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Title

Smartphones and Mobile Applications (Apps) in Clinical Nursing Education: A Student Perspective

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Key Words

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ABSTRACT

Background

Nurse educators are exploring different information and communication technologies as one way to provide additional support to nursing students in clinical practice. In particular, mobile technology is being explored as a way to provide better access to quality educational material that is accessible anywhere, anytime. However, the view of nursing students on the use of smartphone applications (apps) to enhance clinical education has not been explored. Their opinions on the future direction of nursing education are vital if the right technology is to be designed and implemented. This study seeks to understand the perspectives of nursing students in relation to using mobile technology and in particular apps to improve their training in clinical environments.

Method

The proposed study will use a self-reported questionnaire that will be sent to a cross-section of undergraduate nursing students. A newly developed survey, based on previous literature, will examine various aspects of students' opinions towards smartphone applications in clinical education. The survey will be piloted and then administered to participants. Descriptive and inferential statistics will be performed on the quantitative data. Qualitative data from open ended questions will be thematically analysed using the framework approach.

Discussion

The proposed research seeks to understand how nursing students perceive the advent of mobile technology and how it could be applied to improve the training they receive in clinical settings. This is the first study to examine the use of smartphone apps as a support in teaching from a students' perspective. It will help to broaden knowledge of the types of mobile devices and apps currently being used, the kinds of educational content required, and the factors that could affect the implementation of mobile technology in clinical settings.

INTRODUCTION

As nursing education spans both academic and clinical settings, undergraduate students must grapple with the challenges of learning in these two diverse settings. Clinical practice in particular presents a number of barriers for nursing students who must apply the theoretical knowledge and practical skills they gain at university in the real world and acquire new information and expertise in a very unfamiliar and complex landscape. The difficulties students face range from lack of experience (Sharif & Masoumi, 2005) and limited clinical supervision at times (Webb & Shakespeare, 2008), to the ad-hoc nature of learning in ward environments (Windsor, 1987) and problems with translating theory into practice (Landers, 2000). This can result in reduced training opportunities and poor learning outcomes for students.

Nurse educators are beginning to look at alternative ways to support students in a variety of clinical settings; from hospital wards in acute services, to outpatient clinics and more public health and primary care oriented practice placements in the community. One approach that is being explored is the use of different types of information technology that enable learning (Button & Harrington, 2014). For example, one study in the United States used video-conferencing with final year nursing students in clinical practice to enable them to share their experiences online and discuss issues they were having (Babenko-Mould, Andrusyszyn & Goldenberg, 2004). The nursing students valued this approach as they felt connected to their peers and became more confident in dealing with difficulties through the support and information they gained from the virtual sessions. The Internet and social media have also been examined as ways to enhance the education of health professionals (O'Connor et al, 2018). Ajuwon (2003) showed that medical and nursing students used computer resources in clinical areas to access health information via search engines like Yahoo and Google. This study highlighted that access to online educational material was seen as a valuable element to

learning in clinical settings. However, barriers to students using computers in clinical environments were pinpointed such as sharing limited computer resources with other qualified health professionals and poor technical skills among some students.

BACKGROUND

More recently, mobile technologies have been developed and trialled in nursing education as a way to provide better access to quality educational material that is accessible anywhere, anytime (O'Connor & Andrews, 2015). Mobile devices are defined as "handheld IT [information technology] artefacts that encompass hardware (devices), software (interface and applications) and communication (network services)" (Jarvenpaa & Lang, 2005, pg. 8). They have undergone a radical transformation since being pioneered in the 1970s and developed from simple two-way messaging systems, to more complex mobile platforms such as Personal Digital Assistants (PDAs) and Blackberries that have additional functionality, to today's sophisticated wireless enabled smartphones that have a range of applications such as web browsing, photography, and gaming, and can sync to other digital platforms and sensors (Agar, 2013). As the technology has progressed so has its use in nursing education, with researchers initially exploring PDAs (Farrell & Rose, 2008), then moving onto investing iPods (Clay, 2011), and now tablet computers (Bogossian, Kellett & Mason, 2009) and smartphones are becoming more common (Wittmann-Price, Kennedy & Godwin, 2012). However, very little pedagogical research exists about the use of more contemporary mobile devices such as smartphones in clinical nursing education.

