

---

Nursing (graduate) Student Scholarship

Nursing (DNP, MSN and RN-MSN)

---

5-2020

## Mobile Technology in Undergraduate Nursing Education: An Evidence-Synthesizing Project

Jillian Sisson

Follow this and additional works at: [https://mosaic.messiah.edu/grnurse\\_st](https://mosaic.messiah.edu/grnurse_st)



Part of the [Medical Education Commons](#), and the [Nursing Commons](#)

Permanent URL: [https://mosaic.messiah.edu/grnurse\\_st/11](https://mosaic.messiah.edu/grnurse_st/11)

---

Sharpening Intellect | Deepening Christian Faith | Inspiring Action

Messiah University is a Christian university of the liberal and applied arts and sciences. Our mission is to educate men and women toward maturity of intellect, character and Christian faith in preparation for lives of service, leadership and reconciliation in church and society.

MOBILE TECHNOLOGY IN UNDERGRADUATE NURSING EDUCATION:  
AN EVIDENCE-SYNTHESIZING PROJECT

An Evidence-based Practice Capstone Project

Submitted to the Faculty of the

Graduate Program in Nursing

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Nursing

Jillian Sisson

Messiah College

May 2020

2020

Jillian Sisson

All rights reserved

Messiah College  
School of Graduate Studies  
Graduate Program in Nursing

We hereby approve the Capstone Project of

Jillian Sisson

Candidate for the degree of Master of Science in Nursing

\_\_\_\_\_5/9/2020\_\_\_\_\_

Louann B. Zinsmeister, PhD, RN, CNE  
Professor of Nursing, Capstone Advisor

\_\_\_\_\_5/9/2020\_\_\_\_\_

Louann B. Zinsmeister, PhD, RN, CNE  
Professor of Nursing, Coordinator of MSN and CAGS

\_\_\_\_\_

\_\_\_\_\_  
Kim Fenstermacher, PhD, CRNP  
Associate Professor of Nursing, Chief Nursing  
Administrator, Assistant Dean of Nursing

Title of Capstone Project: Mobile Technology in Undergraduate Nursing Education: An  
Evidence-Synthesizing Project

Author: Jillian Sisson

Capstone Advisor: Dr. Louann Zinsmeister

Capstone Approvers: Dr. Louann Zinsmeister  
Dr. Kim Fenstermacher

Abstract

**Background:** Undergraduate nursing students are faced with entering a complex healthcare environment with increasing acuity in which they must perform significant information recall in order to provide safe and quality patient care. Students are also tasked with the translation of nursing theory into ever-changing practice. The purpose of this capstone project was to review published studies to discover what is known about the accessibility of educational content on mobile technology in undergraduate nursing education.

**Methods:** A systematic literature search was conducted using Medline, CINAHL, and the Cochrane Library databases. Articles were chosen for inclusion in the project if they were peer-reviewed, available in full text, published after 2014, and written in the English language. Seven articles were chosen after review.

**Results:** The majority of nursing students already own smartphones and are open to using educational apps. Mobile technology use positively impacted nursing skills performance, confidence levels, class satisfaction, and learning motivation. Accessibility of POC information and evidence-based guidelines was perceived by nursing students to increase quality and safety of patient care.

**Implications:** Undergraduate nursing programs should continue to or begin to use mobile technology with implementation of specific mobile device activities. Further research topics should include randomized controlled trials focused on achievement of curricular outcomes, valid and reliable tools to measure effectiveness, and ways to train and motivate faculty.

*Key words:* mobile technology, mobile devices, cell phones, smartphones, tablets, nursing education

## DEDICATION

I would like to dedicate this capstone project to the Messiah College MSN Nurse Educator cohort of 2020. My classmates provided invaluable writing advice, emotional support, and uplifting encouragement that contributed to the final completion of this project.

## ACKNOWLEDGEMENTS

This capstone project would not have been possible without the mentorship and scholarly advice of my capstone advisor, Dr. Louann Zinsmeister. Dr. Zinsmeister's expertise and input were instrumental in the formation and development of my entire project.



## TABLE OF CONTENTS

		Page
ABSTRACT	.....	iv
CHAPTER I	Introduction.....	1
	Statement of Problem.....	2
	Background and Need.....	2
	Purpose Statement.....	3
	Evidence-based Practice Question.....	3
	Significance to Nursing Education.....	4
	Definition of Terms.....	5
	Chapter Summary.....	5
CHAPTER II	Methods.....	7
	Data Collection of Evidence.....	7
	Evidence-based Practice Model.....	9
	Critical Appraisal of Evidence.....	9
	Chapter Summary.....	10
CHAPTER III	Literature Review and Analysis.....	11
	Active Learning and Student Engagement.....	12
	Translation of Theory into Practice.....	19
	Chapter Summary.....	26
CHAPTER IV	Results and Synthesis.....	27
	Results.....	27
	Synthesis of Results.....	28
	Chapter Summary.....	29
CHAPTER V	Discussion and Conclusion.....	30
	Discussion of Findings.....	30
	Implications of Findings.....	31
	Limitations for Consideration.....	32
	Identified Gaps in Findings.....	32
	Chapter Summary.....	33
	Project Summary.....	33
REFERENCES	.....	34
APPENDICES	.....	37

LIST OF TABLES

Table 1. [Overall quality rating for each level of evidence]..... 28

LIST OF FIGURES

Figure 1. [Flow diagram of the process of article selection for review]..... 8

## APPENDICES

Appendix A [Evidence Summary Matrix].....	37
Appendix B [Synthesis of Levels of Evidence and Quality Table].....	45

## **CHAPTER I**

### **INTRODUCTION**

Advancing technology in all of its various forms is becoming more commonplace in today's society, including in education. While current education methods may be slow to change, research (Herold, 2016; West, 2015) has shown that technology and mobile devices allow for beneficial individualization of educational content for the various learning styles of students. Millennials, commonly identified as those born between 1981 and 1996, are accustomed to personalized content and desire to be more actively engaged in class (Gierdowski, 2019; Pew Research Center, 2019; West, 2015). According to a survey of 53,475 undergraduate students, students report wanting their professors to integrate technology into learning (Gierdowski, 2019). Additionally, the percentage of undergraduate students who believe that smartphones are critical to academic success doubled between 2011 and 2012 (Gierdowski, 2019). According to Pew Research Center's (2019) data, 96% of Americans own a cellphone of some kind, and 81% of Americans have a smartphone. This data represents a drastic increase in smartphone use from the 35% of Americans who owned a smartphone in 2011. Since mobile devices are already commonly used in daily life, they have the potential to be valuable learning tools.

Nursing education has already incorporated technological advancements such as high-fidelity simulations, audio PowerPoints, and online learning. The National League for Nursing (2015) has pushed for further revision of undergraduate nursing education to include available health information technologies as a way to increase the safety and quality of patient care. The development of technology and integration into education has helped to facilitate the switch from teacher-centered lectures to active student-centered learning (Keating & DeBoor, 2018). Active

learning within nursing education is specifically enhanced by mobile technology (Kim & Suh, 2018; Mackay, Anderson, & Harding, 2017; O'Connor & Andrew, 2018).

### **Statement of the Problem**

Nursing students are caring for patients with increasing acuity and complex medical needs. As a result, students have to perform significant information recall at the bedside in order to understand their patient's diagnosis and plan of care. Textbook and drug handbooks are not easily transported to the clinical setting, but students need to access up-to-date medical information and clinical practice guidelines so that they are able to provide safe and quality care to their patients (George & DeCristofaro, 2016; Raman, 2015). In addition, undergraduate nursing content is continually expanding, and nursing faculty are struggling with the issue of content saturation. Including information on every diagnosis that students may encounter is not feasible, therefore, nursing faculty may choose to focus on innovative teaching methods that assist students in active learning and translation of theory into the challenging practice of nursing in order to be safe practitioners (Kim & Suh, 2018; O'Connor & Andrews, 2018).

