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Review

Integrating mobile devices into nursing curricula: Opportunities for implementation using Rogers' Diffusion of Innovation model

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SUMMARY

Objectives: To identify studies reporting mobile device integration into undergraduate and graduate nursing curricula. To explore the potential use of Rogers' Diffusion of Innovation model as a framework to guide implementation of mobile devices into nursing curricula.
Design: Literature review and thematic categorization.
Data sources: Literature published up until June 2013 was searched using EBSCO, PubMed, and Google Scholar.
Review method: The literature was reviewed for research articles pertaining to mobile device use in nursing education. Research articles were grouped by study design, and articles were classified by: 1) strategies for individual adopters and 2) strategies for organizations. Rogers' Diffusion of Innovation theory was used to categorize reported implementation strategies.
Results: Fifty-two research studies were identified. Strategies for implementation were varied, and challenges to integrating mobile devices include lack of administrative support and time/funding to educate faculty as well as students. Overall, the use of mobile devices appears to provide benefits to nursing students; however the research evidence is limited.
Conclusion: Anticipating challenges and ensuring a well laid out strategic plan can assist in supporting successful integration of mobile devices.

Introduction

The use of mobile devices at the point of care has become a growing trend in nursing practice (Mosa et al., 2012; Phillippi and Wyatt, 2011). Many terms are used to describe mobile devices including portable computing devices, personal digital assistants (PDAs), smartphones, and handheld computers; the term 'mobile devices' will be used for the purposes of this paper.

The complexity of patient health issues is intensifying (Billings et al., 2012), and nurses are facing the challenge of effectively managing an increasing amount of clinical information while also managing technological advances (Doran, 2009). Mobile devices have significant potential to support nursing students' decision making and patient care planning because these technologies can quickly bring relevant and evidence-based resources to the point of care (Doran et al., 2010). Nursing schools and nurse educators are being encouraged to support nursing students in their use of mobile devices to document clinical activities, direct students to reputable information resources, and ensure that students understand how to use devices in alignment with professional standards (Altmann and Brady, 2005; Arhin and Cormier, 2007; Bakken et al., 2004; Cornelius, 2005; Griffin-Sobel et al., 2010; Huffstutler et al., 2002; Kenny et al., 2009a; McLeod and Mays, 2008).

Rogers' Diffusion of Innovation theory provides a useful theoretical framework for nursing schools that are considering integrating mobile devices as a tool to enhance learning. This framework can support the planning and adoption of these new technologies because the integration of mobile devices into the nursing curriculum represents a new innovation to many schools and educators.

Methods

A literature review was undertaken to examine publications describing the use of mobile devices in nursing education. The following databases were searched up to June 2013: EBSCO (Academic Search Complete, CINAHL, Medline), PubMed, and Google Scholar. Search terms included: personal digital assistant, PDAs, handheld computers (computers, handheld), mobile (computing) device, pocket computer, wireless device, mobile learning, nursing education, nursing, education, and also 'diffusion of innovation'. No date constraints were applied to the search and only English language articles were included. Articles in domains other than nursing education were excluded. The database

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searches yielded 615 articles, of which 363 were duplicates, leaving 252 articles. Abstracts were reviewed by an individual researcher initially, and then two other researchers independently, yielding 40 research articles, 73 opinion articles and 19 articles related to diffusion of innovation. An additional 12 research articles were identified by searching the reference lists of identified articles. The results of the 52 research studies were grouped by study methodology, and Rogers' Diffusion of Innovation theory was used as the framework for analysis of the implementation strategies reported in the papers. Articles were then grouped by theme related to best practice recommendations for diffusing the innovation of mobile technologies in nursing education.

Summary of Research Studies

Table 1 provides a summary of research studies identified including four randomized controlled trials, 13 quasi-experiments, four qualitative studies, and 18 descriptive studies, and 13 studies using mixed methods. In several studies students reported that using mobile devices to access information saved time (Brubaker et al., 2009; Clay, 2011; Koeniger-Donohue, 2008; Smith and Pattillo, 2006; Thomas et al., 2001; Trangenstein et al., 2007), and that having access to information resources was useful (Cibulka and Crane-Wider, 2011; Fisher and Koren, 2007; Garrett and Jackson, 2006; Miller et al., 2005; Pattillo et al., 2007; Schnall et al., 2011; Stroud et al., 2005; Trangenstein et al., 2007; Williams and Dittmer, 2009; Wittmann-Price et al., 2012), while others reported improvement in student learning (Chioh et al., 2013; de Marcos Ortega et al., 2011; Dearnley et al., 2008; Elliott et al., 2012; Galvao and Püschel, 2012; Kuiper, 2008; Lai and Wu, 2006; Schlairet, 2012; Wu et al., 2012; Wu et al., 2011). Studies that explored student perceptions found that the use of mobile devices for information resources increased student self-efficacy (Bauldoff et al., 2008; Goldsworthy et al., 2006; Kuiper, 2010; Thomas et al., 2001; Wittmann-Price et al., 2012), decreased clinical information stress (Jamieson et al., 2009), and decreased student cognitive load (Wu et al., 2012).

