CJLT RCAT

Canadian Journal of Learning and Technology
La Revue canadienne de l'apprentissage et de la technologie

Volume 39(4) Fall/automne 2013

Examining Informal Learning using Mobile Devices in the Healthcare Workplace

Examen de l'apprentissage informel par l'utilisation d'appareils mobiles dans le milieu des soins de santé

Dorothy (Willy) Fahlman, Athabasca University

Abstract

The study of workplace learning and informal learning are not new to adult education and pedagogy. However, the use of mobile devices as learning tools for informal learning in the workplace is an understudied area. Using theories on informal learning and constructivism as a framework, this paper explores informal learning of registered nurses using mobile devices to meet their learning needs for continuing professional education, professional development, and continuing competence within the challenging healthcare workplace. In this mixed methods study, participants used their devices for self-directed informal learning with non-collaborative strategies/processes for evidence-based support, new procedures/treatments, professional development, patient/client teaching, and maintaining competency. Positive perceptions were articulated. Minimal differences were associated to the nurses' age. However, workplace-related influences were relevant to the informal learning experiences with the mobile devices.

Résumé

L'étude de l'apprentissage en milieu de travail et de l'apprentissage informel n'est pas nouvelle dans le domaine de l'éducation des adultes et de la pédagogie. Cependant, l'utilisation d'appareils mobiles comme outils pour l'apprentissage informel en milieu de travail est un domaine peu étudié. En utilisant comme cadre d'analyse des théories de l'apprentissage informel et le constructivisme, cet article examine l'apprentissage informel des infirmières utilisant des appareils mobiles pour répondre à leurs besoins d'apprentissage en contexte de formation professionnelle continue, de perfectionnement professionnel et de maintien de leurs compétences dans le milieu difficile de la santé. Dans cette étude à méthodologies mixtes, les participants ont utilisé leurs appareils pour un apprentissage autodirigé informel à l'aide de stratégies et de processus non collaboratifs permettant un appui sur des données factuelles, pour produire de nouvelles procédures et traitements, pour leur perfectionnement professionnel, pour enseigner au patient ou au client et pour le maintien de leurs compétences. Des perceptions positives ont été

formulées. Des différences minimes ont été associées à l'âge des infirmières. Cependant, les influences liées au milieu de travail étaient pertinentes pour les expériences d'apprentissage informel avec les appareils mobiles.

Introduction

For several decades, the Canadian healthcare workplace has been in a state of flux, with continuous restructuring and reorganization creating challenges to meet staffing shortages, inflation costs, and rising service demands (Suter, Oelke, Adair, & Armitage, 2009). In this climate, in-person workplace-based education and in-service training of registered nurses (RNs) is becoming less readily accessible (Penz et al., 2007). As self-regulated professionals, RNs are seeking other means to meet their learning needs for professional practice. These alternative means may include using mobile devices as learning tools for informal learning.

Workplace Learning

The workplace provides an important context for the intertwining processes of work and learning (Streumer & Kho, 2006). It is a rich context for formal and informal learning. However, most learning in the workplace is informal, as it is a by-product of the nature of the workplace (Cross, 2007; Eraut, 2004). It is the primary mode for ongoing skill development and knowledge construction in the workplace. Informal learning includes "any activity involving the pursuit of understanding, knowledge or skill which occurs outside the curricula of educational institutions, or the courses or workshops offered by educational or social agencies" (Livingstone, 1999, p. 2). In the healthcare workplace, informal learning is widely prevalent (Wihak & Hall, 2011).

The Canadian Healthcare Workplace

In Canada, the healthcare workplace is both publicly and privately funded, including hospitals, long-term care facilities, community health settings, physicians' offices, private nursing agencies, educational institutions, or other workplaces where healthcare workers are employed or self-employed (Fahlman, 2012). Since the 1990s, this workplace has undergone continuous restructuring in on-going attempts to meet societal demands related to demographic changes, economics, technologies, and social-cultural issues (Shannon & French, 2005). In this dynamic context, knowledgeable healthcare professionals must continually update their knowledge and skills for maintaining competency and to ensure the provision of quality patient care (Schweitzer & Krassa, 2010).

Historically, workplace-based education for RNs has been delivered in a traditional format. However, attendance at face-to-face activities has become limited due to the challenges of "workplace budget constraints, lack of employer or administrative support, and lack of time due to staff shortages, shift work, scheduling difficulties, and family responsibilities" (Penz et al., 2007, p. 58) and the availability of educators has decreased (Schweitzer & Krassa, 2010). Consequently, workplace-based education for nurses is shifting to more autonomous and diverse means (Kenny, Park, Van Neste-Kenny, Burton, & Meiers, 2009). As these authors suggest, the healthcare workplace challenges require new pedagogical approaches and tools to facilitate and support the learning of RNs.

Canadian Registered Nurses

Canadian RNs "work both autonomously and in collaboration with other health care providers to coordinate health care, deliver direct services and support clients in their self-care decisions and actions in health, illness, injury and disability in all stages of life" (Canadian Institute for Health Information (CIHI), 2013, p. 1). As of 2011, there were 270,724 RNs employed in the Canadian healthcare workforce (CIHI, 2013) with the following profile:

Table 1: ***Canadian RNs' Workforce Profile***

Average Age	Gender	Education Level	Work Setting	Areas of Responsibility	Employment Status
45.4 years	Female - 93.6% Male - 6.4%	Diploma- 57.3% Baccalaureate – 38.8% Masters/Doctorate – 3.9%	Hospital -61.6% Community Health -13.3% Nursing Home/ Long Term Care – 10.1% Other place – 15.1%	Direct Care- 89% Administration/ Education/ Research – 11%	Full-time – 56.6% Part-time – 29.2% Casual hours – 12.1%

There are four generations of working Canadian RNs (Canadian Nurses Association (CNA), 2010), as follows:

- Veterans (born 1925 - 1945) - 5%;
- Baby Boomers (born 1946 - 1964) - 54%;
- Generation X (born 1965 - 1980) - 35%;
- Generation Y (born 1981 - 2000) - 6%.

As a regulated profession, Canadian RNs must "obtain, maintain, and continue to enhance their competence through continuous learning" (Canadian Nurses Association & Canadian Association of Schools of Nursing, 2004, p. 2). Competence refers to the "ability of a registered nurse to integrate and apply knowledge, skills, judgement, and personal attributes required to practice safely and ethically in a designated role and setting" (CNA, 2000, p. 6). Mandatory continuous learning includes continuing professional education (CPE) that encompasses all formal and informal learning activities that are intended to enhance and maintain competency (Curran, Kirby, & Fleet, 2006).

Canadian nursing has moved away from clocking hours for CPE towards continuing competency programs, whereby, RNs have the autonomy and flexibility to self-identify individual learning needs and select appropriate learning activities, either formally and/or informally, to meet those needs (Curran et al., 2006). Professional portfolios are used to collect, synthesize and analyze professional experiences, and develop individualized learning plans. RNs specify learning outcomes for maintaining competency reflecting on their personal strengths and weaknesses in professional practice (Bassendowski & Petrucka, 2009). As reflective practitioners, RNs are required to self-evaluate their individual skill sets honestly and frequently, working to resolve any deficits (Nelson & Purkis, 2004).

Informal Learning in the Workplace

Despite the efforts of many researchers, there is no agreed upon or clear definition of informal learning (Colley, Hodkinson, & Malcolm, 2003; Wihak, Hall, & Durand, 2010). Informal learning is often described as learning outside the classroom or training venue that does not follow a prescribed framework of formally constituted educational institutions (Hager & Halliday, 2009; Wihak, et al., 2010). It can occur individually or collectively, face-to-face or in online settings (Thomas & Moisey, 2006). It is within the sphere of informal learning where most of the salient knowledge that people apply in their daily lives and workplaces is obtained (Livingstone, 2001).