### **Background and Need**

As healthcare is continually changing and expanding, nursing education curriculum is challenged to keep pace in order to ensure that the graduates of nursing programs are prepared for practice. Safety and informatics are two of the key competencies of the Quality and Safety Education for Nurses (QSEN) project which is aimed at preparing future nurses for healthcare (QSEN Institute, 2019). Each competency is associated with proposed knowledge, skills, and attitudes (KSAs) for undergraduate nursing students to attain. Acknowledgement of the limitations of one's memory combined with the discussion and implementation of strategies to support information recall and lessen dependence on memory reflect important KSAs for the

competency of safety (QSEN Institute, 2019). Technological resources, particularly mobile technology, can assist nursing students with accessing point-of-care (POC) information as a strategy to reduce errors and increase safety (Day-Black & Merrill, 2015). The informatics competency's KSAs align with the goal of using technology to improve quality and safety of patient care (QSEN Institute, 2019). While research (George & DeCristofaro, 2016) has been conducted on the use of technology within nursing education, mobile technology is rapidly advancing, and research must remain up-to-date in order to be applicable to current practices. A lack of quantitative data on the use of mobile technology in nursing education exists as well as a lack of research on how mobile technology should be integrated into learning and course content (Kim & Suh, 2018).

### **Purpose of the Study**

The purpose of this evidence-synthesizing project was to review published studies to discover what is known about the accessibility of educational content on mobile technology in undergraduate nursing education. Kim and Suh (2018) and Mackay et al. (2017) demonstrated the need for the revision of nursing curriculum to reflect evidence-based nursing education techniques and include current technology. Relevant literature was reviewed to examine how the use of smartphones and tablets affects the safety and quality of nursing students' patient care. The findings of this literature review were used to determine whether or not a practice change of integrating mobile technology into undergraduate nursing education is indicated.

### **Evidence-based Practice Question**

In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology?

## **Significance to Nursing Education**

Mobile technology use pervades every aspect of life whether personally, professionally, or academically (Raman, 2015). Integration of mobile technology into undergraduate nursing education has the potential to improve learning outcomes by catering to millennials' preferred learning styles (Alexander et al., 2017). Accessing POC information such as clinical care guidelines or evidence-based practice protocols on mobile devices can improve students' skill development and confidence levels (Mackay et al., 2017; Wittmann-Price, Godshall, & Wilson, 2017). The use of mobile technology in the classroom, clinical area, or simulation lab also increases student engagement and enables access to large amounts of information at the time it's needed, thus decreasing the burden of content saturation in the classroom (Gallegos, Gehrke, & Nakashima, 2019).

According to Warburton, Trish, and Barry (2016), student-centered learning and increased participation are key aspects of constructivist learning theories (as cited in Keating & DeBoor, 2018). Constructivism emphasizes the need for students to be actively engaged and in control of their education while teachers take on the roles of coaches and facilitators. By participating in active learning, undergraduate nursing students are able to critically think by combining prior knowledge with information from current situations (Mackay et al., 2017). Nursing faculty can prepare future practitioners by teaching critical thinking skills and informatics and encouraging students to apply these fundamental concepts to a variety of situations in order to be prepared for the ever-changing healthcare environment. Quality and Safety Education for Nurses (QSEN) competencies, specifically safety and informatics, are commonly diffused throughout an undergraduate nursing curriculum. However, Bryer and Peterson-Graziose (2014) reported that faculty more readily incorporate safety concepts and are



less likely to integrate informatics' KSAs. Therefore, integration of informatics is an area for improvement in undergraduate nursing education that can potentially be addressed by synthesizing relevant literature to determine evidence-based teaching practices.

### **Definition of Terms**

**Active learning.** Active learning is student-centered learning in which the student remains actively engaged and takes responsibility for their own learning while the teacher acts as a facilitator (Keating & DeBoor, 2018).

**Clinical education.** Clinical education refers to undergraduate nursing education that occurs outside of the classroom within a hospital, community, or simulation lab with a focus on the application of theoretical knowledge, skills performance, patient care, and therapeutic communication.

**Critical thinking.** Critical thinking is a process in which one rationally examines current information while integrating past experiences in order to make judgments about a situation (Wittmann-Price et al., 2017).

**Mobile technology.** Mobile technology refers to small portable devices such as smartphones or tablets that enable wireless communication and Internet connectivity.

**Smartphones.** Smartphones are mobile phone that perform many of the functions of a computer, including Internet connectivity and the ability to download applications.

**Tablets.** Tablets are wireless touch screen computers that are typically larger than a smartphone but perform the same functions.

### **Summary**

Technological innovations are continually evolving, and mobile devices such as smartphones or tablets have become commonplace in everyday life. Millennials comprise the

majority of undergraduate students and are generally technologically literate, preferring active learning strategies in the classroom as opposed to traditional approaches (Gierdowski, 2019). Active learning strategies supported by integration of mobile technology enhance critical thinking and better prepare nursing students to attain safety and informatics learning outcomes (Alexander et al., 2017). It is vital for graduate nurses to achieve the knowledge, skills, and attitudes associated with these two competencies in order to be competent and safe practitioners (QSEN Institute, 2019).

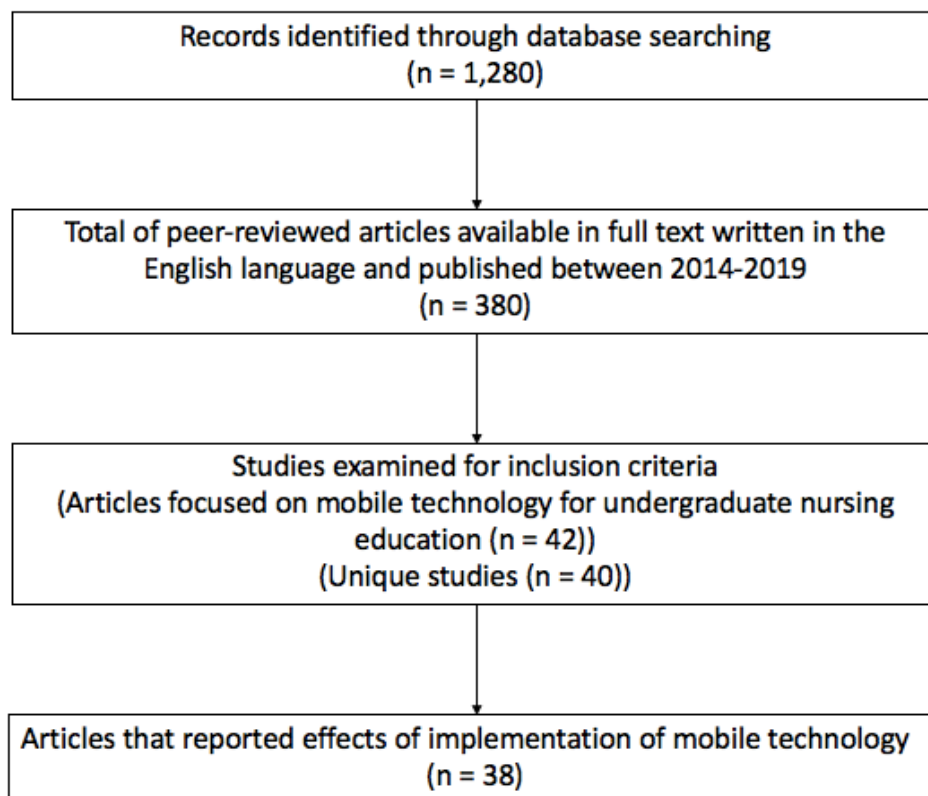
## CHAPTER II

### METHODS

Undergraduate nursing education curricular outcomes include competencies described in the Quality and Safety Education in Nursing (QSEN) Project (Alexander et al., 2017). Graduates of nursing programs are expected to be competent and able to provide quality and safe patient care. In order to effectively prepare nursing students to meet these requirements, nursing faculty members need to regularly update their curriculum to include evidence-based teaching practices focused on active learning and the development of critical thinking (Mackay et al., 2017). Adult learners have grown up in a technological world in which they are likely to have become accustomed to using smartphones and other mobile devices. Mobile technology used as an active learning strategy allows individualization of education and increased engagement (Kim & Suh, 2018). Therefore, it is important to ask the question: in undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology? An evidence-synthesizing project was conducted in order to review published studies to determine whether or not a practice change is recommended.

#### **Data Collection of Evidence**

A systematic database search was used to identify articles relating to mobile technology and undergraduate nursing education. The databases searched included Medline, CINAHL, and the Cochrane Library. Each database was searched using the key words “mobile technology” OR “mobile devices” OR “cell phones” OR “smartphones” OR “tablets” combined with “nursing education”. After using these search terms, 1,280 articles were identified (See Figure 1). The articles were then reviewed according to selective inclusion and exclusion criteria.



*Figure 1.* Flow diagram of the process of article selection for review

After these criteria were applied, the remaining thirty-eight studies were carefully reviewed, and seven articles were chosen for use in this project.

