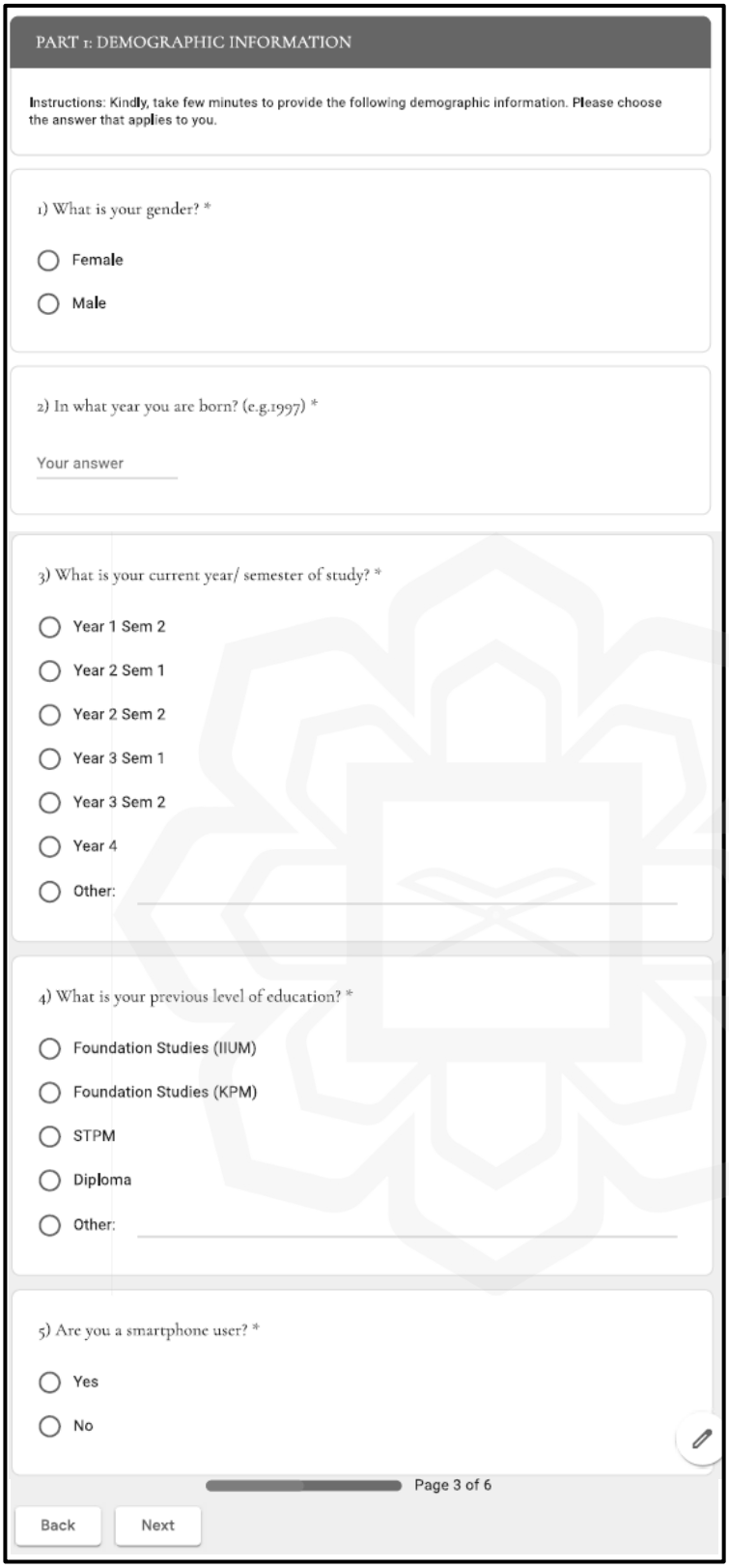
Part 2: Consent Form
Clicking on the "agree" button below indicates that:

- you have agreed with the above information
- you voluntarily agree to participate

*Confirmation *

Agree

Page 2 of 6



PART 1: DEMOGRAPHIC INFORMATION

Instructions: Kindly, take few minutes to provide the following demographic information. Please choose the answer that applies to you.