Several studies that explored types of information resources used found that drug reference guides were the most common resource used by students (Altmann and Brady, 2005; Berglund et al., 2007; Clark et al., 2009; Colevins et al., 2006; Farrell and Rose, 2008; Garrett and Jackson, 2006; George et al., 2010; Hudson and Buell, 2011; Kenny et al., 2009b). Several studies found the use of mobile devices for student assessment via clinical logs, interaction between faculty and students, and peer-to-peer support useful (Bakken et al., 2006; Jenkins et al., 2006; Kneebone et al., 2003; Wu and Lai, 2009). A study by Lee (2007) found that the use of decision support integrated into mobile device-based student clinical logs improved adherence to screening guidelines and Greenfield (2007) found that students using mobile devices had decreased medication calculation errors, but no improvement in course performance. Three studies found that students with previous computer experience found mobile devices easier to use than those who did not have previous experience (Farrell and Rose, 2008; Kenny et al., 2009a; Wang et al., 2012). In addition, several studies found that access to technological support was integral to the success of deployment of mobile devices in nursing education (Carlton et al., 2007; Cibulka and Crane-Wider, 2011; Schnall et al., 2011).

Only three studies found a negative impact of mobile devices including podcasting showed no improvement over classroom learning (Johnston et al., 2010), tablet computers were inconvenient for clinical use (Bogossian et al., 2009), and no added value to student learning when using PDA-based information resources (Morris and Maynard, 2010). In summary, the literature to-date suggests an improvement in nursing education from the use of mobile devices, however, most study designs provide weak evidence.

Of the literature we identified 15 articles that specifically described the integration of mobile devices into nursing curricula. Three of these articles were research studies, the other 12 were review articles. We used Rogers' Diffusion of Innovation theory to analyze these articles.

Rogers' Diffusion of Innovation Theory

Rogers' Diffusion of Innovation theory was first described in 1962 and characterizes people based on their likelihood to adopt technology and categorizes organizations based on their stage of adoption of a new technology. Rogers suggests there are five types of 'adopters' based on their relative likelihood to try out new things including: innovators, early adopters, early majority, late majority and laggards. Table 2 summarizes the characteristics of each type of adopter.

According to Rogers, diffusion of innovation at the individual level occurs in five stages: 1) knowledge, 2) persuasion, 3) decision, 4) implementation, and 5) confirmation, with five characteristics of innovations that influence an individual's decision to adopt or reject an innovation: i) relative advantage, ii) compatibility, iii) complexity, iv) trialability, and v) observability. Rogers suggests that these stages and characteristics be recognized when persuading users to adopt an innovation.

Individual Stages of Adoption and Adopter Groups

Several authors cite Rogers' Diffusion of Innovation (DoI) as a useful framework to guide innovations in nursing (Starkweather and Kardong-Edgren, 2008), to create a culture of innovation in organizations (Melnyk and Davidson, 2009), and to guide research designs (Doran et al., 2010). DoI was used here to categorize adoption strategies for mobile devices in nursing education. Once a decision to incorporate mobile devices into a nursing program is made, applying the phases of DoI to the process may improve the likelihood of acceptance by various stakeholders (Barr, 2002; Huffstutler et al., 2002; Scollin et al., 2007).

Table 3 shows strategies to engage individual adopter types at different phases of integrating mobile devices into the curricula. Although Table 3 appears linear, the process may be iterative, and individuals may appear to be 'laggards' when in fact, they might be 'early majority' types who will engage in the technology when offered the opportunity at the right time.

Organizational Stages of Adoption

According to Rogers, the process of adoption for organizations consists of: initiation phase, decision, and implementation phase. During the initiation phase, the need for an innovation is identified in two steps: *agenda setting* and *matching*. In the agenda setting step individuals in an organization start mobilizing towards a change. During the matching step the best fitting solution is found. The initiation phase ends when a decision is made. The decision is followed by the implementation phase with three stages: *redefining*, *clarifying* and *routinizing*. During the redefining stage the innovation goes through the first modification to fit the organization's needs. Clarifying follows, when the innovation is gradually embedded in the organization and then routinizing in which the innovation is fully incorporated in the organization. Each stage of adoption is outlined below and organizational strategies for adoption are presented.

Stage 1: Agenda Setting

Executive Support & Adequate Funding

A key factor for the effective adoption of mobile devices into nursing curricula is project support from the management/leadership team (Griffin-Sobel et al., 2010; Huffstutler et al., 2002; Melnyk and Davidson, 2009). Lack of administrative support has been noted as a factor in projects that fail (Rogers, 2003). When funding and release time is available for team members projects are more likely to achieve the implementation goals (George et al., 2010; Griffin-Sobel et al., 2010; Huffstutler et al., 2002). Many projects fail due to insufficient funds and/or human resources including technological support (Carlton et al., 2007).