**Inclusion criteria.** Studies were included if they were peer-reviewed and available in full text. The acceptable dates of publication were within the last five years, between 2014 and 2019. Each article was reviewed to ensure that the focus was on specifically on mobile technology, including devices such as smartphones, tablets, or personal digital assistants (PDAs). Population of interest was nursing students enrolled in an undergraduate program.

**Exclusion criteria.** Studies were excluded if they were not written in the English language or focused on another medical specialty outside of nursing. Other exclusion criteria were a focus on graduate nursing programs, continuing education for professional nurses, or

patient education. Studies were also excluded if they focused solely on implementation techniques of mobile technology into nursing curriculum rather than on effects of implementation.

### **Evidence-Based Practice Model**

The evidence-based practice (EBP) model used for determining the level and quality of evidence for this evidence-synthesizing project was the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model. The JHNEBP model follows a systematic approach for appraising and synthesizing evidence in order to conclude whether a change in practice is indicated (Dang & Dearholt, 2018). Both research and non-research evidence is classified into five levels, with level I representing the highest level of evidence and therefore most likely to demonstrate best practice. The first three levels consist of research evidence while levels IV and V are comprised of non-research evidence (Dang & Dearholt, 2018). Level I evidence includes randomized controlled trials (RCTs) or systematic reviews of RCTs, level II includes quasi-experimental studies, and level III includes non-experimental, mixed-methods, or qualitative studies (Dang & Dearholt, 2018). Level IV evidence includes clinical practice guidelines and consensus or position statements while level V, the lowest level of evidence, includes literature reviews, quality improvement reports, expert opinions, clinician or consumer experiences, community standards, case reports, or financial evaluations (Dang & Dearholt, 2018). Literature from all levels of evidence were included for consideration in this study.

### **Critical Appraisal of Evidence**

Once the level of evidence of each piece of literature was determined, each one was critically appraised to determine the quality. The JHNEBP model has two tools to use for this step of the EBP process, the Research and Non-Research Evidence Appraisal Tools (Dang &

Dearholt, 2018). Each piece of evidence was classified as quality A, B, or C, and any piece of evidence with a quality rating of C was excluded from use in this project. Quality rating for research evidence was based on the consistency of results and recommendations, sufficiency of sample size, definitiveness of conclusions, comprehensiveness of the literature review, amount of control. Validity, reliability, and precision of the research were all considered when determining the quality level (Dang & Dearholt, 2018). Level IV pieces of evidence needed to be sponsored by an official organization, include a well-defined literature search strategy, present consistent results, evaluate the included studies, and have been revised within the last five years. Lastly, level V evidence also required consistent results and recommendations in order to be deemed high quality, in addition to requiring a scientific rationale or argument (Dang & Dearholt, 2018).

### **Summary**

In order to accomplish the purpose of this study to discover what is known about the use of mobile technology in undergraduate nursing education, a database search was conducted to find pieces of evidence that would help answer the predetermined evidence-based practice question. The initial search yielded a large amount of articles, so inclusion and exclusion criteria were applied to filter the results. The chosen articles were reviewed further and leveled according to the JHNEBP model (Dang & Dearholt, 2018). Each piece of evidence was critically appraised, and the resulting quality ratings were used to inform the strength of the findings of this evidence-synthesizing project.

### **CHAPTER III**

#### **LITERATURE REVIEW AND ANALYSIS**

The rapid evolution of mobile technology combined with undergraduate nursing students' preferences for individualized and active learning calls for revision of undergraduate nursing curricula (Gierdowski, 2019; NLN, 2015). Active learning strategies enhanced by integration of mobile technology has the potential to increase student engagement, assist in the translation of theory into practice, strengthen critical thinking skills, and foster attainment of core competencies such as safety and informatics (Alexander et al., 2017; Keating & DeBoor, 2018; Kim & Suh, 2018). The purpose of this capstone project was to synthesize available evidence in order to conclude evidence-based teaching practices related to the integration of mobile technology and determine whether a practice change is indicated. Thus, the EBP question was: In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology? Seven articles were identified through a database search and chosen for inclusion in this project.

All seven pieces of research and non-research evidence included addressed the integration of mobile devices into nursing education. However, each author or group of authors applied a different focus to their article. Lee et al. (2016), Gallegos et al. (2019), and Mackay et al. (2017) studied learning motivation, perceptions of engagement and learning, and clinical lecturers' experiences with mobile technology, respectively. O'Connor and Andrews (2018), George et al. (2017), Kim and Suh (2018), and Raman (2015) addressed the impact that mobile devices have on the connection between nursing theory and practice. The articles were divided into two themes for critical appraisal: active learning and student engagement as well as translation of theory into practice.

## **Active Learning and Student Engagement**

In their study on the effects of a mobile-based video clip on identified learning outcomes in undergraduate nursing students, Lee et al. (2016) used a randomized controlled trial with a pretest and posttest design. A convenience sample of 71 second-year undergraduate nursing students enrolled in a Fundamentals of Nursing II course at a university in Seoul, South Korea were randomly assigned to the intervention and control groups. A power analysis was conducted for this sample size and was greater than 80%. All participants completed a pretest questionnaire a week prior to attending a 90-minute lecture on urinary catheterization, during which all students watched the video clip of catheterization of a female simulator according to the skills checklist developed by the researchers. Throughout the following week, the intervention group was able to access the video clip on their mobile devices and were also reminded via text to watch it. The control group had no access to the video clip after the initial viewing. After seven days had passed, all students practiced simulated female catheterization and completed a posttest questionnaire on learning motivation, confidence levels, and class satisfaction. The students were also administered a written exam on urinary catheterization.

Three different instruments were used to collect the data for this study. Learning motivation was measured by the Instructional Materials Motivational Survey (IMMS) which was adapted for this study and translated to Korean (Lee et al., 2016). The IMMS has 36 Likert scale questions that measures attention, relevance, confidence, and satisfaction (ARCS). Instrument reliability was demonstrated with a Cronbach's alpha of .72 to .79. Validity was not addressed in the study, but the IMMS has been used multiple times in other research studies to measure learning motivation. According to Lee et al. (2016), fundamental nursing competency was defined by overall knowledge, skills, and confidence levels, and these three were measured by a



15-question quiz, direct observation of urinary catheterization performance, and a self-reported scale from 0-10, respectively. No validity or reliability was discussed for the quiz; however, the skills performance was evaluated against a 15-item checklist that was developed in line with fundamental nursing textbooks. Lastly, class satisfaction was measured on a self-reported scale of 0-10, with a higher number representing a higher level of satisfaction (Lee et al., 2016). SPSS was used to analyze the resulting quantitative data, using independent t tests and Pearson correlation coefficients.

The intervention group had statistically significant higher results for learning motivation, confidence, and class satisfaction than the control group ( $t = 3.060, p = .003$ ;  $t = 3.031, p = .003$ ;  $t = 2.489, p = .015$ ) (Lee et al., 2016). Additionally, these three variables were all positively correlated with one another. There was no statistically significant difference between the intervention group and control group for knowledge and skills performance, however, the intervention group scored higher overall (Lee et al., 2016). The authors also used additional qualitative information from the intervention group to determine that students who watched the video clip more reported higher confidence and class satisfaction levels. The video clip's perceived usefulness was positively correlated with learning motivation, confidence, and class satisfaction with Pearson correlation coefficients all less than .001 (Lee et al., 2016). The findings of this study demonstrate that a mobile-based video clip can improve learning outcomes by increasing undergraduate nursing students' learning motivation, confidence in performing skills, and overall class satisfaction.

While this study was level I evidence, it only received a B- quality rating due to threats to both internal and external validity. The randomization of study participants increased internal validity, and Lee et al. (2016) tested for homogeneity of participant characteristics and learning

motivation on the pretest in order to assess for selection bias. However, all of the students were enrolled in the same program and therefore were not blinded to the intervention although the intervention group was told not to show the video to the control group (Lee et al., 2016). This lack of blinding is a limitation of the study and a threat to internal validity. The lack of established reliability and validity for both the nursing competency quiz and class satisfaction scale is also a threat to internal validity. Threats to external validity include limited generalizability due to the study examining only one particular skill. The study was also conducted at a single university in South Korea which may limit generalizing the study to undergraduate nursing students in other universities or in other countries.