1) What is your gender? *

- Female
- Male

2) In what year you are born? (e.g.1997) *

Your answer

3) What is your current year/ semester of study? *

- Year 1 Sem 2
- Year 2 Sem 1
- Year 2 Sem 2
- Year 3 Sem 1
- Year 3 Sem 2
- Year 4
- Other:

4) What is your previous level of education? *

- Foundation Studies (IIUM)
- Foundation Studies (KPM)
- STPM
- Diploma
- Other:

5) Are you a smartphone user? *

- Yes
- No

Page 3 of 6

Back Next

PART 2: USAGE OF SMARTPHONE AND SMARTPHONE APPLICATION

Instructions: Please provide the following information regarding your usage of smartphone and smartphone applications. Choose an answer that best applies to you.

1) How many year(s) you have been using smartphone? *

- ◯ Less than one year
- ◯ 2-3 years
- ◯ 4-5 years
- ◯ More than 6 years

2) How many smartphone(s) you are currently using? *

- ◯ 1 smartphone only
- ◯ 2 smartphones at the same time
- ◯ More than 2 smartphones at the same time
- ◯ Other: _____

3) Which type(s) of smartphone OS you are currently using? [you can check more than one] *

- ☐ Android
- ☐ iOS
- ☐ Windows
- ☐ Others

4) How would you rate your level of competence in using smartphone application?

- ◯ Novice: I only have a few apps installed. I use smartphone for calls, texting and emails.
- ◯ Intermediate: I occasionally download apps when I have a need or my friend recommend something new.
- ◯ Advanced: I often installed many of the same apps to evaluate the differences and make recommendations to my friends about the best apps.
- ◯ Expert: I have developed my own mobile apps

5) Concerning your usage of smartphone applications, do you use any applications to support your learning? If YES, how many of them? *

- ◯ No
- ◯ Yes: 1-5 apps
- ◯ Yes: 6-10 apps
- ◯ Yes: More than 10 apps

6) How frequent do you use smartphone apps at these locations? *

	Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently
Home/ dormitory	○	○	○	○	○	○
University campus	○	○	○	○	○	○
University library	○	○	○	○	○	○
In the class	○	○	○	○	○	○
In the clinical skill center	○	○	○	○	○	○
On the go (eg: on the bus, while walking)	○	○	○	○	○	○

7) How frequent do you use smartphone apps for these tasks? *

	Never	Very Rarely	Rarely	Occasionally	Frequently	Very Frequently
Look up course timetable	○	○	○	○	○	○
Look up portal announcements	○	○	○	○	○	○
E-mail faculty staff/classmates	○	○	○	○	○	○
Read lecture notes	○	○	○	○	○	○
Watch lecture videos	○	○	○	○	○	○
Watch instructional video	○	○	○	○	○	○
Do library /literature searches	○	○	○	○	○	○
Surf the web for learning material	○	○	○	○	○	○
Share notes with classmates	○	○	○	○	○	○
Making note	○	○	○	○	○	○
Record learning activities	○	○	○	○	○	○

Page 4 of 6

Back Next

PART 3: PERCEIVED BEHAVIORAL INTENTION TO USE SMARTPHONE APPLICATION FOR ENHANCING SELF-DIRECTED CLINICAL SKILL LEARNING

This part contains survey items of perceived behavioral intention to use smartphone application to enhance self-directed clinical skill learning.

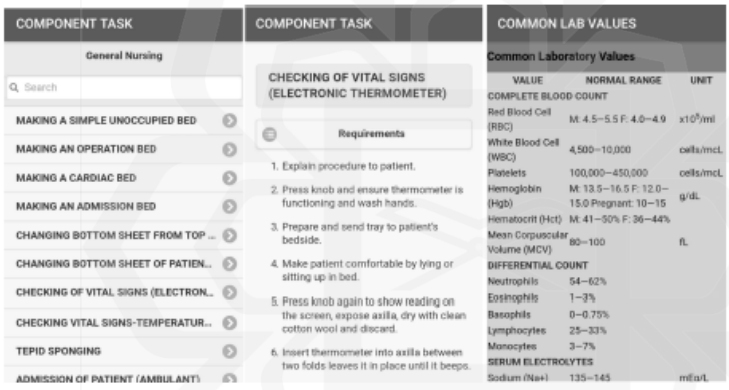
You are required to answer the survey questions based on the scenario provided in the 'Trigger' section below:

