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Document Version:
Author submitted manuscript (preprint)

Citation for published version:

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Development of an information management knowledge transfer framework for evidence-based occupational therapy

I couldn't navigate the evidence, interpret it, manage it, apply it, or even figure out how to file it once I'd tried the first tasks. I'd search at work or in my private practice between seeing clients, or at home while I watched TV, but I'd have trouble prioritizing which articles to skim, read, or print. I found it annoying when I did find a good article on the Internet but I couldn't gain access, so I bought some articles but once I got them, some turned out to have no practical application. After a while I realised that I needed some guidance. (Leigh, OT Private Practitioner).

1. Introduction

Occupational therapy was founded in 1917 by a group of professionals that included medical doctors, nurses, social workers, secretaries and teachers of arts and crafts (Gordon 2009, p.206).

The profession has continued to grow and develop across the globe throughout the past century and there are now 57 full member nations and 16 associate member nations of the World Federation of Occupational Therapists (WFOT) representing over 350,000 occupational therapists internationally (World Federation of Occupational Therapists 2011).

From its inception, the founders of the profession articulated the importance of basing occupational therapy practice on scientific knowledge (Gordon, 2009). Since that time the profession has focused much attention on maintaining the original vision of being a knowledge-based, science-driven profession (American Association of Occupational Therapists, 2006).

The evidence-based practice era emerged in the 1990s, just as occupational therapy was consolidating its own theories and models. As a result of the emergence of the evidence-based practice era occupational therapy enjoyed a period of significant growth through research and publishing. Literature shows that people in areas such as medicine and business were also
researching and writing about evidence, best practice and knowledge management at this time (Spender & Grant, 1996; Greenhalgh, 1997).

Information and computing technology has changed how people interact with information and with each other (Kietzmann, Silvestre, McCarthy, & Pitt, 2012; Zhao, 2006) to the point that now almost all education environments, community services and workplaces in the western world require at least basic computer skills (Hargittai, 2005) in order to access information and services. The knowledge era in the wider community emerged in parallel to the evidence-based practice era in healthcare during the 1990s and the speed of change during this period was fuelled by growing access to computer technology (McDermott, 1999; Spender & Grant, 1996). As a consequence to these rapid changes information literacy and digital literacy emerged as two essential competencies for life in the 21st Century (Kenton & Blummer, 2010).

The purpose of this paper is to present some of the findings from a study designed to examine digital literacy in the occupational therapy profession in the context of information literacy, information management and knowledge transfer for evidence-based practice. The findings presented in this paper focus on an Information Management Knowledge Transfer (IM-KT) Framework for occupational therapy practice that emerged from the study.

2. Literature Review

2.1. The Evolution of Occupational Therapy

Occupational therapy has its philosophical roots in the period of Enlightenment when doctors and nurses noted that people with mental illnesses who were in asylums, or people who were immobilized due to conditions such as polio, improved their state of physical and mental health through participation in occupations (Gordon, 2009). Over the past ninety years occupational therapy has incorporated scholarship from disciplines including psychiatry, medicine, nursing,
social work, psychology, architecture, engineering health promotion and public health (Gordon, 2009). Today occupational therapists work with individuals, families, groups and communities to overcome physical cognitive and social barriers that limit participation in day-to-day activities, and play an important role in the areas of health, education and social care.

In reviewing the occupational therapy literature it became apparent that several shifts have occurred in the philosophies and theories guiding the profession. In the very early years occupational therapy was founded on a belief that engagement in occupations had the power to restore health (Gordon, 2009; Shannon, 1977), with a particular focus on mental health (Gordon, 2009). This focus changed during WWI and WWII and shifted occupational therapy's focus towards application of medically based rehabilitation interventions (Shannon, 1977). A re-examination of the core beliefs of the profession during the 1960s and 1970s saw a "renaissance of occupation" start to emerge in occupational therapy (see Whiteford et al., 2000) which led to the development of a plethora of occupation-based models and theories during the 1980s and 1990s (Christiansen & Baum, 1997; Dunn et al., 1994; Kielhofner & Burke, 1980; Law et al., 1990; Law et al., 1996; Mosey, 1981; Schkade & Schultz, 1992; Wilcock, 1998).

The early pioneers of occupational therapy had a clear vision that occupational therapy would develop as both a scholarly and a practical profession (Gordon, 2009). Shannon (1977) claimed that occupational therapy had become derailed and had lost its focus on occupation as its core domain of practice and had become a pseudo-medical profession. Gordon (2009) states that during this era occupational therapy sought legitimacy by being seen as a medically based profession. Hooper (2006) agrees with Shannon’s assertion that the occupational therapy profession had lost its focus on occupation; however she reflects that the profession has experienced growth since that era and has seen significant eras of change in the profession since the 1970s.