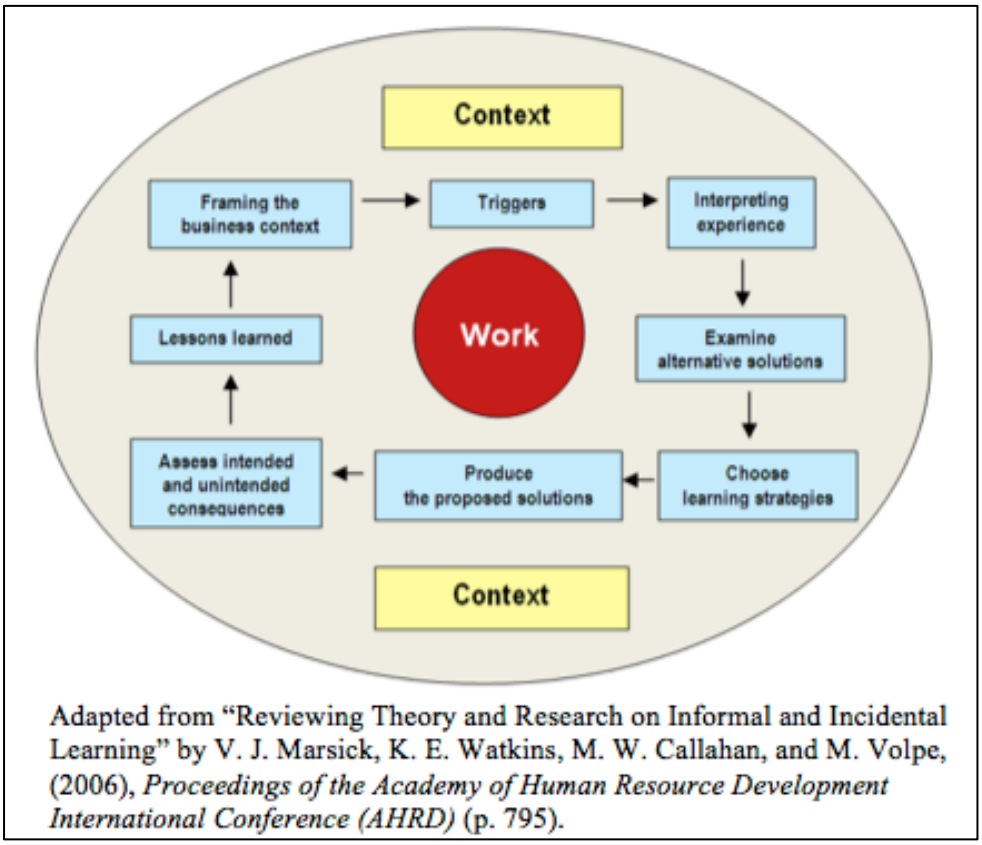
Informal learning includes learning that is self-directed and intentional, incidental or unplanned learning that becomes conscious after an experience, and tacit learning that is neither intentional nor conscious (Schugurensky, 2000). In their seminal work, Watkins and Marsick (1992) proposed the theory of informal and incidental learning in the workplace. The elements considered central to this theory include:

- based on learning from experience;
- embedded in the organizational context;
- oriented to a focus on action;
- governed by non-routine conditions;
- concerned with tacit dimensions that must be made explicit;
- delimited by the nature of the task, the way in which problems are framed, and the work capacity of the individual undertaking the task;
- enhanced by proactivity, critical reflectivity, and creativity.

Marsick, Watkins, Callahan, and Volpe (2006) added the concepts of implicit learning as part of tacit/implicit knowing, whole-person learning theory, and communities of practice. These authors proposed the model of informal and incidental learning as displayed in Figure 1.

This model is based on problem solving using reflective thought (Marsick, Watkins, & Lovin, 2011) beginning with the learner responding to triggers for a learning experience leading to strategies, solutions, and lessons learned that frame the business context within the workplace.

Livingstone's (1999) benchmark study of New Approaches to Lifelong Learning (NALL) explored informal learning. His findings indicated Canadian adults averaged six hours/week of workplace informal learning and only those under 24 years spent significantly more time in informal learning activities. Livingstone and Scholtz's (2006) Canada-wide survey of work and lifelong learning (WALL) suggested more than 80% of employed Canadians were involved in informal learning averaging more than five hours/week. Cheetman and Chivers' (2001) investigation reported that much of professional competence development occurs informally and recommended that informal learning should be explicitly recognized for its key contributions using reflection for constructing knowledge and meaning-making. Berg and Chyung's (2008) survey of professionals revealed that the lack of a learning organizational culture did not inhibit workplace informal learning. Also, these researchers stated that gender and level of education did not influence engagement in informal learning.



Adapted from "Reviewing Theory and Research on Informal and Incidental Learning" by V. J. Marsick, K. E. Watkins, M. W. Callahan, and M. Volpe, (2006), *Proceedings of the Academy of Human Resource Development International Conference (AHRD)* (p. 795).

Figure 1: **Re-conceptualized informal and incidental learning model**

Informal learning opportunities exist in abundance in the healthcare workplace (Bjork, Toien, & Sorensen, 2013). In this context, informal learning occurs from participation in group activities, working alongside others, tackling challenging tasks, and working with clients (Eraut, 2004). However, there is a paucity of research in this area. As Livingstone (1999) posits, informal learning is like an iceberg "mostly invisible on the surface and immense" (p. 9). Livingstone, Mirchandi, and Sawchuk (2008) note that within all spheres of work that informal learning "may represent our most important learning for coping with our changing environment" (p. 4). Besides being under-researched, Eraut (2004) explains that the workplace context could bring new perspectives to the investigation of informal learning.

Informal Learning using Mobile Devices in the Healthcare Workplace

Mobile devices have become more commonplace tools, yet how they are used in learning and work is not well known (Kukulska-Hulme & Pettit, 2009). These handheld technologies include personal digital assistants (PDAs), smartphones, tablets, and other portable wireless devices that enable learners to interact, maximize ideas, and expand the boundaries for just-in-time learning (McGreal, 2005). Due to their convenience, portability, and multimedia capabilities, mobile devices can take learning out of classrooms and into the authentic workplace for both formal and informal learning.

Mobile devices can provide learners with the choice to engage in learning individually or collaboratively, as well as the potential for learner-centered control over the physical and social

context where learning occurs (Clough, Jones, McAndrew, & Scanlon, 2008). The creation of knowledge and meaning-making that occurs from informal learning using mobile devices can be viewed from the perspective of cognitive and socio-cultural constructivism. Cognitive constructivism contends that learners construct new knowledge individually based on previous learning (Kanselaar, 2002), whereas, socio-cultural constructivism asserts that knowledge is constructed collaboratively through social discourse (Crawford, 1999). In the workplace, Billett (2009) suggests that learning is situated and scaffolded through participation in the community. This reflects the view of a community of practice where individuals are engaged and meaning is constructed through participation in a sociocultural practice (Lave & Wenger, 1991). Depending upon the context, either theory may help to explain the processes involved in the use of mobile devices as learning tools for informal learning.