TRIGGER

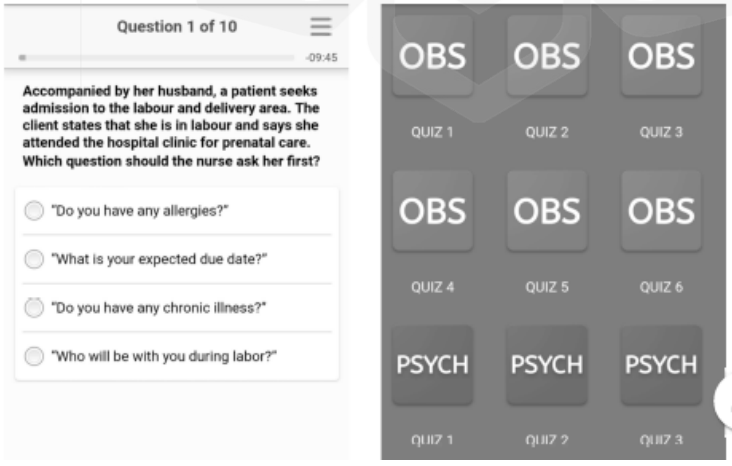
Imagine you are attending a lecture on clinical nursing topic delivered by one of your nursing professors/lecturers in a class. Upon completion of the lecture, you are being brought to the clinical skill laboratory for demonstration of the procedure for two hours. After demonstration of procedure, your lecturer has ordering you to attend the clinical skill laboratory for self-practice in any interval of academic schedules, or self-directed learning slot as scheduled by the faculty. Since this session is self-directed, you have to manage your own time and learn independently in the skill laboratory.

Imagine you are attending a lecture on clinical nursing topic delivered by one of your nursing professors/lecturers in a class. Upon completion of the lecture, you are being brought to the clinical skill laboratory for demonstration of the procedure for two hours. After demonstration of procedure, your lecturer has ordering you to attend the clinical skill laboratory for self-practice in any interval of academic schedules, or self-directed learning slot as scheduled by the faculty. Since this session is self-directed, you have to manage your own time and learn independently in the skill laboratory.