In addition, the perspective of all stakeholders in nursing education needs to be taken into account to ensure that mobile devices and their associated software applications (apps) are designed, developed and implemented appropriately (Phillippi, 2011; O'Connor & Andrews,

2015). As the trend towards the use of more mobile technology in nursing education increases, students are beginning to be asked about the types of digital applications they want developed and are starting to co-design these platforms with faculty (O'Connor & Andrews, 2016). This process is important to ensure high quality educational content is designed and delivered and that mobile apps are user-friendly and personalised to students' needs where possible (Millard et al, 2009). However, the views of nursing students in relation to the use of smartphone apps to enhance clinical training has not been explored in depth as previous research focused on older forms of mobile technology. Given that smartphone apps are becoming ubiquitous in everyday life to gain access to useful multimedia information, record and monitor learning activities, and communicate and share information with others, their transition into clinical nursing education is inevitable. Therefore, students' opinions on how to apply smartphones and mobile apps as educational tools in clinical settings is vital, if the right technology is to be designed, evaluated and rolled out.

Aims

The aim of this study is to understand the perspectives of nursing students in relation to using smartphones and mobile apps to enhance learning in clinical environments.

METHODS

Design

The study adopted a descriptive cross-sectional design to examine the perspectives of nursing students towards the use of educational apps in clinical training.

Ethical Considerations

Ethical approval was sought and granted from University College Cork's institutional ethics committee. Nursing students received information about the study; including its aims, informed consent, voluntary participation, the right to withdraw and anonymity of data collected.

Data Collection

A 25-item questionnaire was developed based on concepts uncovered during a review of the literature on this topic (O'Connor & Andrews, 2015). The self-reported questionnaire was broken down into six major sections, which included questions on:

1) Demographics (gender, age, nursing discipline, year of study),
2) Students' current use of mobile devices (make, model, rationale for choice of handset) and educational apps (type of app, frequency of use),
3) Educational resources used in clinical settings (frequency of use, usefulness),
4) Educational content students would like on a nursing app (information format, clinical focus),
5) Factors affecting the use of mobile technology in clinical areas,
6) Educators' contributions to the use of mobile apps in nursing practice.

The questionnaire included multiple choice questions, Likert style scales and open-ended text boxes to elicit more detailed information. A paper-based version was piloted with nursing students in 2014 to determine content validity and gauge completion time. Student feedback was used to refine questions where necessary and improve their clarity.

Participants and Setting

Undergraduate nursing students, from a range of disciplines and time points within a four-year Bachelor of Science (B.Sc.) Nursing programme, were invited to participate in the study. Convenience sampling was used to reach groups of students from each discipline and year, as it was the most practical strategy to employ across varying programme timetables and student schedules. Inclusion criteria were that students were over eighteen years of age and enrolled in a full-time nursing degree programme. Paper-based questionnaires were distributed at the end of well-attended teaching sessions during the 2014/15 and 2015/16 semesters to gain the maximum number of respondents' possible, after a short information session explaining the study was delivered.

Data Analysis

The quantitative results of the questionnaire were analysed using descriptive statistics, including frequencies and percentages, to describe the participants and the kinds of mobile platforms and apps they currently use. Qualitative data from open-ended questions were analysed using thematic analysis (Braun & Clarke, 2006). Student responses were read and re-read and initial ideas noted, from which preliminary codes were generated and collated into themes. Emerging codes and themes were crosschecked and mapped until a rich understanding of students' perspectives on educational apps in clinical training materialised.

Rigour

This study was conducted by two nursing researchers who were not teaching any of the participant groups to help minimise response bias (Van de Mortel, 2008). Peer debriefing was used and a coding clinic held with a research colleague to quality check samples of the analyses.

These forms of reflexivity helped minimise researcher bias and improve the rigour of the study's results (Lincoln and Guba, 1985).

RESULTS

Two hundred students, across all four years of an undergraduate nursing degree programme completed the questionnaire. The majority of students were female, aged 18 to 21 years and studying adult nursing. A summary of participant characteristics can be found in Table 1.