As mobile devices become more ubiquitous, they have the potential to rapidly accelerate participation in informal learning (Clough et al., 2008; Wihak & Hall, 2011). However, using mobile devices as learning tools is a new and understudied area of research, and their use for informal learning in the healthcare workplace is a relatively unexplored area altogether. Due to the paucity of research on informal learning and use of mobile devices by RNs in the healthcare workplace, several studies were considered specifically relevant to this mixed methods study. Clough et al., (2008) studied mobile devices as potential learning tools for supporting and enhancing the informal learning experience with professionals. The findings suggested that the professionals used mobile devices extensively in an informal learning context and adapted the device's features to suit their learning needs. Doran, Haynes, Kushniruk, et al. (2010) examined the potential of mobile devices for enhancing Canadian nurses' access to information resources in order to support quality patient care in healthcare worksettings. They reported that mobile devices provided access to information resources that assisted in clinical practice, positively impacted care, and supported the nurses' learning needs. Another Canadian study investigated mobile devices for nurses' access to evidence‐based resources at point-of-care (Doran, Haynes, Estabrooks et al., 2010). The findings suggested the frequent use of mobile devices for accessing information resources supported the nurses' learning needs and improved job satisfaction significantly over time.

This paper presents the findings of a mixed methods study that explored how RNs engage in informal learning using mobile devices in the healthcare workplace, using the theories from informal learning in the workplace and perspectives of constructivism. Results presented in this paper address the following research questions:

1. What informal learning strategies or processes do RNs engage in when using mobile devices in the healthcare workplace?
2. For what purposes do RNs employ informal learning strategies or processes using mobile devices in the healthcare workplace?
3. Are there differences between how RNs use individual and collaborative modes of informal learning with mobile devices in the healthcare workplace?
4. Is there a relationship between the age of RNs and their use of mobile devices for informal learning in the healthcare workplace?

Research Method

Mixed Methods

This single mixed methods study was conceptualized as a continuum using quantitative and qualitative methods whereby the data conversed with each other rather than two segregated research projects (Fahlman, 2012). Mixed methods are useful for investigating complex phenomena such as informal learning using mobile devices in the healthcare workplace that requires data from a range of approaches (Sale, Lohfed, & Brazil, 2002). A sequential explanatory research design, combined a quantitative online survey followed by qualitative interviews, to either confirm or disconfirm the quantitative findings and provide further explanation of the results (Teddlie & Tashakkori, 2009). Priority or more weighting in the sequential explanatory design was given to the quantitative approach. Moreover, this sequential explanatory research design combined methodological breadth informed by theoretical rigor for constructing understanding and meaning of the study phenomena.

Participants and Sampling

The population was composed of approximately 1,450 diploma-prepared and practicing Canadian RNs in a Bachelor of Nursing program at a single-mode distance university in Western Canada. The program did not require RNs to use mobile devices.

In late 2011, participants were recruited using email for the online survey. As the percentage of RNs in the wider population using mobile devices for informal learning was unknown, a non-proportional quota-sampling scheme was used to ensure sufficient numbers to address the research questions and conduct a detailed analysis. Quotas of at least 15 participants self-reporting using collaborative modes of informal learning and at least 15 respondents for each age category of Generation Y, Generation X, and Baby Boomers were set. 170 useable online surveys were obtained (response rate of 11.7%) and quotas were met.

From the online survey, the RNs' descriptive profile indicated that the majority were Generation X females employed for over ten years as staff nurses in urban Canadian hospitals. This profile is similar to the national norms of RNs (CNA, 2010; CIHI, 2013). The participants mainly used smartphones in their workplaces, for less than two years, and were employed in 11 of the 13 Canadian provinces/territories.

Rogers (2003) classifies potential adopters of an innovation into five categories including (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards based on receptivity to innovation. Kaminski (2011) provides the following adopter category examples in relation to nurses and the use of technology:

1. Innovators – technology enthusiasts who are risk takers and venturesome;
2. Early adopters – visionaries who are trend setters and willing to trial the technology;
3. Early majority – pragmatics with technology who want to avoid any risks;
4. Late majority – conservatives who are cautious, skeptical, and technologically shy;
5. Laggards – resistors who think of technology as a hindrance and want to maintain the status quo.

Using Rogers' adoption categories, nearly 97% of the participants could be considered as innovators or early adopters in terms of self-reporting their mobile device use.

A multi-stage purposive sampling scheme was used to select interviewees. Criterion sampling recruited RNs who self-reported frequently using mobile devices for the individual and collaborative strategies/processes and purposes of informal learning on the online survey. From this criterion sample, RNs were selected using maximum variation sampling as to different age categories, gender, location, work setting, occupational position, years employed, and type and length of mobile device usage. Furthermore, a quantitative outlier from the online survey was selected in order to add strength and richness to the data. This was a RN who self-reported using her mobile device only for administrative purposes such as medication calculations and not for informal learning in her workplace. Ten participants from seven Canadian provinces/territories were purposively sampled and interviewed (see Table 2).

Table 2: ***Interviewees' Demographic Profile and Mobile Device Use***

Age Generation	Gender	Location	Work Setting	Occupation Position	Years as RNs	Mobile Device Used*	Length of Mobile Device Usage
Gen Y - 3 (born 1981-2000) Gen X - 4 (born 1965 - 1980) Baby Boomers - 3 (born 1946-1964)	Female - 8 Male - 2	Population Centre - 7 Rural - 3	Hospital - 6 Long Term Care - 1 Community Nursing - 1 Private Clinic - 1 Home Care - 1	Staff Nurse - 6 Management - 2 Educator - 1 Community Nurse - 1	3 - 20	Smart Phone - 8 iPad/Tablet - 2 iPod - 1 PDA - 1	<3 months to 5 years

*Some participants used more than one device.

Procedures

Prior to data collection, ethical consent to undertake the study was obtained. Data collection procedures included an anonymous, online cross-sectional survey, and semi-structured interviews. Both of these data collection methods operationalized the research questions.

A literature search revealed no validated questionnaires or potential combination of validated questionnaires for the online survey that specifically addressed the research questions. Consequently, a questionnaire was developed based on the studies of Lohman (2005), and Berg and Chyung (2008) on the informal learning strategies/processes. A combination of sixteen fill-in-the-blank and multiple-choice questions collected self-reported data on demographic information, mobile device usage in the healthcare workplace, perceptions of technological receptiveness, and learning modes including the strategies/processes (with and without a mobile device) and purposes for informal learning in the healthcare workplace. The questionnaire was

field tested for content and face validity, and the online survey was piloted. The online survey took approximately 20 minutes to complete

The online survey data informed the semi-structured interview questions to collect thick and rich descriptions of the phenomena for probing for depth and greater clarity of understanding. The interview questions were piloted. The interviews were conducted over the phone, digitally recorded, and transcribed with all identifying information removed.

Data Analysis

Descriptive and inferential statistical analyses were performed on the data collected in the online surveys. Careful attention was paid to appropriate sampling, instrumentation, and statistical analysis for validity and possible replication.

Inductive analysis of the interview transcripts involved an iterative process of careful examination and constant comparison, condensing the raw data into codes using ATLAS.ti® by which categories and themes emerged for further interpretation. Trustworthiness was ensured through member checking, peer debriefing, and data source triangulation.

Results and Discussion

Guided by the research questions, the quantitative and qualitative findings were inductively integrated to gain an in-depth understanding of the study phenomena. Mixing of the results can produce integrated findings that are greater than the sum of their parts (Woolley, 2009).

Strategies and Processes for Informal Learning using Mobile Devices

The Wilcoxon Signed-Ranks test found significant differences at the 5% level (Z = -11.312, N = 170, p = .000) indicating more participants self-reported using the strategies/processes for informal learning without a mobile device (M = 31.37, SD = 5.15) than those using a mobile device (M = 22.21, SD = 6.49). This finding was not surprising, considering as Doran, Haynes, Kushniruk, et al. (2010) suggest, the use of mobile devices in nursing practice is relatively new innovation in the healthcare workplace.