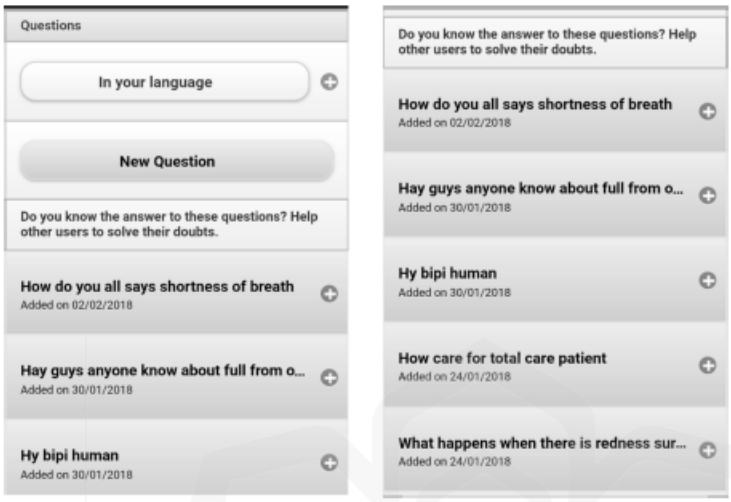
Procedure Checklist



Quizzes

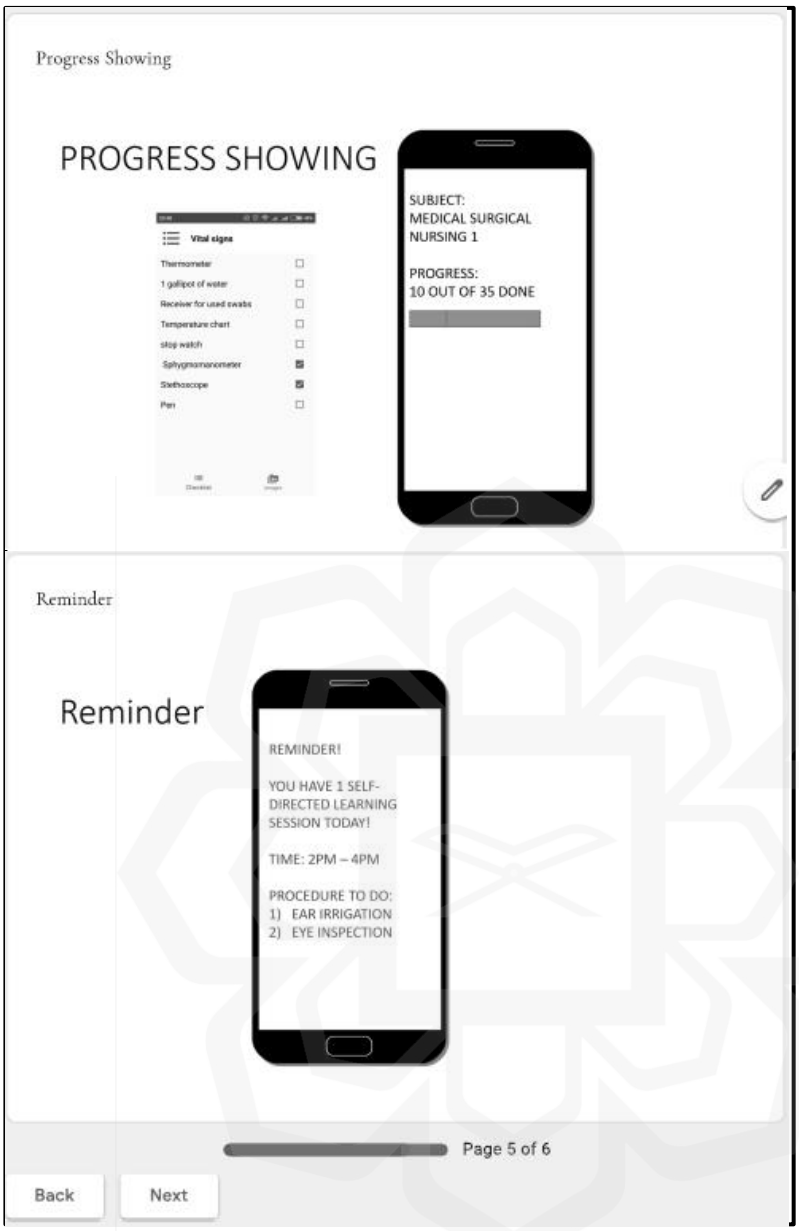


Forum



Behavior Monitoring

Teaching Video


Progress Showing
PROGRESS SHOWING
Vital signs
Thermometer
1 gallipot of water
Receiver for used swabs
Temperature chart
stop watch
Sphygmomanometer
Stethoscope
Pen
SUBJECT:
MEDICAL SURGICAL
NURSING 1
PROGRESS:
10 OUT OF 35 DONE
Reminder
Reminder
REMINDER!
YOU HAVE 1 SELF-
DIRECTED LEARNING
SESSION TODAY!
TIME: 2PM – 4PM
PROCEDURE TO DO:
1) EAR IRRIGATION
2) EYE INSPECTION
Page 5 of 6
Back
Next

PART 3: PERCEIVED BEHAVIORAL INTENTION TO USE SMARTPHONE APPLICATION TO ENHANCE SELF-DIRECTED CLINICAL SKILL LEARNING

INSTRUCTION:
With respect to the features and functions of the apps as shown to you, what do you think of using this kind of app for self-directed learning?
You can perceive the features and functions of this apps based on your experience using other similar types of apps.

You may rate each statement based on the following scale:
1: Strongly Disagree, 2: Disagree, 3: Somewhat Disagree, 4: Neutral, 5: Somewhat Agree, 6: Agree, 7: Strongly Agree

1) I think using a smartphone application to enhance my self-directed clinical skill learning ... *

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
.... is useful to me	○	○	○	○	○	○	○
.... help me to accomplish clinical skill activities more quickly	○	○	○	○	○	○	○
.... help me to complete more clinical skill activities (e.g. building nursing diagnosis, completing procedure checklist).	○	○	○	○	○	○	○

2) In my opinion, it is important that my interaction with a smartphone application for enhancing my self-directed clinical skill learning to be... *

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
.... easy to learn.	○	○	○	○	○	○	○
.... clear and understandable.	○	○	○	○	○	○	○
.... easy to use	○	○	○	○	○	○	○
.... easy for me to become skillful at using it.	○	○	○	○	○	○	○