Table 1

Participants Characteristics

Characteristic	Number and Percentage (n=200)
Gender	
Female	184 (92%)
Male	16 (8%)
Age	
18-21 years	119 (59%)
22-25 years	53 (27%)
26-30 years	14 (7%)
31-39 years	8 (4%)
> 40 years	6 (3%)
Nursing Discipline	
Adult	158 (79%)
Child	37 (19%)
Integrated (Adult & Child)	5 (2%)
Year of Study	

1st Year	58 (29%)
2nd Year	63 (32%)
3rd Year	3 (1%)
4th Year	76 (38%)

Mobile Device & App Use

All but five students (n=195, 98%) reported using a smartphone, demonstrating it is a popular type of technology to own and use. Nursing students had a range of hardware devices and varied in their choice of mobile technology. Those who reported the type of mobile device they used and some of their reasons for choosing it are summarised in Table 2. Just under half of students who responded to whether they used a smartphone app to support learning in clinical practice answered yes (n=94, 47%) and the majority answered no (n=103, 52%), showing mobile apps still have a way to go in terms of nursing students adopting them as learning tools. The students who answered yes used a range of educational apps in practice, the most common of which were a calculator (n=69, 35%) drug reference guide (n=53, 27%), medical dictionary (n=49, 25%), diseases and disorders handbook (n=25, 13%), language translator (n=13, 7%) and clinical skills guide (n=13, 7%). Other less popular apps reported as being used included an anatomy and physiology app, a BMI calculator, Glasgow Coma Scale app, first aid and Medscape application. Those who used educational apps in clinical practice did so with varying frequency but the majority of students only accessed apps every once in a while (25%), when needed, others used apps rarely (12%) or often (10%) and only two (1%) used it almost always.

Table 2

Type of mobile device used and reasons for choosing it

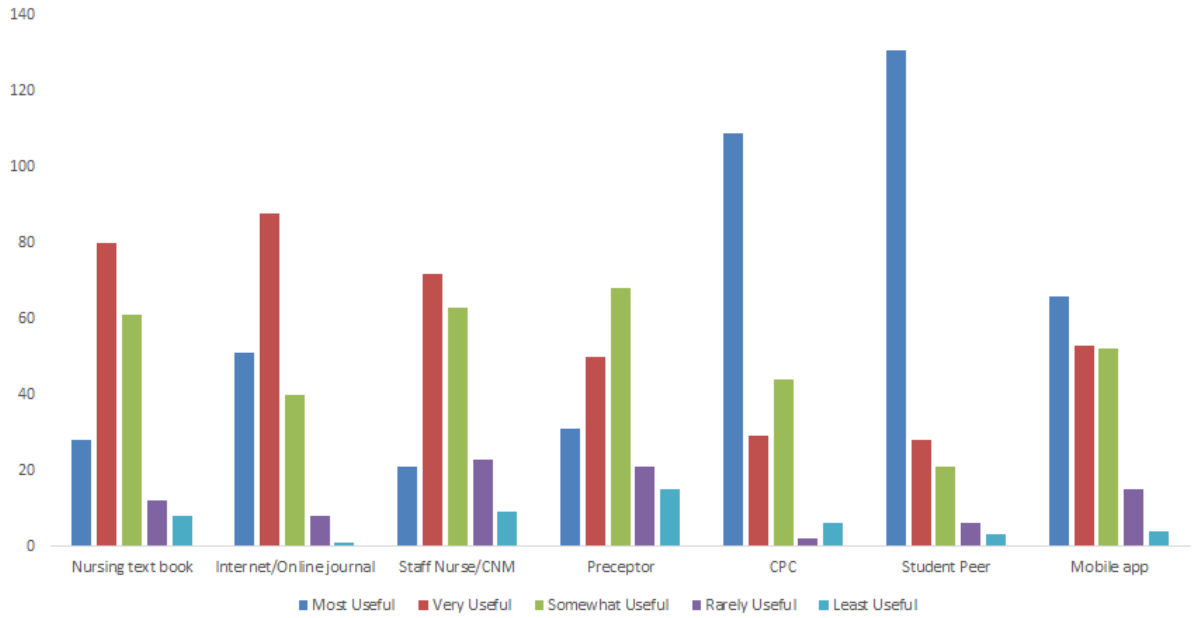
Make & Model	No of Students	Reasons for Choosing the Device
iPhone (iPhone, 3, 4, 5, iPad)	99	Able to access email, Internet access; Due to the excellent camera and the ability to iMessage; Easy to Use; Hand me down; I like Apple products; iPhone have a good reputation; Popular brand, reliable; To have more access to social media sites and apps; Upgrade; You can do everything on it;
Samsung (Galaxy S3, S4, S5, Mini, Blue)	51	Affordable; Best Price; Clear bright screen; Easy to Use; Good quality camera for photos; Got it as a present; Good size; Good memory and camera also; New release at time; I was due an upgrade; To download apps; To listen to free songs!
Sony (Xperia)	19	100% for function and technology; Easy to use; It can hold many apps; They told me in the shop it was a good phone "unreal phone for pictures"; Value for price; Within my budget!
Nokia (Lumia)	10	Cheap; It was an upgrade which was offered to me; Opens Microsoft office documents; Was given to me for free.
HTC (Desire, One)	7	Affordable; It was a present however it was chosen under the guidance of phone shop personnel; Shop Recommended; Technology was meant to be better than an iPhone or Samsung.
Huawei	6	Big Screen & affordable price; Cheap & efficient; Wanted a touch phone.
Motorola	2	Best value for money; Its fast, the newest model.