While Lee et al. (2016) focused on learning motivation and engagement related to clinical nursing skills, Gallegos et al. (2019) used a convergent parallel mixed-methods descriptive design to explore student engagement levels and perceptions of using a mobile device in a theoretical, nonclinical course. Using a convenience sampling method, the researchers recruited fifty-nine undergraduate junior level nursing students who were enrolled in a nursing research course at a public university. No power analysis was conducted, and data saturation was not discussed. Fifty-eight students completed the online survey, and ten completed the qualitative interviews. Each participant was given an iPad with an included application called Nearpod (Gallegos et al., 2019). Students were required to complete all readings and assignments prior to coming to class, and each class followed the same format of lecture, discussion, and groupwork with Nearpod use integrated throughout. Instructors delivered interactive lectures including videos, quizzes, and poll questions using Nearpod as the platform accessible by all students.

The researchers developed their own study survey based off of previously established instruments from other research articles (Gallegos et al., 2019). The instrument to measure

perceptions of engagement (POE) and learning (POL) included nine questions that used a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree). There was not established reliability or validity for the POE and POL instrument in this research article or in the two articles that Gallegos et al. (2019) referenced. Self-efficacy was measured by the Nursing Research Self-Efficacy Scale (NURSES), a 22-item, 4-point Likert scale (1 = no confidence to 4 = high confidence) with Cronbach's alpha coefficients above .9 for all subscales. Attitudes, knowledge, and skills in EBP was measured by the Evidence-Based Practice Competence Questionnaire (EBP-COQ), a 25-item, 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) with a Cronbach alpha of .89 (Gallegos et al., 2019). In order to collect qualitative data, an interview guide was also developed to focus on learning using Nearpod.

Quantitative data was analyzed using SPSS and reported using mean and standard deviation (SD). Student reported increased engagement in class (mean, 3.02), motivation to learn class material (mean, 2.84), and attention span (mean, 2.9). Students disagreed that iPad caused distraction in class (mean, 1.97). Overall, using the mobile devices was reported to enhance learning (mean, 3.31), increase confidence (mean, 2.95) and connectivity of ideas (mean, 3.02), and aid in application of content (mean, 3.10) and development of skills (mean, 3.24) (Gallegos et al., 2019). The NURSES was not specific to iPad use but revealed that students feel confident using electronic databases (mean, 3.22) and internet search engines (mean, 3.19) to access research articles. Students also reported using references of research articles as sources for further resources (mean, 3.29). Lastly, on the EBP-COQ, the majority of students strongly agreed that EBP can improve patient outcomes (mean, 4.67) (Gallegos et al., 2019). While students reported they did not enjoy reading research articles (mean, 2.6), they did agree that they would like to see EBP used in practice (mean, 4.53).

Gallegos et al. (2019) analyzed qualitative data by content analysis and eventually coded into two final themes after repeated review, first independently by each researcher and then as a collective team. The two themes were instructor/course practices facilitating learning engagement and learner practices strengthening relevance and ownership. Students expressed that immediate instructor feedback during group assignments, the active learning that Nearpod promoted, and having larger assignments broken down into baby steps were all beneficial for learning and engagement. Students also offered insight that they were unfamiliar with EBP and disliked research at the beginning of the course, but they gained appreciation and understanding of EBP and the research process after progressing through the class (Gallegos et al., 2019).

This mixed-methods study was a level III and received a B quality rating. Gallegos et al. (2019) addressed gaps in nursing literature related to pedagogical approaches that incorporate mobile technology. The implementation of the course and the use of the Nearpod technology was described clearly thus verifying auditability. Credibility of the qualitative results was enhanced by the use of multiple researchers reviewing the interviews and identifying codes but was reduced by the lack of peer debriefing. The absence of demonstrated validity and reliability for the POE and POL tool was a threat to internal validity, particularly because this was the instrument that most directly addressed the purpose of the study. The convenience sampling, access to free iPads, and specific student population were all threats to external validity as they limit generalizability.

Lee et al. (2016) and Gallegos et al. (2019) focused on nursing students in their studies measuring engagement and class satisfaction, but Mackay et al. (2017) studied clinical lecturers' experiences with using mobile devices in undergraduate nursing education. Mackay et al. (2017) used a qualitative descriptive design and conducted the study over eight months in three phases:

formation, implementation, and analysis. The researchers detailed their decision process during the formation phase, including reasons for choosing clinical practice as the research setting and iPads as the mobile device. Information was also obtained from a literature review about helpful applications. During the eight-month implementation phase, six clinical lecturers from within one nursing department were given iPads to use in their clinical teaching, and information technology (IT) support was provided to lecturers as needed. The clinical lecturers maintained ongoing journals throughout the implementation phase and also met with each other to learn more about the applications and iPad use.

During the analysis phase, the journals were collected, and the lecturers were invited to be a part of a focus group interview (Mackay et al., 2017). One researcher conducted the focus group in a semi-structured interview style while another researcher listened to a recording of the discussion and took notes about key points. The researchers conducted peer debriefing by presenting derived key points to the clinical lecturers for corroboration and to allow for any additional information. Thematic analysis of the journals and interview was first performed individually by the researchers followed by collective agreement on final themes.

Six themes resulted from the thematic analysis (Mackay et al., 2017). Factors that enabled iPad use in the clinical setting included resources and technology as well as management and technology support. The clinical lecturers noted that easy access to multiple resources on the iPad was beneficial for their students. Lecturers also expressed that support from IT and management was essential for project success. Factors that hindered iPad use included clinical staff engagement and lecturer experience with technology. Inexperience with the iPad and application use was noted to be a barrier particularly at the beginning of the study, and some clinical lecturers had less time in clinical than others to practice with and fully use the iPad

(Mackay et al., 2017). Negative opinions about educational iPad use in the hospital was expressed by clinical staff and was a constraining factor. Lastly, connectivity and student engagement were identified to be both enabling and constraining factors. When the wireless connection worked well, the clinical lecturers appreciated the ease of access to emails and the learning platform while at clinical. Lecturers also remarked that the iPads allowed them to provide immediate feedback to a question and individualized point-of-care education to each student. However, some lecturers were concerned that iPad use may interfere with relationship building with students.

Mackay et al.'s (2017) qualitative study is a level III and received an A- quality rating. Collecting data from both journals and focus groups is a form of triangulation that enhanced the credibility of the article. Individual analysis by the researchers helped to overcome intrinsic bias, and the use of peer debriefing ensured accuracy of their conclusions. Participant quotes were included in the article to verify themes as well. Mackay et al. (2017) clearly described their research design and analysis of data, however auditability was lacking for the implementation phase as they did not outline how clinical lecturers used the iPad. Results from this study were not transferable due to the lack of data saturation and absence of information regarding the type of clinical settings where the study was conducted. Nevertheless, Mackay et al. (2017) provided information that can serve as a guide for future researchers.

### **Translation of Theory into Practice**

In their descriptive cross-sectional study on smartphones and applications (apps), O'Connor and Andrews (2018) examined undergraduate nursing students' perspectives on the use of mobile devices in clinical education. The authors were particularly focused on how to help students translate nursing theory into practice using mobile technology in order to

ultimately improve student learning outcomes. O'Connor and Andrews (2018) surveyed a convenience sample of 200 undergraduate nursing students enrolled in a four-year BSN program in order to obtain both quantitative and qualitative results. The researchers did not include information about a power analysis or data saturation to ensure an adequate sample size.

The authors had previously conducted a review of literature in 2015 on the use of educational apps in nursing education and developed a 25-item questionnaire based on this information (O'Connor & Andrews, 2018). The six question sections covered a variety of topics such as basic demographics, current use of mobile devices, educational resources that are available in the clinical setting, what educational content students want, what may benefit or restrict mobile technology use, and how educators are contributing to use of mobile apps. O'Connor and Andrews (2018) had previously administered the questionnaire as a pilot project and edited the questions based on student feedback. For the purpose of this study, the researchers administered the one-time finalized questionnaire at the end of well-attended teaching sessions and received a response rate of 86%. Reliability and validity of the questionnaire was not discussed within the article (O'Connor & Andrews, 2018). While this is not necessary for qualitative studies, it is necessary for this research article because they obtained quantitative results.