3) I am most likely will be using a smartphone application for enhancing my self-directed clinical skill learning if... *

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
... people who are important to me (e.g. lecturer, clinical instructor, friends) think that I should use it.	○	○	○	○	○	○	○
... people who influence my behavior (e.g. lecturer, clinical instructor, friends) think that I should use it.	○	○	○	○	○	○	○
... people whose opinions that I value (e.g. lecturer, clinical instructor, friends) prefer that I use it.	○	○	○	○	○	○	○

4) In my opinion, ... *

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
.... I have the resources necessary (e.g. online tutorial) to use smartphone application for enhancing my self-directed clinical skill learning	○	○	○	○	○	○	○
.... I have the knowledge necessary to use smartphone application for enhancing my self-directed clinical skill learning	○	○	○	○	○	○	○
.... smartphone application for enhancing my self-directed clinical skill learning are compatible with other technologies I use	○	○	○	○	○	○	○
.... I can get help from others (e.g. faculty, friend, app provider) when I have difficulties using smartphone application for enhancing my self-directed clinical skill learning.	○	○	○	○	○	○	○

5) I believe using smartphone application to enhance my self-directed clinical skill learning .... *

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
.... would be fun	○	○	○	○	○	○	○
.... would be enjoyable	○	○	○	○	○	○	○
.... would be very entertaining	○	○	○	○	○	○	○

Appendix VII: Information Sheet and Consent Form for Evaluation Study

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملايسيا

This informed consent form is for nursing students of Kulliyyah of Nursing, IIUM who have experienced practicing their clinical skill in clinical skill centre.

Airul Azizan Zainudin
Kulliyyah of Nursing, International Islamic University Malaysia
Name of Project and Version: User perception on using *Nurskill 1.0 app* prototype for clinical skill self-directed learning among undergraduate nursing students.

This Informed Consent Form has two parts:

- **Information Sheet**
- **Certificate of Consent**

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction

I am Airul Azizan Zainudin, postgraduate nursing student from International Islamic University Malaysia. I am intent to explore the user perception on using smartphone application prototype named *Nurskill 1.0* as a tool for undergraduate nursing student to self-direct their clinical skill learning. I am going to give you more detailed information and you can talk to anyone regarding this study. This consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. You also can ask me about the research if you have questions later.

Purpose of the research

Understanding user perception towards important features of smartphone application in earlier development phase is pivotal. It helps us to recognize important design requirements in improving the effectiveness of using smartphone application for clinical skill self-directed learning. For that reason, we would like to explore the undergraduate nursing students' perception on using *Nurskill 1.0* application as a tool for self-directed clinical skill learning.

Type of Research Intervention

This research will involve usability evaluation methods such as in-depth interview and participatory design that will take about forty-five minutes. The interview session will be video and audio recorded.

Participant Selection

You are invited to take part in this research because we feel that your experience can to fulfill the need of the research. Based on the purpose of the study, the inclusion criteria for this study are 1) undergraduate nursing student of Kulliyyah of Nursing, 2) came from second semester and above, 3) a student with an active status in database, 4) own and use smartphone. Meanwhile, the exclusion criteria include: 1) non-undergraduate nursing students of Kulliyyah of Nursing, 2) students of undergraduate came from first semester, 3) students on leave, 4) do not own any smartphone.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate all the services you receive at this university will continue and nothing will change.

Procedures
The interview session will be guided by me and you are open to ask any questions about the research. The interview session will be set in a designated place within Kulliyyah of Nursing building. No one else but the interviewer will present unless you would like someone to accompany you. The entire interview session will be video- and audio-recorded, but no one will be identified by name on the tape. Each participant will be identified by a code. The interview session then will be transcribed and translated into English language. The audio file will be coded by number and it is anonymous. The recorded file will be kept by me in Kulliyyah of Nursing. The record is confidential, and no one else except the research team will have access to access it. It will be destroyed once the project completed.

Duration
The interview session will be held once and will take about forty-five minutes.

Risks
You may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for this to happen. You do not have to answer any question or take part in the interview if you feel the question(s) are too personal or makes you feel uncomfortable.

Benefits
There will be indirect benefit to you, your participation is likely to help us find out more about how to improve this tool for self-directed clinical skill learning.