Mobile Apps for Learning

Although many students did not actively use apps to help them learn in clinical settings, when asked if they would consider doing so the majority said yes (n=172, 86%), a smaller group felt maybe (n=21, 11%), one was unsure (1%), and only three (2%) refused to use mobile apps as learning tools. Most nursing students reported they would anticipate utilising educational apps in practice often (n=90, 45%) or every once in a while (n=60, 30%), with a smaller number predicting they would only use apps on rare occasions (n=26, 13%). Compared to other approaches students ranked mobile apps as the third most useful source of information for learning in clinical practice, after student peers and Clinical Placement Coordinators (CPCs), with online journals or databases and preceptors ranking fourth and fifth most useful (Figure 1). When asked what educational information should be on a mobile app to support learning, most nursing students strongly agreed that written information on key nursing skills (n=131, 66%), followed by diagrams or images (n=109, 55%) and audio clips (n=89, 45%) would be most useful. Students were also given a list of learning opportunities in clinical practice that could be enhanced by a mobile app. Most students strongly or mildly agree that an app would be a valuable learning tool (n=124, 62%), that it would enhance their nursing knowledge (n=125, 63%), improve confidence in performing clinical skills (n=112, 56%) and improve clinical decision-making (n=110, 55%).

Figure 1

How useful certain information sources are to support learning in clinical practice



Finally, nursing students were asked for recommendations on how clinical teaching and learning could be enhanced by using mobile apps. They felt that having a mobile device was convenient as they were popular communication tools, which students could use to access educational resources when and where it suited them during clinical practice. The speed at which information could be accessed via mobile apps was also thought to be beneficial for learning over more traditional methods. In cases were training opportunities were limited in clinical areas or students were self-conscious about learning, one undergraduate nurse felt mobile apps were a useful adjunct to have. However, one student did remark she felt mobile learning would not substitute the value of being trained in simulated environments and another believed direct patient contact was the best way to learn (see Table 3).

In addition, nursing students made the following suggestions on how to improve the pedagogical aspects of educational apps. Several students wanted to see more audio-visual

information being made available on apps, either through diagrams, audio clips or videos. Step-by-step guides on how to preform clinical skills that students were required to achieve competency in was also requested for inclusion in mobile apps to improve learning. The necessity to have educational information short and to the point was emphasised by several students', due to the time constraints on accessing training material in busy clinical areas. Medication management was frequently mentioned as an area of concern for students, who wanted more detailed information on drugs and how to administer them. Finally, two students felt that the mobile app should include a chat room where peers and qualified nurses could come together to share their practice experiences and learn from each other (see Table 3).

Implementation of Mobile Apps

Nursing students had varying opinions about using educational apps in practice and highlighted potential barriers they might experience. Most students either strongly or mildly agreed that negative attitudes from nursing staff (n=105, 53%) may be a problem when trying to use a mobile device and app for learning and that some patients or family members could also frown upon the use of this technology in clinical settings (n=74, 37%). Issues such as a lack of technical skills (n=141, 71%), the small screen size of their device (n=112, 56%) or insufficient training to use an app (n=126, 63%) were not felt to be overly pertinent as most students mildly or strongly disagreed with these statements. Students also expressed concern about using a mobile device in practice as some feared it could be lost (n=50, 25%), stolen (n=53, 27%) or damaged (n=49, 25%).