The survey respondents self-reported a high frequency for *searching the Web (including the Intranet)* and for *searching an online database (e.g. Medline)* and least frequently the process of *asking questions in a professional listserv or online community* (see Table 3). The interviews yielded strong support for these findings. Berg and Chyung's (2008) study on professionals' informal learning obtained similar result where this process of asking questions was the least reported.

Incidental learning through the process of trial and error was minimally reported and no indications of tacit learning were found in this study. Wihak and Hall (2011) speculate that tacit informal learning is often not articulated, as the learner is unaware that learning has occurred; ethnographic research may be better suited than online surveys and interviews to assess tacit informal learning in the workplace (Berg & Chyung, 2008).

Interviewees described their informal learning using mobile device as a planned and intentional response to new and non-routine situations in their workplaces (see Figure 2). These triggers

were the catalysts for self-directed informal learning using the mobile device whereby the RNs compared these situations "with prior experience, identify similarities or differences, and use their interpretation to make sense of the new challenge" (Marsick & Watkins, 2001, pp. 29-30). Through reflective practice, RNs problem solved using reflection-in-action during their experience, and self-evaluated after the encounter using reflection-on-action, to develop more effective ways of action for future practice (Schön, 1987).

Table 3: ***Frequency of Strategies/Processes of Informal Learning using a Mobile Device***

Strategy/Process	M	n	SD	Median
Reflect on previous action and knowledge using notes, diary, or some other method using my mobile device	1.99	170	.926	2.00
Learn by trial and error	1.90	167	.896	2.00
View a video, webcast or podcast	2.15	163	.931	2.00
Search the Web (including the Intranet)	2.88	169	.867	3.00
Search an online database (e.g., Medline)	2.56	169	.956	3.00
Read books, magazines, and/or journals	2.18	168	.999	2.00
Observe others on the job such as photos	1.99	165	1.036	2.00
*Talk on the phone with others	2.42	166	1.080	2.00
*Interact with other people via e-mail	2.69	167	1.069	3.00
*Ask questions in a professional listserv or online community	1.87	164	1.022	2.00

Note. * - Collaborative modes. Never = 1, Sometimes = 2, Often = 3, Always = 4.

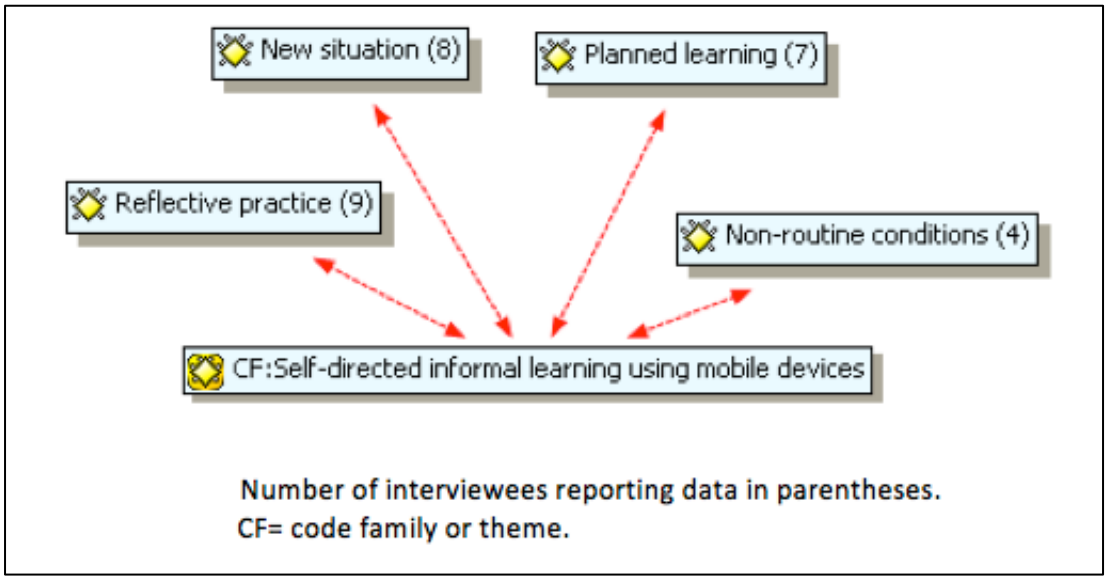


Figure 2: **Self-directed informal learning using mobile devices.**

The context of the healthcare workplace may have influenced the selection of informal strategies/ processes implemented using the mobile devices (see Figure 3). Marsick et al. (1999)

posit that the context is pervasive, influencing every step of informal learning. The RNs proactively engaged in informal learning strategies/processes with their mobile devices when faced with lack of formal education and/or current educational resources. Lack of workplace Internet connectivity may have also influenced the selection of informal learning strategies/processes. For example, two rural RNs downloaded Web resources at home and then accessed these resources offline in their workplaces. Most interviewees used their personal mobile devices and incurred data plan costs to engage in workplace informal learning. Some interviewees expressed trepidations related to employer's perceptions of inappropriate mobile device use for personal communication.

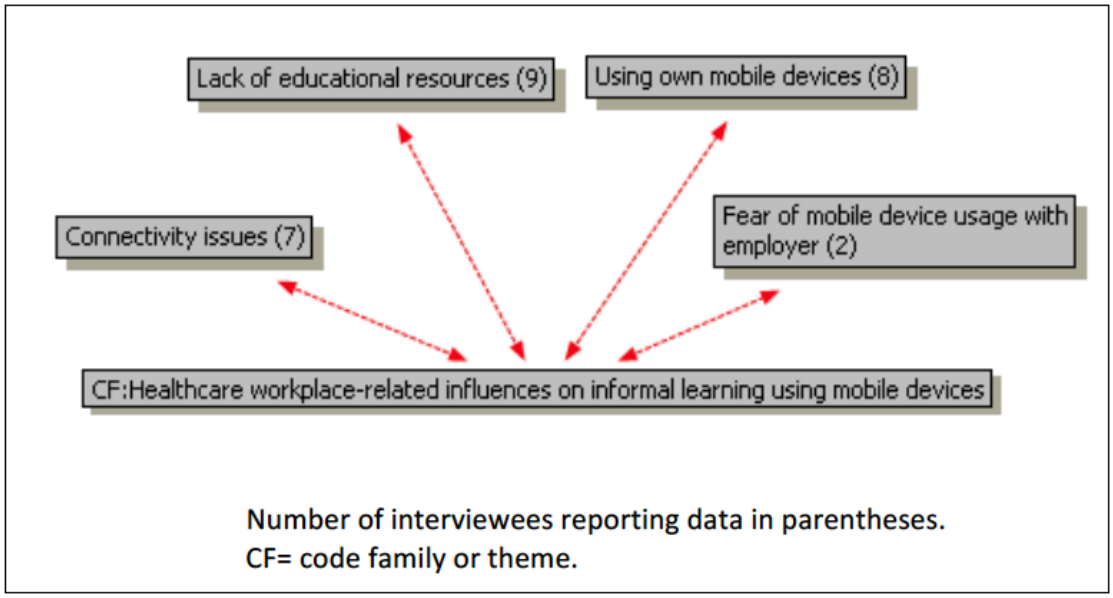


Figure 3: **Healthcare workplace-related influences on informal learning using mobile devices**

Furthermore, the interviewees expressed positive perceptions of engaging in informal learning strategies/process using mobile devices (see Figure 4). The interviewees alluded to increased self-confidence and efficiencies in clinical practices attributed to the proactive use of mobile devices for accessing timely up-to-date information for informal learning. Watkins and Marsick (1992) propose that proactivity might enhance a sense of autonomy and empowerment. Eraut (2004) argues that confidence affects self-efficacy and the ability to execute a particular task or successfully perform a role in the workplace. Self-reflection on the strategies/processes implemented may have led to new perceptions that challenged initial beliefs, behaviors, or feelings (Watkins & Marsick, 1992).