Reimbursements
You will not be provided any incentive to take part in the research. However, we will give you Ringgit Malaysia Ten (RM 10) and a pack of souvenir for your time.

Confidentiality
We will not share any information about you to anyone outside of the research team. The information that we collect from this research project will be kept private.

Sharing the Results
Nothing that you tell us today will be shared with anybody outside the research team, and nothing will be attributed to you by name. Following the meetings, we will publish the results so that other interested people may learn from the research.

Right to Refuse or Withdraw
You do not have to take part in this research if you do not wish to do so. If you choose not to participate all the services you receive at this Kulliyyah will continue and nothing will change. You may stop participating in the interview at any time that you wish. I will give you an opportunity at the end of the interview to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

Who to Contact
If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact any of the following:

Assist. Prof. Dr. Norfadzilah Ahmad
Kulliyyah of Nursing,
International Islamic University Malaysia,
Jalan Hospital,
25150 Kuantan, Pahang.
Phone number: 09-570 7269
Email: fadzilah_hmd@iium.edu.my

Airul Azizan Zainudin
Kulliyyah of Nursing,
International Islamic University
Malaysia,
Jalan Hospital,
25150 Kuantan, Pahang.
Phone number: 013-9678320
Email: azizanzainudin@gmail.com

Part II: Certificate of Consent

I have been invited to participate in research about exploring user experience on using *Nurskill 1.0* application for self-directed clinical skill learning among undergraduate nursing students.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Name of Participant:

_____

Signature of Participant:

_____

IC No:

_____

Date: _____
Day/month/year

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of Witness:

_____

Signature of Witness:

_____

IC No:

_____

Date: _____
Day/month/year

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

Interview session.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher/ person taking consent:

_____

Signature of Researcher /person taking the consent

_____

Date

_____

Day/month/year

Appendix VIII: Interview Protocol for Evaluation Study

USABILITY TEST ON USING *NURSKILL 1.0 APP* PROTOTYPE FOR CLINICAL SKILL SELF-DIRECTED LEARNING AMONG UNDERGRADUATE NURSING STUDENTS.

SECTION A: DEMOGRAPHIC INFORMATION

Instructions

This section is seeking information about your background. Please provide the following demographic information. Please choose the answer that best applies to you.

1. Gender	☐ Male ☐ Female
2. Current year of study	☐ Year 1 Sem 2 ☐ Year 2 Sem 1 ☐ Year 2 Sem 2 ☐ Year 3 Sem 1 ☐ Year 3 Sem 2 ☐ Year 4 Sem 1 ☐ Year 4 Sem 2
3. Background of study	☐ Foundation Study, IIUM ☐ Foundation Study (KPM) ☐ STPM ☐ Diploma ☐ Others _____ (please state)
4. Experience of using smartphone	☐ Less than a year ☐ 2-3 years ☐ 4-5 years ☐ More than 6 years

PERSONA

Mr Azizan is a first-year undergraduate student attending Bachelor of Nursing in Kulliyyah of Nursing, International Islamic University Malaysia. He is 21 years old and currently on second semester of study. In current semester, he is taking an introduction subject for clinical nursing skill named Subject 1. He has to attend lecture sessions by a nursing lecturer followed by hand-on demonstration and practical session in clinical skill laboratory.

SCENARIO

After the demonstration of the procedure, the lecturer asked him and his colleagues to attend the clinical skill laboratory for self-practice in any interval of the academic schedules as prepared by the faculty. Since the session is self-directed, Mr Azizan has to manage his own schedule to get to practice in the clinical skill centre.

In order to assist Mr Azizan, he has been informed to download and install *Nurskill 1.0,* an application in smartphone which is provided by the faculty to facilitate the self-directed learning session. Mr Azizan has registered a profile into the smartphone application, then he started to look out the list of procedures for learning. He chooses Subject 1 and select Procedure 1 which is *'Temperature taking: oral, axilla, tympanic'* for learning. Then, he learned from a tutorial video on performing temperature taking procedure and begin to look for the steps for the procedure in a form of checklist. He feels that learning from video and checklist is easy and set to perform the procedure individually during his free time. He plans to be competent in the procedure in two-week time.

Since the facilities are quite limited to cater a big number of students in one time, *Nurskill 1.0* provide an information for the students to select available time for booking a place for practicing with a clinical instructor. To improve the communication between Mr Aziz and clinical instructor, he used messaging feature to discuss things.