Quantitative results were analyzed using frequencies and percentages to illustrate participant characteristics and mobile device use (O'Connor & Andrews, 2018). While the students reported a variety of types of mobile devices used, only five of the students did not own a smartphone. However, very few students used mobile applications in a clinical environment ( $n = 94, 47\%$ ). Students who used mobile apps for learning reported that their most used apps were a calculator ( $n = 69, 35\%$ ), drug reference guide ( $n = 53, 27\%$ ), and medical dictionary ( $n = 49,$

25%) (O'Connor & Andrews, 2018). Only an extremely small percentage of surveyed students were opposed to using mobile apps in a clinical setting (n = 3, 2%). Students reported they would like apps to include written information on key nursing skills (n = 131, 66%), diagrams (n = 109, 55%), and audio clips (n = 8, 45%).

Qualitative responses from the open-ended questions were analyzed by two separate researchers who read through student answers multiple times in order to develop two main themes each with multiple subthemes (O'Connor & Andrews, 2018). The main themes were mobile apps for learning and implementation of mobile apps. The surveyed students expressed that they would be interested in using mobile applications for educational purposes, agreeing that it would improve their knowledge, confidence, and decision-making skills. Students voiced that access to medication information would increase patient safety. Notably, several students emphasized the importance of keeping information easy to access and short (O'Connor & Andrews, 2018). Three primary barriers to implementation of mobile technology in the clinical setting that were discovered included negative attitudes of nursing staff and patient families, lack of technological skills, and lack of awareness of available apps. Students recommended educating nurses and patients about the use of mobile apps for learning.

This study was a level III due to its mixed methods design and received a B- quality rating for some significant limitations. The lack of established reliability and validity of the questionnaire is a large threat to internal validity. However confounding variables such as student demographics were addressed, and response bias was minimized because the two researchers did not teach the course the students were taking (O'Connor & Andrews, 2018). The vague inclusion and exclusion criteria as well as the one-time questionnaire at a single university limits generalizability and is a threat to external validity. When critically appraising the quality



of the qualitative aspects, the peer debriefing, triangulation of two researchers, and use of multiple methods increases the credibility of the article. O'Connor and Andrews (2018) included participant quotes which contributes to fittingness; however, data saturation was not included, thus decreasing transferability. Overall, while this research article did not receive a high-quality rating, it adds to the dearth of literature on the use of mobile devices in undergraduate education.

Similar to O'Connor and Andrews (2018), George et al. (2017) used a qualitative descriptive design to study undergraduate nursing student perceptions of ability, learning, and motivation when using mobile devices. George et al. (2017) recruited a convenience sample of first semester nursing students enrolled in a BSN program at a public university. In the first week of the course, students downloaded the required body mass index (BMI) calculator and electronic preventive service selector (ePSS) onto their personal smartphone. The following two weeks were spent using the apps to complete interactive case studies. Beginning in week four, the students completed three clinical hours in a community setting, using the apps to perform preventative screening and provide education for patients. After these hours were complete, a survey of six open-ended questions was administered. Seventy-one of the seventy-eight students completed surveys.

The survey questions focused on students' overall experience, acquired skills, factors that impacted performance in the clinical setting, patient responses to app use, opinion of smartphone use in nursing practice, and likelihood of continuing to use smartphone apps in future practice (George et al., 2017). Survey responses were analyzed by two researchers and coded into seven final themes. Students reported that they enhanced their communication and patient interaction skills, grew in their cultural competence, improved their patient education skills, translated theory into practice, and learned more about the nursing role. Over 90% of the surveyed students

had a positive experience with using the smartphone apps and voiced a desire to continue using them. Interestingly, students also reported that patients and staff were accepting of students' smartphone use in the clinical setting.

This qualitative study by George et al. (2017) is level III evidence and received a B-quality rating due to multiple limitations. Credibility was significantly decreased by the lack of peer debriefing and individual content analysis by the researchers. There also was a risk for bias as one researcher was an instructor in the course students were enrolled in. Positively, students were free to deny participation in the study without risk for retribution. Student quotes were also included to validate thematic conclusions. Auditability was established by a clear description of the study design and inclusion of the survey questions. The apps used in the study are free and available for both iPhones and Androids. While the results demonstrate the usefulness of mobile device apps in undergraduate clinical education, they would not be transferable to other groups of students as this study lacked data saturation and a diverse sample of students.

Kim and Suh (2018) were also concerned about undergraduate nursing students' ability to translate theory into practice and be prepared for practice after graduation. The authors maintained that clinical practice is crucial and should be focused on student centered learning (Kim & Suh, 2018). By utilizing a randomized control trial pretest-posttest method, Kim and Suh (2018) investigated the effects of an interactive clinical nursing skills (ICNS) mobile application on undergraduate nursing students' knowledge, self-efficacy, and skills performance. A power analysis of 80% was established, and sixty-six senior nursing students who were enrolled in a nursing school in South Korea completed the study. The application was developed for the study with 3-D nursing simulation education in mind and integrated with a theoretical framework that is similar to social learning theory. The ICNS app included four interactive

modules that were enhanced by videos, 3-D images, subtitles, pop-up messages, and quizzes. During the week of intervention, the thirty-four students in the experimental group utilized the ICNS application while the thirty-two students in the control group utilized a non-ICNS application with non-interactive nursing skill videos (Kim & Suh, 2018). The pretest was administered on the first day, and the posttest was administered after one week of application use.

Knowledge of clinical nursing skills was evaluated using a 23-item questionnaire. The questionnaire was based on a nursing textbook and had a content validity score of .93 (Kim & Suh, 2018). Because the questionnaire used true/false questions, a Kuder-Richardson Formula 20 (KR-20) was calculated as a .43. Self-efficacy was measured by a 5-item instrument using a 10-point Likert scale. While validity of this instrument was not discussed within the article, reliability was established with a Cronbach's alpha of .90 (Kim & Suh, 2018). Lastly, nursing skills performance was measured by Objective Structured Clinical Examinations (OSCE) and evaluated according to a checklist from a nursing textbook. The researchers pilot tested the OSCE scenarios and standardized the evaluation (Kim & Suh, 2018).

The results were analyzed using SPSS and descriptive statistics. Independent t-tests, chi-square tests, and Fisher's exact tests established homogeneity of study participants, and an independent t-test and paired t test assessed differences between the control group and experimental group (Kim & Suh, 2018). When assessing students' baseline knowledge, self-efficacy, and nursing skill performance in the pretest, there was no difference between the groups ( $t = 1.03, p = .309$ ;  $t = -1.17, p = .247$ ;  $t = 0.42, p = .677$ ). However, there were statistically significant differences between the two groups at the posttest for knowledge and nursing skill performance ( $t = 3.34, p = .001$ ;  $t = 7.05, p < .001$ ). While there was no statistically significant

difference between the control group and experimental group for self-efficacy at the posttest ( $t = 1.18, p = .243$ ), the increase in self-efficacy from pretest to posttest for the experimental group was statistically different than the increase from pretest to posttest for the control group ( $t = 2.46, p = .017$ ) (Kim & Suh, 2018). Thus, students who used the ICNS app were more likely to demonstrate increased knowledge, self-efficacy, and nursing skills performance than students who used the non-ICNS app.

Kim and Suh's (2018) research article was level I evidence and received an A- quality rating. Internal validity was strengthened by randomization of study participants, testing for homogeneity of participants, establishing interrater reliability for the skills performance evaluation, and blinding the students to which group they were in. The intervention was also limited to a one-week period in order to decrease the risk of diffusion effect. The KR-20 of 0.43 for the knowledge scale is a threat to internal validity, however, the researchers established high content validity in order to justify inclusion of the instrument (Kim & Suh, 2018). There were also threats to external validity as the study participants were all from the same nursing school in South Korea, thus limiting generalizability. A strength of this research article was Kim & Suh's (2018) explicit description of their study design, data collection methods, and data analysis.

Raman (2015) wanted to examine the overall benefits and concerns of using mobile technology and address strategies for effective use of mobile devices. Thus, a literature review was conducted to explore articles written about the use of mobile technology in nursing education. Key search terms such as "nursing students", "mobile technology", and "handheld devices" were used to search Academic Search Complete, CINAHL, and Medline databases. Exclusion criteria were applied to the resulting 317 articles, and a total of 17 articles were chosen

for inclusion. Raman (2015) included a large table listing the research question, sample, procedure, research design, data analysis, and key findings of each of the 17 articles.

The synthesized findings of the literature review were divided into three categories: benefits of mobile technology, concerns related to use, and strategies to overcome concerns (Raman, 2015). Benefits of mobile technology included easy accessibility evidence-based information improved student performance at clinical, improved student-teacher interactions, and enhanced simulation learning. Concerns related to mobile technology use included cost of mobile devices, lack of IT support, negative clinician opinions, and lack of faculty training and guidance on how to integrate mobile devices into the curriculum. Lastly, Raman (2015) addressed strategies from various articles aimed at mitigating a few of the concerns.