When asked what educators could to do enhance mobile learning in practice via technology, students identified several points. Firstly, they suggested educating staff nurses and patients about the benefits of mobile devices and apps for learning, to address the potential

tensions that could develop when students wanted to use this technology to develop professional knowledge and skills in clinical areas. Secondly, nursing students recommended that educators inform them of the best types of mobile apps to use to support learning and how to apply them effectively. Thirdly, some mentioned investing in technical infrastructure such as support staff and Wi-Fi in clinical areas to enable mobile learning. Finally, the design and content of mobile apps was commented upon as something nursing educators could contribute to, as some students felt that information on apps was not specific enough to their needs and could be better designed (see Table 4).

DISCUSSION

Overall, student feedback about using mobile devices and apps in clinical training was positive, in that most reported they would use a smartphone app to help them learn in clinical practice and many had already done so. This finding is similar to a survey carried out with medical students in the United Kingdom which revealed mobile apps were used frequently in practice (Payne et al, 2012). The types of mobile apps that students reported using to support learning such as calculators, drug reference guides and medical dictionaries have been noted in other studies. Kupier (2010) showed that drug reference guides were one type of mobile application nursing students employed to check unfamiliar drugs, dosages, contraindications and side effects. This could improve students' pharmacological knowledge and medication management skills, which may enhance patient safety. Furthermore, Haffey et al (2014) reviewed current apps for prescribing medication and found three-hundred and sixty in total, demonstrating mobile learning is popular among healthcare professionals too. George et al (2010) also found that nursing students frequently used a medical dictionary application to aid learning key clinical concepts and terms. Students in this study who had used smartphone apps

had done so on their own mobile device, which is a trend seen in the general mobile health literature (Koehler et al, 2013). Given the proliferation of electronic health records, virtual learning platforms and other computer systems in healthcare, there may be an argument for providing smartphones or tablet computers preloaded with approved apps to both students and nursing staff to support mobile learning. More rigorous research on mobile devices and apps in nursing education is necessary to determine which ones are useful for students in different contexts and what benefits are derived from them. Some clinical trials are currently underway to explore this area in more detail and provide clearer answers on whether mobile apps improve learning (Strandell-Laine et al, 2017).

Interestingly, most nursing students reported they would use mobile apps often to learn in practice and preferred them over other sources of educational information, with the exception of student peers and CPCs. Peer teaching by other students has been described as increasing confidence in clinical practice, which can lead to improvements in learning (Seacomb, 2008). This may provide a rationale why student peers were ranked first as the most useful source of information and a preferred method for learning over mobile apps. In addition, the pedagogical literature has shown that clinical placement coordinators provide individual student support during clinical training. CPCs are highly valued by students as they provide a link between clinical teams and other support services (Drennan, 2002) and help reduce the theory-practice gap (Lambert & Glacken, 2005). This may help explain why CPCs were ranked as the second most useful source of information for learning by nursing students, who preferred them over mobile apps. CPCs are also a well-established support mechanism for learning, are integrated into clinical areas and seen as an acceptable form of support in nursing education, in contrast to mobile technology. More research on which types of educational support students prefer in practice and why, how often these are utilised and their impact on learning would further our

understanding in this area and ensure the right personal and technological systems are put in place by educators. Moreover, research exploring how best to integrate smartphones and mobile apps into clinical nursing education would be beneficial so they can become a conventional mode of learning for students.

Nursing students made a number of suggestions about how learning could be improved via mobile apps such as making educational information available quickly and easily on them, to overcome the lack of computer equipment in clinical environments. This lack of technical infrastructure has been noted in previous eLearning studies as it creates a barrier to student learning in practice (Ajuwon, 2003). More research on whether mobile devices can fill this gap and give additional educational opportunities to nursing students at different timepoints during their training across a variety of clinical settings is needed. Nursing students also felt being able to use mobile technology helped reduce their anxiety around learning, made them more independent and meant they did not have to waste staff time with unnecessary questions. Some of these benefits have been reported by researchers exploring older mobile devices such as Personal Digital Assistants (PDAs) in nursing education (Secco et al, 2010). Further research on how mobile apps can reduce stress and support autonomous modes of learning among nursing students would help provide an evidence base for this technology in practice. Educational theories and frameworks may also need to be developed or adapted to strengthen how mobile technology is applied to aid learning. However, a handful of students did not value learning via smartphones and apps and preferred more traditional forms of education. The diversity of learners means that different types of pedagogical approaches are necessary and mobile learning is only one mode that could be offered in clinical practice amongst others. In addition, students thought the design of electronic training material available on apps could be enhanced by adding more audio-visual information that is personalised to the needs of students

specifically. This finding is echoed by others who found that nursing students wanted more tailored digital educational resources (Johansson et al, 2013), as the quality of educational apps can vary. Co-designing mobile technology with nursing students is one approach being explored to create tailor made apps (O'Connor & Andrews, 2016). Additional research in this space would be beneficial to identify how nursing educators can create personalised, high quality, smartphone apps that aid learning, in particular to meet students' needs around medication management.