Along this two-week, Mr Azizan managed to look for his progress and shared his activities with other students. Vice versa, he can look for others' friends shared activities as well. Besides, he can create a topic in a forum for discussion with his colleagues. Other than that, he able to monitor the percentage of completion of other procedures for the subjects he took in the semester.

SECTION B: TASKS

Instructions

Based on persona and scenario provided above, please take as long as you need to complete each task below. If you are unable to complete a task then please move to the next one.

Task 1: Set up your profile
(*You can enter false or real details here*)
Task 2: Walk through the introduction and select quick tutorial that teach you to open the menu
Task 3: Read the third notification at Home page
Task 4: Find Forum at the menu tab
Task 5: Explore *Nurskill 1.0* social network platform (My Activity)

a) Comment 'OK' at the most recent post
b) Create a new post and share.
c) Search a friend named 'Azmir', follow him, and view his profile.

Task 6: **Learn** about a procedure:

a) Learn about temperature taking procedure (Subject 1, Year 1 Semester 2)
b) Watch the video and its checklist.
c) Create a note for yourself to read the thermometer at eye level.

Task 7: **Practice** and being assessed in a procedure:

a) Send a request to practice temperature taking procedure (Subject 1, Year 1 Semester 2)
b) Notify the instructor that you are ready to perform the procedure, and finish the procedure.
c) Create a new reflection note for yourself to document the temperature result.

Task 8: Find and view feedback report from the instructor dated 29/1/2020 10:02 AM
Task 9: Send message to SN Ayu and say 'Thank you' to her.

Task 10: Appointment

a) View list of appointments for today.
b) Create a new appointment on 9th February 2020 at 10:00 AM for Procedure 2, Subject 1, Year 2 Semester 1
c) Create a reminder for this appointment on 8th February 2020.

Task 11: Forum

a) Reply to the comment in the first post.
b) Create a new forum post entitled 'Discussion on medication for febrile patient'

Task 12: Identify your app usage by finding total screen time for today.
Task 13: Identify the progress of your procedures completion progress for Year 2 Semester 1
Task 14: Create a new report to report on an app problem.

SECTION C: SYSTEM USABILITY SCALE

Instructions

Please check the box that reflects your immediate response to each statement. Make sure you respond to every statement based on this scale:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	**2**	**3**	**4**	**5**

No	Item					
1	I think I would like to use *Nurskill 1.0* app frequently.	1	2	3	4	5
2	I found *Nurskill 1.0* app unnecessarily complex.	1	2	3	4	5
3	I thought *Nurskill 1.0* app was easy to use.	1	2	3	4	5
4	I think I would need the support of a technical person to be able to use this *Nurskill 1.0* app.	1	2	3	4	5
5	I found various functions in this *Nurskill 1.0* app were well integrated.	1	2	3	4	5
6	I thought there were too much inconsistencies in this *Nurskill 1.0* app.	1	2	3	4	5
7	I would imagine that most people would learn to use this *Nurskill 1.0* app very quickly.	1	2	3	4	5
8	I found *Nurskill 1.0* very cumbersome to use.	1	2	3	4	5
9	I felt very confident using *Nurskill 1.0* app.	1	2	3	4	5
10	I need to learn a lot of things before I could use this *Nurskill 1.0* app.	1	2	3	4	5

SECTION D: USER PERCEPTIONS ON THE FEATURES OF *NURSKILL 1.0* (POST-TEST INTERVIEW)

Instructions

This is a post-test interview session. You will be asked about your perceptions towards each features of *Nurskill 1.0* at supporting your self-directed clinical skills learning practice.

1. What do you think of about feature X?
2. Would it be useful or not useful? Why so you think it is useful or not useful?
3. What do you like the most about this app?
4. What do you like least about this app?
5. How do you think this app could be improved to support clinical skill self-directed learning? What is your recommendation?