Recommendations included introducing mobile technology early on in the curriculum in order to familiarize both students and faculty and minimize need for IT support. Additional faculty training and “super-users” were advised to assist faculty members in using mobile technology.

Raman’s (2015) literature review was level V evidence and received an A quality rating. The majority of the articles included in the review were current and written within the past five years. The design, procedure, and key findings of each article in were presented in a neatly formatted table while the body of the paper contained a meaningful analysis of definitive conclusions. While recommendations for future practice and research were not thoroughly presented, they included a suggestion to develop specific assignments incorporating mobile technology and document whether the activity is successful (Raman, 2015).

## **Summary**

The seven pieces of evidence chosen for inclusion in this evidence-synthesizing project about the integration of mobile technology into undergraduate nursing education were carefully

reviewed and critically appraised. Type of evidence, sample characteristics, data collection and analysis procedures, and instrument reliability and validity were explained for each article if applicable. Quantitative statistics, qualitative findings, and non-research conclusions were presented. After presentation of article details, each piece of evidence was critically appraised according to the JHNEBP Research and Non-Research Evidence Appraisal Tools in order to determine a quality rating (Dang & Dearholt, 2018).

## CHAPTER IV

### RESULTS AND SYNTHESIS

Ensuring that new graduate nurses obtain the knowledge, skills and attitudes of the safety and informatics competencies of QSEN is vital for ensuring delivery of safe and quality patient care (QSEN Institute, 2019). The use of mobile technology in undergraduate nursing education has the potential to increase student engagement and critical thinking, leading to decreased and increased safety (Gallegos et al., 2019; Mackay et al., 2017). Thus, the EBP question was: In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology? A database search was conducted to find pieces of literature that might help to answer the EBP question and provide guidance about whether a practice change was indicated. After critical appraisal of the seven pieces of evidence chosen for inclusion in this project, the results were presented and synthesized for further review.

#### **Results**

As shown in Table 1, there were two level I articles, four level III articles, and one level V article. Representing the highest level of evidence according to the JHNEBP model, both level I articles were RCTs and thus held to a high standard during critical appraisal (Kim & Suh, 2018; Lee et al., 2016). The overall quality rating was a B because while both studies performed randomization and testing for homogeneity of sample groups, there were threats to internal validity as well as a lack of generalizability. Both the mixed-methods and qualitative studies were classified as level III evidence (Gallegos et al., 2019; George et al., 2017; Mackay et al., 2017; O'Connor & Andrews, 2018). Qualitative research quality indicators such as credibility, fittingness, and auditability were considered when assigning the overall B quality

Table 1

*Overall quality rating for each level of evidence*

Level of evidence	Number of articles	Overall quality rating
I	2	B
III	4	B
V	1	A

rating in addition to considering threats to internal and external validity for the mixed-methods studies. The only piece of non-research evidence was a level V literature review that received an A quality rating (Raman, 2015).

### **Synthesis of Results**

The level I articles demonstrated that interactive mobile apps and videos accessible on a mobile device significantly increase confidence and self-efficacy levels (Kim & Suh, 2018; Lee et al., 2016). Learning motivation, class satisfaction, knowledge, and nursing skills performance were also positively impacted by using an interactive mobile technology intervention. The level III articles established that the majority of undergraduate nursing students already own smartphones and are open to using educational apps in a clinical setting (George et al., 2017; O'Connor & Andrews, 2018). The use of mobile technology use in the classroom and clinical setting enabled immediate feedback from instructors and positively impacted students' confidence levels, enhanced learning and class satisfaction, and increased student engagement (Gallegos et al., 2019; Mackay et al., 2017). Smartphones and tablets helped to further translation of nursing theory into practice through accessibility of point-of-care information on downloaded apps. Students reported improved skills performance and a perceived increase of patient safety as a result of apps with nursing skills and medication information. Lastly, the level



V article included evidence that while there are concerns about using mobile technology, there are multiple benefits such as accessibility of evidence-based information, and strategies can be implemented to mitigate concerns (Raman, 2015).

### **Summary**

The seven pieces of evidence included in this evidence-synthesizing project were reviewed and critically appraised using JHNEBP model guidelines. The articles represented varying levels of evidence, but all received A or B quality ratings (See Appendices A and B). Study findings that were pertinent to answering the EBP question and accomplishing the purpose of the project were identified and synthesized into major overall themes. The synthesized results were then presented according to level of evidence.

## CHAPTER V

### DISCUSSION AND CONCLUSION

Multiple challenges face undergraduate nursing students as they approach graduation and enter the workforce. Increasing patient acuity and substantial amounts of information to commit to memory may become barriers to quality and safe patient care (George & DeCristofaro, 2016; Raman, 2015). Constructivist learning theories emphasize the importance of active learning as it fosters critical thinking and the ability to apply classroom learning to practice (Warburton et al., 2016, as cited in Keating & DeBoor, 2018). Mobile technology has the potential to enhance active learning and increase student engagement. However, there is a lack of quantitative data on mobile device use and minimal information on strategies for implementation (Kim & Suh, 2018). Thus, the purpose of this evidence-synthesizing project was to review published studies to discover what is known. The guiding EBP question was: “In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology?”

#### **Discussion of Findings**

Pew Research Center (2019) discovered that the majority of Americans already own a smartphone. This readily available form of technology combined with the NLN’s (2015) push for the revision of undergraduate nursing curriculum to include advancing technology calls for inclusion of smartphones in pedagogical strategies. The seven articles included in this project addressed the integration of mobile technology into undergraduate nursing education and how it impacts active learning and student engagement as well as the translation of theory into practice. Undergraduate students prefer individualized education, and research studies (Mackay et al., 2017; O’Connor & Andrews, 2018) showed that smartphones and tablets facilitate

personalization and the ability to cater to various learning styles in a clinical learning environment (West, 2015). Interactive applications and videos available on mobile devices increased learning motivation and class satisfaction (Kim & Suh, 2018; Lee et al., 2016). Mobile technology was also found to positively impact student engagement in the classroom by increasing students' attention spans and fostering critical thinking (Gallegos et al., 2018).

Students learn large amounts of information in the classroom, and the burden of recalling that information at the bedside can negatively impact the quality and safety of patient care. Accessing POC information and evidence-based guidelines on mobile devices in the clinical setting improves patient safety by assisting recollection, thus helping students develop important KSAs of the safety competency of QSEN (George et al., 2017; QSEN Institute, 2019; Raman, 2015). Using technology to improve the quality and safety of patient care, a KSA of the informatics competency, is accomplished by using mobile apps to access information about key nursing skills or to provide patient education (George et al., 2017; O'Connor & Andrews, 2018; QSEN Institute 2019).

### **Implications of Findings**

If undergraduate nursing programs currently use mobile technology as an active learning strategy, they should continue to do so. Otherwise, nursing programs should begin to integrate mobile technology into the classroom, clinical settings, and simulation laboratories. The pieces of evidence included in this project confirmed that the ability to access educational content on mobile devices positively influences curricular learning outcomes, thus answering the EBP question and supporting translation into practice.

## **Limitations**

Technology is constantly advancing, so a limitation of this evidence-synthesizing project was that the included pieces of evidence may not fully represent the current use of technology in nursing education. For example, Raman (2015) discussed the cost of smartphones as a concern, however, the majority of undergraduate students already own smartphones and free educational apps are available (George et al., 2017; O'Connor & Andrews, 2018). Some articles may have been overlooked that could have led to a more thorough literature review. Another limitation was that none of the quantitative research articles were generalizable, nor were any of the qualitative studies transferable due to a variety of reasons. Although many of the included pieces of evidence had limitations, articles with lower quality ratings were still included in this project as they contributed to the dearth of literature on this topic.

## **Gaps in Findings**

As mentioned in the introduction of this project, there were very few RCTs available about the use of mobile technology in nursing education. Additionally, statistical measurement of quality and safety outcomes was lacking. While many qualitative studies addressed students' perceived increase in knowledge and skills after mobile device use, there is a need for quantitative research studies to be conducted in order to evaluate the specific impact of mobile device use on curricular competencies. There also was little guidance in the literature about how to actually implement a mobile technology teaching strategy. Thus, nursing faculty should receive training about mobile technology use and information about specific applications to download for classroom, clinical, and simulation use (Mackay et al., 2017; Raman, 2015). Lastly, as negative opinions were noted as a barrier to mobile device use in the clinical setting, recommendations for nursing practice include education of clinicians and patients about the

usefulness of mobile devices for nursing students in order to decrease stigma (Mackay et al., 2017, O'Connor & Andrews, 2018; Raman, 2015).