A number of recommendations were made by nursing students on how to improve the implementation of mobile learning in practice. The attitudes of nursing staff and patients was one issue highlighted as they sometimes frowned upon the use of mobile devices in clinical areas. This difficulty around the professional use of hand-held technology in clinical settings has been reported numerous times, as some are concerned mobile devices could be used inappropriately in practice for example by compromising patient confidentiality or tarnishing the professional image of nursing (Beauregard et al, 2017; Johansson et al, 2013). This could be addressed through educating health professionals and patients about the value of utilising smartphones and apps to educate students in practice. Changing policy to support mobile working and learning in healthcare could also assist in bringing about a cultural shift that supports this approach. More research to uncover why people hold negative views of mobile learning and how to address these would be beneficial to move clinical nursing education forward. Another recommendation students made was for educators to tell them which smartphone apps to use. However, as Doyle et al (2014) highlighted nursing faculty may not have adequate knowledge about mobile apps for learning and capacity building may be necessary in this area to ensure nurse educators understand the pros and cons and which apps are good quality and worthwhile using. More research that identifies how much knowledge

nursing faculty have in this area and whether they currently recommend educational apps to students or not would be useful to know. This evidence could be used to design training courses for nurse educators to upskill them in mobile technology. Finally, the technical infrastructure in place in clinical practice was another area students felt needed investment to ensure they could access Wi-Fi and technical support needed for mobile learning. Strandell-Laine et al (2015) also identified poor connectivity and George et al (2010) found a lack of IT support acted as barriers to using mobile devices in clinical practicum. These barriers need to be addressed before mobile technology can be fully integrated into clinical nursing education.

Strengths and Limitations

A strength of this study is the student perspective that was adopted, as this viewpoint on smartphones and apps in clinical nursing education has not been explored in detail. Previous research has looked at older technologies such as Personal Digital Assistants (PDAs) which are no longer in fashion (O'Connor & Andrews, 2015). The questionnaire was also based on a thorough review of the literature in this field so pertinent questions could be asked and answered. Quantitative and qualitative data were collected to give students an opportunity to express their opinions and share their experiences of the actual and potential benefits and drawbacks of mobile learning in clinical environments. In addition, the sample size and range of different nursing student perspectives across all four years of a degree programme were captured. This helped provided novel findings and enabled a better understanding of nursing students' views on mobile apps to improve education and training in clinical practice.

A limitation of this study was convenience sampling. While recruitment to the questionnaire aimed to be as comprehensive as possible, fewer students from child health participated and none from mental health, learning disability or midwifery took part. As these

students' train in a variety of clinical settings their experience of using smartphones and apps could be different. In addition, the questionnaire was only administered at one time-point during nursing students training, at one higher education institution, which may reduce the generalizability of results. A longitudinal dataset across multiple learner groups, universities and geographic regions may better represent nursing student's perceptions and experiences of mobile learning in clinical settings. A final limitation is the questionnaire that was used had not undergone rigorous reliability and validity testing, due to the costs and timescale involved in developing measurement instruments which may have reduced the quality of the findings to some degree.

CONCLUSION

Nursing students continue to face challenges when learning and applying knowledge and skills in clinical practice. Although many strategies are in place to support student learning, such as nurse preceptors or mentors who directly supervise students and Clinical Placement Coordinators (CPCs), who act as liaison officers to provide additional training and assistance, nurse educators are exploring ways to extend and improve these. As mobile technology advances and its use continues to proliferate, the boundaries are beginning to blur between traditional approaches to learning and those emerging through electronic and mobile learning. Nursing faculty and students are starting to adopt and use mobile devices and apps to support education and training in practice. However, more work needs to be done to address the barriers that exist to integrating mobile learning in clinical nursing education and to ensure we have robust evidence that underpins this new 21st century pedagogical approach.

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