Appendix IX: The Approval of Research Proposal by Kulliyyah of Nursing Postgraduate and Research Committee

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملايسيا
(Company No. 101067-P)

KULLIYYAH OF NURSING

Our Reference : IIUM/313/DDPG&R/C/20/4/10
Date : 3rd January 2018
5 Rabiul Akhir 1439H

Airul Azizan Zainudin
G1629619
Postgraduate Student
Doctor of Philosophy in Nursing
Kulliyyah of Nursing IIUM

السلام عليكم ورحمة الله وبركاته

Dear Br. Airul Azizan,

APPROVAL OF RESEARCH PROPOSAL
- DOCTOR OF PHILOSOPHY IN NURSING

May this letter find you in the best of health with the grace of Allah SWT.

With reference to the above matter, kindly be informed that your research proposal title "Investigating Factors Influencing Acceptance and Designing Smartphone Application for Undergraduate Nursing Skill Self-Assessment" has been approved by the Kulliyyah of Nursing Postgraduate and Research Committee (KNPGRC) No. 8/2017 dated 27th December 2017.

Kindly proceed with necessary action accordingly.

Thank you والسلام

Yours sincerely,

ASST. PROF. DR. AZLINA DAUD
Deputy Dean (Postgraduate & Research)
Kulliyyah of Nursing

cc : Dean, Kulliyyah of Nursing

Postgraduate Coordinator
Kulliyyah of Nursing

Supervisor

Garden of Knowledge and Virtue
Kulliyyah of Nursing, International Islamic University Malaysia
P.O. Box 141, 25710 Kuantan, Pahang Darul Makmur.
Tel. No.: +609-570 7210 / 570 7202 Fax. No.: +609-513 3615
Email: nursing@iium.edu.my URL: http://www.iium.edu.my/nursing

Appendix X: The IIUM Research Ethics Committee (IREC)

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام أنتارابغسا ملايسيا
(Company No 101067-P)

RESEARCH MANAGEMENT CENTRE

Our Ref. : IIUM/504/14/11/2/ IREC 2018-175
Date : 15 May 2018

Asst. Prof. Dr. Hazwani Binti Mohd Mohadis (Principal Investigator)
Department of Information System
Kulliyyah of Information Communication Technology
International Islamic University Malaysia
P. O. Box 10
50728 Kuala Lumpur

Dear Asst. Prof. Dr.,

The IIUM Research Ethics Committee (IREC) has reviewed your study protocol as mentioned below:-

ID NO.	:	**IREC 2018-175**
TITLE	:	**Investigating Factors Influencing Acceptance and Designing Smartphone Application for Undergraduate Nursing Skill Self-Assessment**
REGISTRATION DATE	:	**5 Apr 2018**
CO-INVESTIGATOR	:	**Assoc. Prof. Dr. Mohd Zulfaezal Che Azemin, Asst. Prof. Dr. Norfadzilah Ahmad**
STUDENT	:	**Airul Azizan B Zainudin (Postgraduate Student)**
NAME OF SITE	:	**Kulliyyah of Nursing, IIUM**
SAMPLE SIZE	:	**Qualitative Phase: 16, Quantitaive Phase: 215**
ETHICAL EXPIRY DATE	:	**15 May 2019**

The IIUM Research Ethics Committee (IREC) operates in according to the Declaration of Helsinki, International Conference of Harmonization Good Clinical Practice Guidelines (ICH-GCP), Malaysia Good Clinical Practice Guidelines and Council for International Organizations of Medical Sciences (CIOMS) International Ethical Guidelines.

The following documents have been received and reviewed to the above study:-

1. Study Proposal/Protocol: Version 1, revision 00, dated 1 Nov 2017
2. Informed Consent Form (ICF):-
   i. Information Sheet – English: Version 1, revision 01, dated 15 May 2018
   ii. Consent Form – English: Version 1, revision 01, dated 15 May 2018
   iii. Information Sheet – Malay: Version 1, revision 01, dated 15 May 2018
   iv. Consent Form – Malay: Version 1, revision 01, dated 15 May 2018
3. Demographic Information, dated 20 Apr 2018
4. Approval Letter from Kulliyyah
5. Principal Investigator's CV

QUALITY SYSTEM
SIRIM
CERTIFIED TO MS ISO 9001:2008
Registration No. AR 3492

Garden of Knowledge and Virtue

Office Address: Research Management Centre, Level 1, Block 2, Office of The Campus Director, IIUM Kuantan Campus,
Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan Pahang.
Tel: +609 570 4220 / 4223 **Fax:** +609 571 6741 **E-mail:** rmcKuantan@iium.edu.my **Website:** www.iium.edu.my/research