The interviewees suggested the mobile devices provided just-in-time access to information for informal learning that could mitigate risks associated with client care. They commented that clients reacted positively to the mobile devices; no negative reactions were reported. These perceptions were associated with the RNs' competencies for "integrating and applying knowledge, skills, and attributes required to practice safely and ethically in a designated role or setting" (CNA, 2000, p. 6). One RN provided the following interesting narrative:

> These days with the younger generation, if you pull out your iPad or Palm and you come up with the information, you are seen as competent. You are seen as having the advanced knowledge. If you say "well just a minute, I have to go find my book" and you are flipping through the book then you are seen as old fashioned and that you aren't as current as you should be. I don't know that if it is necessarily a competence thing, but a lot of young people these days aren't going to sit there and want to watch you look through a book.

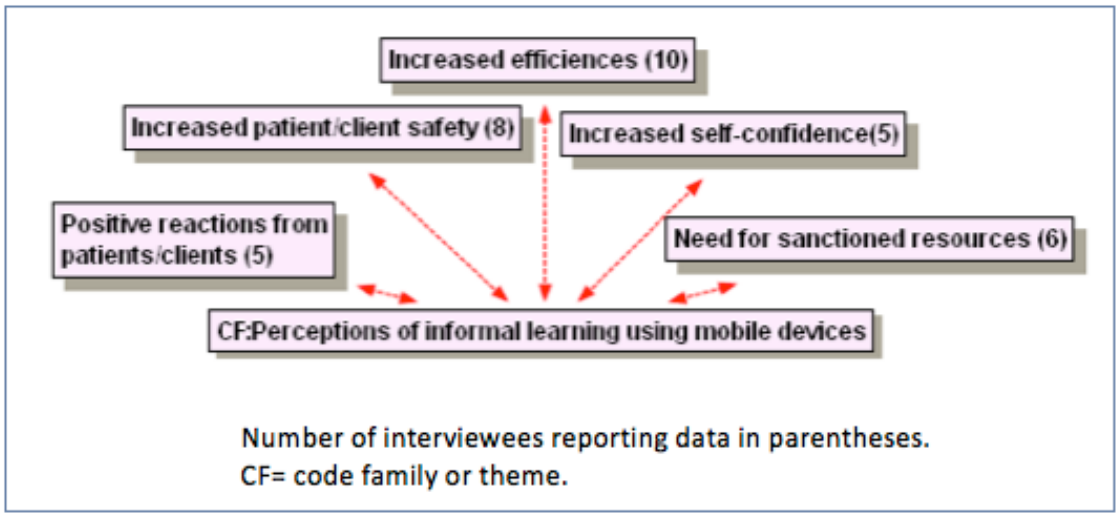


***Figure 4*: Perceptions of informal learning using mobile devices**

The need for sanctioned resources for informal learning including websites and applications, and employer-supplied mobile devices was also voiced.

Purposes of Informal Learning using Mobile Devices

Chi-square analysis revealed statistically significant differences ($p<.05$) for the following:

- accessing resources for evidence-based support (X^2 (1, N = 170) = 10.376, p = 0.001);
- professional development (X^2 (1, N = 170) = 7.624, p = 0.006);
- maintaining competency (X^2 (1, N = 170) =7.624, p = 0.006).

For *accessing resources for evidence-based support* and *professional development*, the actual frequency was more than expected while for *maintaining competency* the actual frequency was less than expected.

The interviewees reported using their mobile devices for informal learning for the purposes as depicted in Figure 5.

Table 4: ***Frequency of Purposes of Informal Learning using a Mobile Device***

Purpose (N = 170)	M	SD
New procedure/treatment	.48	.501
Accessing resources for evidence based support	.62	.486
Patient/client teaching	.44	.498
Professional development	.61	.490
Maintaining competency	.39	.490

As in the Doran, Haynes, Kushniruk, et al. (2010) study, the mobile technologies facilitated timely access to evidence-based resources to promote client care delivery. For professional development, the interviewees alluded to proactively engaging in informal learning using their mobile devices for knowledge and skills acquisition to inform their professional practice. Similar to Berg and Chyung's (2008) findings, participants may be more likely to engage in informal learning strategies/processes for the purpose of gaining new knowledge that was necessary to perform at a higher level in their professional practice.

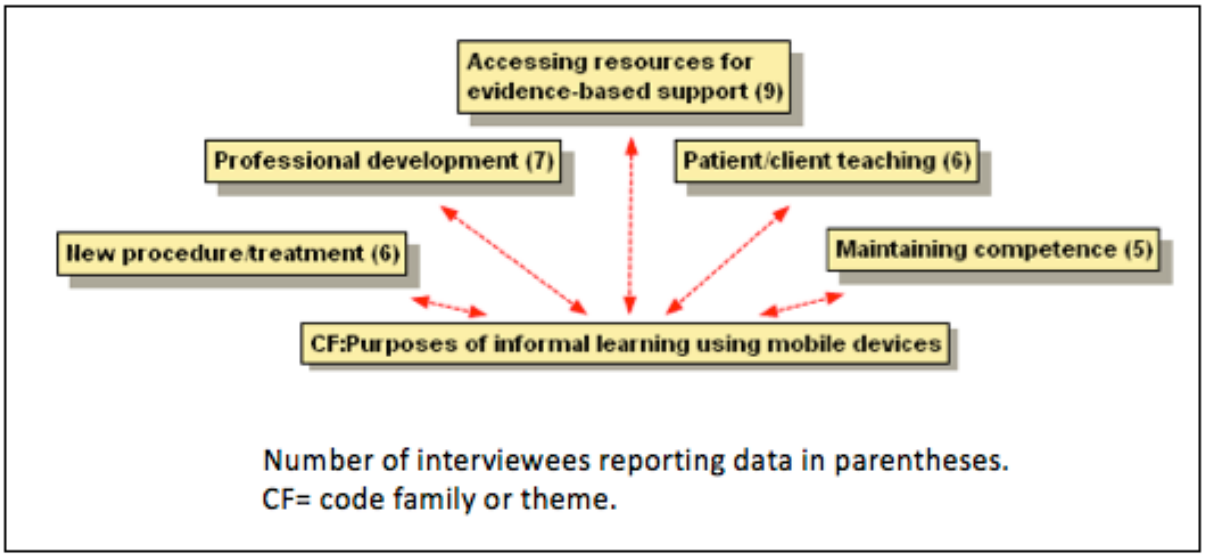


***Figure 5*: Purposes of informal learning using mobile devices**

Although the interviewees cited examples of how they applied their informal learning in their clinical practice, there was a general unawareness of including informal learning using mobile devices in learning plans to satisfy the competency requirements for professional practice. This deficit may have influenced the responses related to the purpose of *maintaining competency*.

Individual and Collaborative Informal Strategies and Processes using Mobile Devices

The collaborative modes ($M = 2.33$, $SD = .885$) were used slightly more frequently than the individual modes ($M = 2.21$, $SD = .696$) for informal learning with mobile devices. However as

per Figure 6, only two interviewees acknowledged using collaborative modes (*interacting with other people via e-mail* and *asking questions in a professional listserv or online community*). In the online survey, *interacting with other people via e-mail* was frequently self-reported. But when probed, the interviewees stated that they emailed via their mobile devices for communication purposes only (i.e., they did not use this process for informal learning).