### **Chapter Summary**

After critical appraisal of all seven pieces of evidence and synthesis of the results, the findings were discussed in relation to the two overarching themes presented in Chapter III. The concluding evidence derived from each article demonstrated that mobile technology used as an innovative teaching method helped to adequately prepare future nurses to provide safe and quality patient care. Sufficient evidence was provided to answer the EBP question and recommend a practice change to include mobile technology in undergraduate nursing education. Limitations of the project and gaps in the findings were presented for consideration as well.

### **Project Summary**

Many steps were taken throughout the five chapters of this evidence-synthesizing project about the impact mobile technology, specifically smartphones and tablets, may have on learning outcomes and the safety and quality of nursing students' patient care. The background, problem, and significance to nursing education were first presented in Chapter I in order to establish the framework and purpose of the project. Chapter II detailed the literature search, inclusion and exclusion criteria, and EBP model that was used. Following the JHNEBP model guidelines, each article was then critically appraised and assigned a quality rating in Chapter III. After presentation of the results in Chapter IV, the overall findings were discussed in Chapter V, and it was determined that mobile technology does indeed have a positive impact on student learning and should be integrated into undergraduate nursing curricula.

## References

- Alexander, S., Gambo, J. M., Bahreman, N. T., Watties-Daniels, D., Neal, M., & Swoboda, S. M. (2017). Can mobile technology enhance learning and change educational practice? *CIN: Computers, Informatics, Nursing*, 35(8), 375–380.
- Bryer, J., & Peterson-Graziose, V. (2014). Integration of quality and safety competencies in undergraduate nursing education: A faculty development approach. *Teaching & Learning in Nursing*, 9(3), 130–133.
- Dang, D., & Dearholt, S. L. (2018). *Johns Hopkins nursing evidence-based practice: Model and guidelines* (3<sup>rd</sup> ed.). Indianapolis, IN: Sigma Theta Tau International.
- Day-Black, C. & Merrill, E. B. (2015). Using mobile devices in nursing education. *ABNF Journal*, 26(4), 78-84.
- Gallegos, C., Gehrke, P., & Nakashima, H. (2019). Can mobile devices be used as an active learning strategy? Student perceptions of mobile device use in a nursing course. *Nurse Educator*, 44(5), 270–274.
- George, T. P., & DeCristofaro, C. (2016). Use of smartphones with undergraduate nursing students. *Journal of Nursing Education*, 55(7), 411–415.
- 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), 1-8.
- Gierdowski, D. C. (2019). *ECAR Study of Undergraduate Students and Information Technology, 2019*. Retrieved from: <https://library.educause.edu/-/media/files/library/2019/10/studentstudy2019.pdf?la=en&hash=25FBB396AE482FAC3B765862BA6B197DBC98B42C>

- Herold, B. (2016). Technology in education: An overview. *Education Week*. Retrieved from <http://www.edweek.org/ew/issues/technology-in-education/>
- Keating, S. B., & DeBoor, S. S. (2018). *Curriculum development and evaluation in nursing education* (4<sup>th</sup> ed.). New York, NY: Springer.
- Kim, H., & Suh, E. E. (2018). The effects of an interactive nursing skills mobile application on nursing students' knowledge, self-efficacy, and skills performance: A randomized controlled trial. *Asian Nursing Research*, 12(1), 17–25.
- Lee, N., Chae, S., Kim, H., Lee, J., Min, H. J., & Park, D. (2016). Mobile-based video learning outcomes in clinical nursing skill education. *CIN: Computers, Informatics, Nursing*, 34(1), 8–16.
- Mackay, B. J., Anderson, J., & Harding, T. (2017). Mobile technology in clinical teaching. *Nurse Education in Practice*, 22, 1–6.
- National League for Nursing. (2015). *A Vision for The Changing Faculty Role: Preparing Students for the Technological World of Health Care*. Retrieved from: [http://www.nln.org/docs/default-source/about/nln-vision-series-\(position-statements\)/a-vision-for-the-changing-faculty-role-preparing-students-for-the-technological-world-of-health-care.pdf?sfvrsn=0](http://www.nln.org/docs/default-source/about/nln-vision-series-(position-statements)/a-vision-for-the-changing-faculty-role-preparing-students-for-the-technological-world-of-health-care.pdf?sfvrsn=0)
- O'Connor, S., & Andrews, T. (2018). Smartphones and mobile applications (apps) in clinical nursing education: A student perspective. *Nurse Education Today*, 69, 172–178.
- Pew Research Center. (2019). *Mobile Fact Sheet*. Retrieved from: <https://www.pewinternet.org/fact-sheet/mobile/>
- Quality and Safety Education for Nurses (QSEN) Institute. (2019). *QSEN Competencies*. Retrieved from: <https://qsen.org/competencies/pre-licensure-ksas/#>

- Raman, J. (2015). Mobile technology in nursing education: Where do we go from here? A review of the literature. *Nurse Education Today*, 35, 663-672.
- West, D. M. (2015). *Connected Learning: How Mobile Technology Can Improve Education*. Retrieved from: [https://www.brookings.edu/wp-content/uploads/2016/07/west\\_connected-learning\\_v11.pdf](https://www.brookings.edu/wp-content/uploads/2016/07/west_connected-learning_v11.pdf)
- Wittmann-Price, R. A., Godshall, M., & Wilson, L. (2017). *Certified nurse educator (CNE) review manual* (3rd ed.). New York, NY: Springer.



## Appendix A

## Evidence Summary Matrix

**Student Name: Jillian Sisson****Key:**

- **Article #** - Assign a number to each piece of reviewed evidence. Provides an easy way to organize articles.
- **Author, Publication Source, and Date** – Indicate the last name of the first author, and the evidence source, date of publication.
- **Evidence Type** – Indicate the type of evidence reviewed. Examples: Original research study (quantitative or qualitative); Systematic review; Literature review; Clinical practice guidelines; Expert opinion article
- **Purpose** – State the purpose of the piece of evidence
- **Sample Type/Size/Setting** – Only applicable to Level I, II, III, and Level V quality improvement, financial or program evaluation evidence. Provides a quick view of the population, number of participants, and where the study took place.
- **Study Findings** – Indicate study findings – focus on those findings that are most pertinent to answering the PICO(T) question.
- **Limitations** – include a critical appraisal of the piece of evidence that may or may not have been indicated in the article. For example – for a quantitative study – note presence of threats to internal and external validity; for a qualitative study – note presence of trustworthiness, credibility, fittingness, auditability, and transferability. Refer to non-research appraisal tool in the JHEBP toolkit for non-research evidence.
- **Evidence Level and Quality** – Refer to the JHEBP Levels and Quality of Evidence tools in Dang and Dearholt (2018).

**PICO(T) Question:** In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology?

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
1	Lee et al., 2016. <i>CIN: Computers, Informatics, Nursing.</i>	Randomized controlled trial with pretest/posttest design.  Purpose: To identify the effects of mobile-based video clips on learning	Convenience sample of 71 second-year undergraduate nursing students enrolled in a Fundamentals of Nursing II course at a university in Seoul, South Korea. Participants were randomly	The intervention group, those who had unlimited access to the mobile-based video clip, reported statistically significant higher levels learning motivation, confidence in skills performance, and overall class	No validity or reliability reported for two of the data collection instruments. Selection effects of only one nursing skill in one setting limited generalizability and threatened external validity.	I	B-

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
		motivation, competency, and class satisfaction	assigned to the control or intervention group. Power analysis greater than 80%.	satisfaction than the control group. There were no statistically significant different in knowledge and skills performance between the two groups, although the intervention group did receive higher scores.	Selection bias was present due to inability to blind students to the intervention versus control group.		
2	Gallegos et al., 2019. <i>Nurse Educator</i> .	Convergent parallel mixed-methods descriptive design.  Purpose: To explore student engagement levels and perceptions of using a mobile device in a theoretical, nonclinical course.	Convenience sample of 59 undergraduate junior level nursing students enrolled in a nursing research course at a public university. No power analysis or data saturation.	Student reported increased engagement in class, motivation to learn class material, and attention span. Overall, using the mobile devices was reported to enhance learning, increase confidence and connectivity of ideas, and aid in application of content and development of skills. Students expressed that immediate instructor feedback	Lack of demonstrated validity and reliability for the POE and POL data collection tool. Lack of generalizability due to convenience sampling, availability of free iPads, and a specific student population. Selection bias and selection effects due to the sampling method threatened both internal and external validity.	III	B