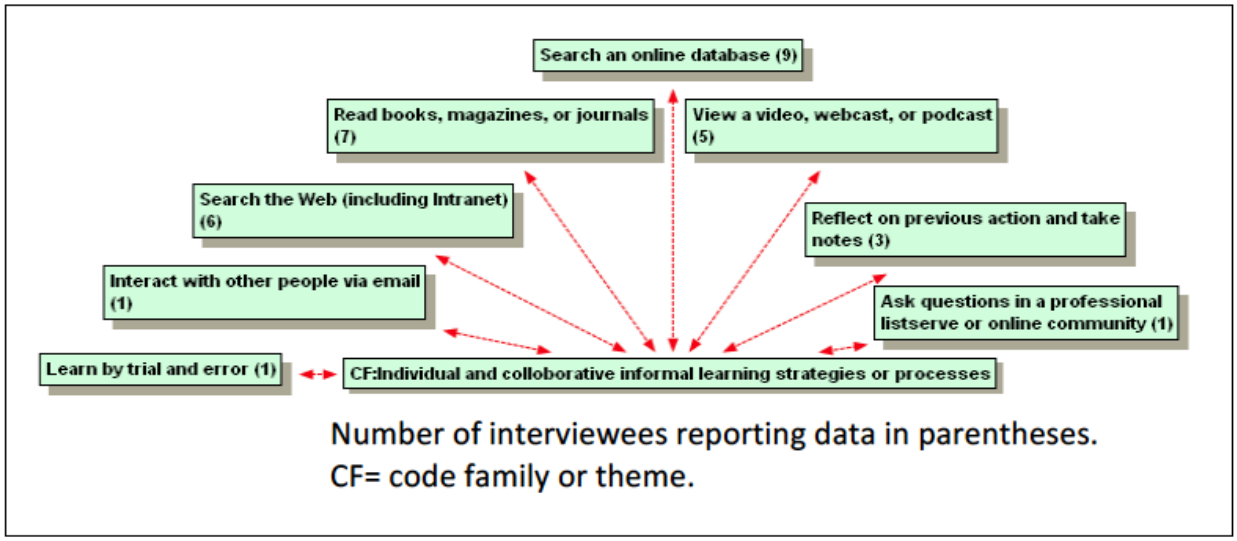


***Figure 6*: Individual/collaborative informal strategies/processes using mobile devices**

The integration of the quantitative and qualitative findings may not always provide corroborative evidence, but "may well add depth or breadth to a study and perhaps even hold the key to understanding the processes which are occurring" (Bazeley, 2004, p. 144). Clough, Jones, McAndrew, and Scanlon's (2009) study on informal learning with mobile devices found that some participants used their devices to communicate, but lacked awareness as to their participation in collaborative informal learning. Their finding is relevant to this mixed methods study; when completing the online survey, some participants may not have recognized a difference between using email for communication and using email for collaborative informal learning. The divergence in the collaborative findings suggests the need for further research.

Table 5: ***Responses for Individual Modes and Purposes of Informal Learning using Mobile Devices***

Purpose	Mann-Whitney U	Asymp. Sig (2-tailed)	Mean Ranks			
			Selected	n	Not selected	n
New procedure/treatment	2264.5	.004	89.70	76	68.96	81
Accessing resources for evidence-based support	2154.5	.009	86.24	99	66.65	58
Patient/client teaching	2046.5	.000	92.97	73	66.86	84
Professional development	2365.5	.056	84.36	98	70.09	59
Maintaining competency	2112.0	.003	92.44	62	70.23	95

All of the purposes except *professional development* were significantly different ($p<.05$) when the individual modes were used with mobile devices, as displayed in Table 5. No significant differences were found with the collaborative modes.

As per cognitive constructivism perspectives, the participants primarily used the individual informal learning modes with their mobile devices to construct new knowledge. These findings concur with Wihak and Hall's (2011) claim that self-directed informal learners prefer individual modes.

Age and Use of Mobile Devices for Informal Learning

Minimal differences were associated to age with informal learning using mobile devices in the healthcare workplace. Using the Kruskal-Wallis test, only the process of *interacting with other people via email* was statistically significant (X^2 (2, N = 162) = 7.689, p = 0.021) with the mean ratings of Generation Y = 57.18 (n = 22), Generation X = 84.05 (n = 104), and Baby Boomers = 89.00 (n = 36). Generation Y participants tended to interact with other people via email less often than the other generations. No differences were found for the strategies/processes used for informal learning among the age generations from the narratives.

For age and the purposes of informal learning using mobile devices, the Kruskal-Wallis test revealed only significant differences ($p<.05$) for *professional development* (X^2 (2, N = 165) = 6.108, p = .047), with mean ranks: Generation Y = 67.25 (n = 22), Generation X = 88.50 (n = 105), and Baby Boomers = 76.92 (n = 38). For professional development, Generation Y used mobile devices for informal learning less than the other generations. Similar findings were found in the narratives.

The Kruskal-Wallis test measured no statistically significant differences ($p<.05$) for the individual modes (X^2 (2, N = 153) = 2.431, p = .297) or collaborative modes (X^2 (2, N = 156) = 4.280, p = .118) with age. As per Table 6, Generation Y self-reported the highest frequency with individual modes while conversely Baby Boomers had highest frequency with the collaborative modes. In the narratives, collaborative mode use was only reported by two Baby Boomers.

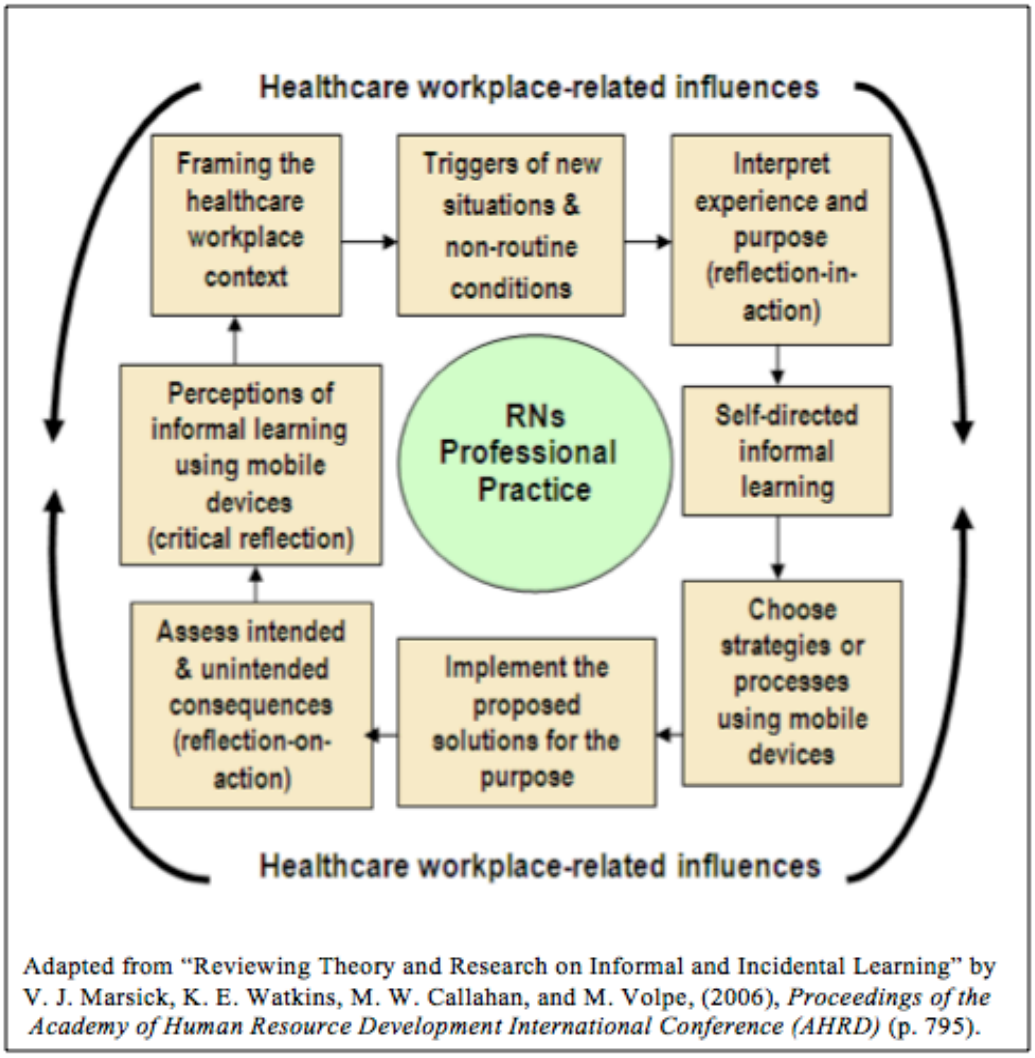
Table 6: ***Frequency and Age for Modes of Informal Learning using Mobile Devices***