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
				during group assignments, the active learning that Nearpod promoted, and having larger assignments broken down into baby steps were all beneficial for learning and engagement.			
3	Mackay et al., 2017. <i>NEP: Nurse Education in Practice.</i>	Qualitative descriptive design.  Purpose: To study clinical lecturers' experiences with using mobile devices in undergraduate nursing education.	Six clinical lecturers from one nursing department who were given iPads to use in their clinical teaching.	The clinical lecturers noted that easy access to multiple resources on the iPad was beneficial for their students. Lecturers also expressed that support from IT and management was essential for project success. Inexperience with the iPad and application use was noted to be a barrier particularly at the beginning of the study, and some clinical lecturers had less time in clinical	Lack of auditability for the implementation phase as the researchers did not outline how the clinical lecturers used the iPad in their practice. Decreased transferability due to the lack of data saturation and absence of information regarding the type of clinical settings where the study was conducted.	III	A-

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
				<p>than others to practice with and fully use the iPad. Negative opinions about educational iPad use in the hospital was expressed by clinical staff and was a constraining factor. Lecturers remarked that the iPads allowed them to provide immediate feedback to a question and individualized point-of-care education to each student.</p>			
4	O'Connor & Andrews, 2018. <i>Nurse Education Today</i> .	<p>Descriptive cross-sectional mixed-methods design.</p> <p>Purpose: To examine undergraduate nursing students' perspectives</p>	<p>Convenience sample of 200 undergraduate nursing students enrolled in a four-year BSN program. No power analysis or data saturation.</p>	<p>The majority of students already owned a smartphone, and while most did not use mobile apps in a clinical environment, almost all of the students were open to using them. The surveyed students expressed that they would be</p>	<p>Lack of established reliability and validity for the questionnaire. Vague inclusion and exclusion criteria. Only one-time administration of the questionnaire at a single university. Decreased</p>	III	B-

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
		on the use of mobile devices in clinical education		interested in using mobile applications for educational purposes, agreeing that it would improve their knowledge, confidence, and decision-making skills. Students voiced that access to medication information would increase patient safety. Three primary barriers to implementation of mobile technology in the clinical setting that were discovered included negative attitudes of nursing staff and patient families, lack of technological skills, and lack of awareness of available apps.	transferability due to lack of data saturation.		
5	George et al., 2017. <i>Healthcare.</i>	Qualitative descriptive design.	Convenience sample of 71 first semester nursing	Students reported that they enhanced their communication	Decreased credibility due to the lack of peer	III	B-

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
		Purpose: To study undergraduate nursing student perceptions of ability, learning, and motivation when using mobile devices	students enrolled in a BSN program at a public university. No data saturation.	and patient interaction skills, grew in their cultural competence, improved patient education skills, translated theory into practice, and learned more about the nursing role. Over 90% of the surveyed students had a positive experience with using the smartphone apps and voiced a desire to continue using them. Students also reported that patients and staff were accepting of students' smartphone use in the clinical setting.	debriefing and individual content analysis. Risk for bias present. Decreased transferability due to homogenous sample and lack of data saturation.		
6	Kim & Suh, 2018. <i>Asian Nursing Research</i> .	Randomized control trial pretest-posttest design.	Sixty-six senior nursing students enrolled in a nursing school in South Korea were randomly assigned to experimental	Students who used the ICNS app were more likely to demonstrate increased knowledge, self-efficacy, and nursing	The KR-20 of 0.43 was an instrumentation threat to internal validity. Selection effects due to a specific	I	A-

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
		Purpose: To investigate the effects of an interactive clinical nursing skills (ICNS) mobile application on undergraduate nursing students' knowledge, self-efficacy, and skills performance.	and control groups. Power analysis of 80%.	skills performance than students who used the non-ICNS app. While there was no statistically significant difference between the control group and experimental group for self-efficacy at the posttest, the increase in self-efficacy from pretest to posttest for the experimental group was statistically different than the increase from pretest to posttest for the control group.	sample group limited generalizability and threatened external validity.		
7	Raman, 2015. <i>Nurse Education Today</i> .	Literature review.  Purpose: To explore articles about mobile technology in nursing education.	Seventeen articles chosen for inclusion in review based on inclusion/exclusion criteria.	Benefits of mobile technology include accessibility of evidence-based information, improved student performance at clinicals, and enhanced learning in simulation. Concerns include cost of	There were very few limitations. Recommendations for future practice and research were included but not thoroughly presented.	V	A

Article #	Author, Publication Source, & Date of Publication	Evidence Type and Purpose	Sample Type, Size, Setting	Study Findings	Limitations	Evidence Level	Quality Rating
				mobile devices, lack of IT support, negative clinician opinions, and lack of faculty training. Strategies to mitigate concerns include introducing mobile technology early on in the curriculum and providing additional faculty training.			

From: Dang, D., & Dearholt, S. L. (2018). *Johns Hopkins evidence-based practice: Model and guidelines* (3rd ed.). Indianapolis, IN: Sigma Theta Tau.



## Appendix B

## Synthesis of Levels of Evidence and Quality Table

**Student Name: Jillian Sisson**

**PICO(T) Question:** In undergraduate nursing students, does the ability to access educational content on mobile devices influence curricular learning outcomes compared to no integration of mobile technology?

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings: Evidence That Answers the PICO(T) Question
<b>Level I</b> <ul style="list-style-type: none"> <li>• Experimental study</li> <li>• Randomized controlled trial (RCT)</li> <li>• Systematic review of RCTs with or without meta-analysis</li> <li>• Explanatory mixed method design that includes only a Level quantitative study</li> </ul>	2	B	<ul style="list-style-type: none"> <li>▪ Interactive mobile apps or videos accessible on a mobile device significantly increased confidence and self-efficacy</li> <li>▪ Knowledge, skills performance, learning motivation, and class satisfaction were all positively impacted by intervention of interactive mobile technology</li> </ul>
<b>Level II</b> <ul style="list-style-type: none"> <li>• Quasi-experimental studies</li> <li>• Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis</li> </ul>	0	N/A	
<b>Level III</b> <ul style="list-style-type: none"> <li>• Nonexperimental study</li> <li>• Systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or nonexperimental studies only, with or without meta-analysis</li> <li>• Qualitative study or meta-synthesis</li> </ul>	4	B	<ul style="list-style-type: none"> <li>▪ The majority of undergraduate nursing students already own smartphones and are open to using educational apps in a clinical setting</li> <li>▪ Mobile technology use in the classroom and clinical setting enabled immediate feedback from instructors and positively impacted students' confidence levels,</li> </ul>

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings: Evidence That Answers the PICO(T) Question
<ul style="list-style-type: none"> <li>• Exploratory, convergent, or multiphasic mixed-methods studies</li> <li>• Explanatory mixed method design that includes only a level III quantitative study</li> </ul>			<p>enhanced learning and class satisfaction, and increased student engagement</p> <ul style="list-style-type: none"> <li>▪ Mobile device use furthered translation of nursing theory into practice through accessibility of point-of-care information on apps</li> <li>▪ Students reported improved skills performance and increased patient safety due to apps with nursing skills and medication information</li> </ul>
<p><b>Level IV</b></p> <ul style="list-style-type: none"> <li>• Opinions of respected authorities and/or reports of nationally recognized expert committees or consensus panels based on scientific evidence</li> </ul>	0	N/A	
<p><b>Level V</b></p> <ul style="list-style-type: none"> <li>• Evidence obtained from literature or integrative reviews, quality improvement, program evaluation, financial evaluation, or case reports</li> <li>• Opinion of nationally recognized expert(s) based on experiential evidence</li> </ul>	1	A	<ul style="list-style-type: none"> <li>▪ Benefits: accessibility of evidence-based information, improved student performance at clinicals, and enhanced learning in simulation</li> <li>▪ Concerns: cost of mobile devices, lack of IT support, negative clinician opinions, and lack of faculty training</li> <li>▪ Strategies to mitigate concerns: introduce mobile technology early on in the curriculum and provide additional faculty training.</li> </ul>