Age Generations	Individual Modes		Collaborative Modes	
	Mean Rank	n	Mean Rank	n
Generation Y	84.21	21	59.58	20
Generation X	78.94	97	80.27	101
Baby Boomers	67.30	35	84.20	35

No quantitative or qualitative differences were found between the age generations and location (rural and population centres) for informal learning using mobile devices in the healthcare workplace.

The minimal differences associated with age in this study were similar to Livingstone's (1999) findings in the NALL survey. He found no differences related to age and informal learning activities between middle-aged adults or adults approaching or entering retirement.

Based on the previously discussed model of informal and incidental learning in the workplace, Figure 7 illustrates the informal learning of RNs using their mobile devices in the healthcare workplace for informing their professional practice.



Adapted from "Reviewing Theory and Research on Informal and Incidental Learning" by V. J. Marsick, K. E. Watkins, M. W. Callahan, and M. Volpe, (2006), *Proceedings of the Academy of Human Resource Development International Conference (AHRD)* (p. 795).

***Figure 7*: Informal learning of RNs using mobile devices in the healthcare workplace**

Recommendations

Drawing from the results, there are recommendations for nursing professional practice and future research. In the healthcare workplace, RNs require more information and/or education on self-directed informal learning. Regulatory bodies, employers, and educators have an important role to play in raising RNs' awareness and recognition of informal learning for contributing to CPE, professional development, and continuing competency.

Healthcare organizations and employers should recognize and support the informal learning that RNs are already engaged in using their mobile devices. Restrictions that inhibit informal learning using mobile devices for professional practice should be reviewed. As Farrow (2013) argues,

mobile devices are not a passing fad and organizations need to recognize that they are here to stay. The concerns related to mobile devices use and employee performance, costs, and technological infrastructures warrant further study. Organizational guidelines, policies, and procedures are required for RNs to maximize their workplace informal learning opportunities using mobile devices and to mitigate liability risks including those associated with nurses bringing their own devices into their worksettings.

The expressed need for sanctioned resources for RNs' informal learning using mobile devices, including approved websites and applications, and employer-supplied handheld devices calls for further consideration by healthcare organizations and regulatory bodies.

As this mixed methods study was exploratory, additional studies (including longitudinal studies) on informal learning using mobile devices are needed to:

- assess and provide further breadth and depth on the strategies, processes, and purposes used;
- explore individual and collaborative modes to understand how social processes may influence informal learning and inform professional nursing practice;
- investigate how workplace influences (including employers' perceptions and understandings of the use of mobile devices) affect the RNs' informal learning processes for CPE, professional development, and continuing competency;
- study the reasons why RNs are using mobile devices for greater understanding of the motivations for engaging in informal learning in nursing practice;
- examine the adoption of mobile devices by nurses to determine the receptiveness for uptake in the healthcare workplace.

Furthermore, investigations of other professions related to informal learning using mobile devices may add to the theory base of informal learning and to the body of knowledge on workplace learning.

Conclusion

Throughout this investigation, RNs expressed the importance of informal learning using mobile devices for offering flexibility and learner-centred control to acquire knowledge and develop skills for professional practice. The RNs selected self-directed strategies/processes to individually engage in informal learning using their mobile devices regardless of whether their workplaces had structures in place to support their learning.

While we should be wary of generalizing, due to the major limitation inherent in this study associated with the participants' enrollment in an online Bachelor of Nursing program and their perceptions of receptiveness to adopting new technologies in the healthcare workplace, the findings point to the significance of RNs' using mobile devices as learning tools for informal learning for their professional practice. The substantial changes in the nature of work and its meaning for 21st century workers have created a fruitful climate for the exploration of new pedagogical practices and models of work and learning (Marsick et al., 2011). Further empirical inquiry on informal learning using mobile devices is needed to obtain an in-depth understanding of the intertwined processes of work and learning.

References

Bassendowski, S., & Petrucka, P. (2009). Perceptions of select registered nurses of the continuing competence program of the Saskatchewan Registered Nurses' Association. *The Journal of Continuing Education in Nursing*, *40*(12), 553.

Bazeley, P. (2004). Issues in mixing qualitative and quantitative approaches to research. In R. Buber, J. Gadner, & L. Richards (Eds.), *Applying qualitative methods to marketing management research* (pp. 141–156). UK: Palgrave Macmillan.

Berg, S. A., & Chyung, S. Y. (2008). Factors that influence informal learning in the workplace. *Journal of Workplace Learning*, *20*(4), 229–244.

Billett, S. (2009). Realising the educational worth of integrating work experiences in higher education. *Studies in Higher Education*, *34*(7), 827–843. doi:10.1080/03075070802706561

Bjork, I., Toien, M., & Sorensen, A. (2013). Exploring informal learning among hospital nurses. *Journal of Workplace Learning*, *25*(7).

Canadian Institute for Health Information. (2013). *Regulated nurses: Canadian trends, 2007 to 2011*. Ottawa, ON: Canadian Institute for Health Information (CIHI).

Canadian Nurses Association. (2000, September). A national framework for continuing competence programs for registered nurses. Retrieved from http://www.cnanurses.ca/CNA/documents/pdf/publications/National_Framework_Continuing_Competence_e.pdf

Canadian Nurses Association, & Canadian Association of Schools of Nursing. (2004, June). Joint position statement: Promoting continuing competence for registered nurses. Retrieved from http://www.cna-nurses.ca/CNA/documents/pdf/publications/PS77_promoting_competence_e.pdf

Canadian Nurses Association. (2010, June). 2008 Workplace profiles of registered nurses in Canada. Retrieved from http://www2.cna-aiic.ca/CNA/documents/pdf/publications/2008_RN_Snapshot_e.pdf

Cheetman, G., & Chivers, G. (2001). How professionals learn in practice: An investigation of informal learning amongst people working in professions. *Journal of European Industrial Training*, *25*(5), 246–292.

Clough, G., Jones, A. C., McAndrew, P., & Scanlon, E. (2008). Informal learning with PDAs and smartphones. *Journal of Computer Assisted Learning*, *24*(5), 359–371.

Clough, G., Jones, A. C., McAndrew, P., & Scanlon, E. (2009). Informal learning evidence in online communities of mobile device enthusiasts. In M. Ally (Ed.), *Mobile Learning Transforming the Delivery of Education and Training* (pp. 99–112). Edmonton, AB: AU Press.

Colley, H., Hodkinson, P., & Malcolm, J. (2003). *Informality and formality in learning: A report for the Learning and Skills Research Centre* (pp. 1–93). London, UK: Learning and Skills Research Centre.

Crawford, R. (1999). Teaching and learning it in secondary schools: towards a new pedagogy? *Education and Information Technologies*, *4*(1), 49–63.

Cross, J. (2007). *Informal learning: Rediscovering the natural pathways that inspire innovation and performance*. San Francisco, CA: Pfeiffer.

Curran, V., Kirby, F., & Fleet, L. (2006). The characteristics of continuing professional education systems in the health professions in Canada. *Canadian Journal of University Continuing Education*, *32*(1), 47–82.

Doran, D., Hayne, B., Estabrooks, C., Staus, S., Kushniruk, A., Hall, L. M., et al. (2010). *PDA evaluation, Phase 2. The emerging role of PDAs in evidence based practice: An evaluation among frontline nurses* (Final Report). Ontario: Ministry of Health and Long-Term Care.

Doran, D., Haynes, R., Kushniruk, A., Straus, S., Grimshaw, J., Hall, L. M., et al. (2010). Supporting evidence-based practice for nurses through information technologies. *Worldviews on Evidence-Based Nursing*, *7*(1), 4–15.

Eraut, M. (2004). Informal learning in the workplace. *British Journal of Educational Psychology*, *26*(2), 247–273.

Fahlman, D. (2012). *Informal Learning of Registered Nurses using Mobile Devices in the Healthcare Workplace*. (Doctoral Thesis). Athabasca University, Athabasca, Canada. Retrieved from https://dt.athabascau.ca/jspui/handle/10791/21

Farrow, M. (2013, March). Leave employees to their own devices. *Canadian Nurse, 109*(3), 42.

Hager, P., & Halliday, J. (2009). *Recovering informal learning: Wisdom, judgement and community* (Vol. 7). Dordrecht, Netherlands: Springer.

Kaminski, J. (2011). Diffusions of innovation theory. *Canadian Journal of Nursing Informatics*, *6*(2). Retrieved from http://cjni.net/journal/?p=1444

Kanselaar, G. (2002, July). Constructivism and socio-constructivism. Retrieved from http://edu.fss.uu.nl/medewerkers/gk/files/Constructivism-gk.pdf

Kenny, R. F., Park, C., Van Neste-Kenny, J., Burton, P. A., & Meiers, J. (2009). Using mobile learning to enhance the quality of nursing practice education. *Mobile learning: Transforming the delivery of education and training* (pp. 51–75). Edmonton, AB: AU Press.

Kukulska-Hulme, A., & Pettit, J. (2009). Practitioners as innovators: Emergent practice in personal mobile teaching, learning, work, and Leisure. *Mobile learning: Transforming the delivery of education and training*, 135–155.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Livingstone, D. (1999). Exploring the iceberg of adult learning: Findings of the first Canadian survey of informal learning practices. University of Toronto: Ontario Institute for Studies in Education. Retrieved from https://tspace.library.utoronto.ca/retrieve/4451/10exploring.pdf

Livingstone, D. (2001). *Adults' informal learning: definitions, findings, gaps and future research* (WALL Working Paper No. 21) (pp. 1–49). Toronto, ON: University of Toronto.

Livingstone, D., Mirchandani, K., & Sawchuk, P. H. (2008). Introduction: Critical Perspectives on learning and work in turbulent times. In D. W. Livingstone, K. Mirchandani, & P. H. Sawchuk (Eds.), *The future of lifelong learning and work* (pp. 1–10). Rotterdam, Netherlands: Sense Publishers.

Livingstone, D., & Scholtz, A. (2006). *Work and lifelong learning in Canada: Basic findings of the 2004 WALL Survey* (pp. 1–77). Toronto, ON: University of Toronto.

Lohman, M. C. (2005). A survey of factors influencing the engagement of two professional groups in informal workplace learning activities. *Human Resource Development Quarterly*, *16*(4), 501–527.

Marsick, V. J., Volpe, M., & Watkins, K. E. (1999). Theory and practice of informal learning in the knowledge era. *Advances in Developing Human Resources*, *1*(3), 80–95.

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. *New Directions for Adult and Continuing Education*, *2001*(89), 25–34.

Marsick, V. J., Watkins, K. E., Callahan, M. W., & Volpe, M. (2006). Reviewing theory and research on informal and incidental learning. *Proceedings of the Academy of Human Resource Development International Conference (AHRD)* (pp. 794–800). Columbus, OH.

Marsick, V. J., Watkins, K. E., & Lovin, B. (2011). Revisiting informal and incidental learning as a vehicle for professional learning and development. *Elaborating Professionalism*, 59–76.

McGreal, R. (2005). Mobile devices and the future of free education. Presented at the International Council for Distance Education 2005, October 24-28, New Delhi, India: International Council for Distance Education.

Nelson, S., & Purkis, M. E. (2004). Mandatory reflection: The Canadian reconstitution of the competent nurse. *Nursing Inquiry*, *11*(4), 247–257.

Penz, K., D'Arcy, C., Stewart, N., Kosteniuk, J., Morgan, D., & Smith, B. (2007). Barriers to participation in continuing education activities among rural and remote nurses. *The Journal of Continuing Education in Nursing*, *38*(3), 58–66.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York , NY: Simon and Schuster.

Sale, J. E. M., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. *Quality & Quantity*, *36*(1), 43–53.

Schön, D. A. (1987). *Educating the reflective practitioner*. San Francisco, CA: Jossey-Bass.

Schugurensky, D. (2000). *The forms of informal learning: Towards a conceptualization of the field* (No. 19). NALL Working Paper (pp. 1–8). Toronto, ON: University of Toronto

Schweitzer, D., & Krassa, T. (2010). Deterrents to nurses' participation in continuing professional Development: An integrative literature review. *The Journal of Continuing Education in Nursing*, *41*(10), 441–447.

Shannon, V., & French, S. (2005). The impact of the re-engineered world of health-care in Canada on nursing and patient outcomes. *Nursing Inquiry*, *12*(3), 231–239.

Streumer, J. N., & Kho, M. (2006). *Work-Related Learning*. Dordrecht, Netherlands: Kluwer Academic.

Suter, E., Oelke, N., Adair, C., & Armitage, G. (2009). Ten key principles for successful health systems integration. *Healthcare Quarterly, 13*, 16-23.

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Islands, CA: SAGE.

Thomas, P., & Moisey, S. (2006). Women entrepreneurs: Informal learning and the Internet. *Journal of Small Business and Entrepreneurship*, *19*(2), 183 –202.

Watkins, K. E., & Marsick, V. J. (1992). Towards a theory of informal and incidental learning in organizations. *International Journal of Lifelong Education*, *11*(4), 287–300.

Wihak, C., Hall, G., & Durand, C. (2010). Workplace informal learning: Understanding research and practice. *The Canadian Learning Journal*, *14*(2), 20, 21, 30.

Wihak, C., & Hall, G. (2011). *Work-related informal learning*. Centre for Workplace Skills. Retrieved from http://www.workplaceskills.ca/

Woolley, C. M. (2009). Meeting the mixed methods challenge of integration in a sociological study of structure and agency. *Journal of Mixed Methods Research*, *3*(1), 7–25.

Author

Willy Fahlman earned her Doctor of Education in Distance Education at Athabasca University. She facilitates learning as a Distance Educator at Athabasca University and as an eHealth Educator at Alberta Health Services. Her research interests include e-learning, informal learning, eHealth, workplace learning, and mobile learning. Email: willyf@athabascau.ca