The first of these significant eras of change was between the 1970s and 1990s when the profession
started to develop its own occupation-based theories and models. Hooper (2006) states that in this era occupational therapy was creating its own narrative and theories and differentiating itself from the medical profession.

The second era, between the 1990s and 2010s, saw many within the profession embracing an evidence-based approach to practice; this era paralleled the evidence-based-medicine movement (Cusick & McCluskey, 2000). Much of the focus of the evidence-based-practice era was placed on helping occupational therapists understand how to structure answerable, practice-based questions, undertake literature searches in databases, find reliable published and non-published evidence, and interpret information so that it could be applied in context (McCluskey & Cusick, 2002; Zimmerman, 2008). A third era, termed the knowledge era, appears to have started to emerge in both occupational therapy (see Figure 1) and in medicine (see Figure 2).

A search of the SCOPUS database was undertaken to review the literature using specific terms that represented the eras. The number of publications that occurred in each five-year period between 1961 and 2010 published in English were tabulated and graphed. The findings show that, in each period, both occupational therapy and medicine published on each of the categories: models, evidence-based practice and knowledge management. Digital literacy and ICT was included as one of the search categories, however publications about digital literacy and ICT are still relatively few in both occupational therapy and medicine.

Similar trends in publication have occurred in both occupational therapy and medicine, however occupational therapy has shown a higher proportion of publications from the search category of 'models' and medicine has shown a higher proportion of publications from the search category 'evidence-based practice'. This supports the assertion by Hooper (2006) that by developing its own theories and models occupational therapy was creating its own narrative and theories and differentiating itself from the medical paradigm. See Table 1 and Table 2 for the search terms used...
and Figure 1 and Figure 2 to see the graphic representation of the results.

Table 1. Search terms used in SCOPUS to examine trends in publications in occupational therapy

Table 2. Search terms used in SCOPUS to examine trends in publications in medicine

Figure 1. Publications in Occupational Therapy by Topic

Figure 2. Publications in Medicine by Topic

The three eras discussed above illustrate that the occupational therapy profession started from a position that was based in the information provided by others. The profession then moved through an era dominated by the medical paradigm and has transitioned to a position where its knowledge still draws on the knowledge of others whilst also creating knowledge of its own, based on its own theories and models. In the evidence-based practice era and the knowledge era occupational therapists are expected to be able to locate and understand evidence, and they are also expected to translate the evidence in the context of their practice and create new knowledge for practice. These expectations can lead to the experience of information overload (Green, 2011; Skinner, 2004), therefore a new set of competencies is required for occupational therapists to be evidence-based practitioners in the knowledge era.

2.2. Competence in the evidence-based practice and knowledge era

Two key competencies, information literacy and digital literacy, have emerged in the evidence-based practice and knowledge eras. Health care professionals recognize that ongoing professional development is essential for best practice but knowledge from continuing professional development becomes obsolete after two to five years (Brennan, 1992; Ferrell, 1988; Tassone & Heck, 1997). Regular ongoing professional development is necessary in order to stay up-to-date and deliver best
practice health services. Technology is one avenue that provides access to professional
development activities (Sargeant et al., 2006; Younger, 2010) and evidence-based practice (David
et al., 2012). Having the skills to find and use relevant, high quality information became the key
focus in the evidence-based practice era but, after many health care practitioners struggled to find
appropriate information to answer practice-based questions, it became clear that there was also a
need to develop advanced skills to access and apply best evidence for practice. As mentioned
above, these skills are now founded on having strong information literacy and digital literacy
competencies.

2.2.1. Information literacy

A plethora of information comes at professionals through formal and informal modes, and much of
the information comes unfiltered through graphical, aural, and textual modes (Bundy, 2004, p.3). It
is necessary for us to process this information, to organise and store it for future access to be able to
share, discuss, understand and apply information and transform it to knowledge.

In order for people to take in, process the information and then construct knowledge, they need to
develop information literacy skills (Marcum, 2002; Salisbury & Karasmanis, 2011). Patricia
Breivik (Marcum, 2002, p.2) has been credited with promoting the information literacy initiative in
the 1980s. Breivik’s work presented a structure for understanding the process of developing
information literacy and presented it as an essential skill for lifelong learning (Marcum, 2002, p.2).
Lupton (2008) states that information literacy has two distinct phases of seeking and then applying
information and has created a definition of information literacy based on a broad range of sources.
Lupton (2008, p.399) states that information literacy is:

“...seeking, locating, evaluating, selecting and organizing information. It also involves
using information to analyze, synthesize, create new knowledge, communicate, make
decisions and problem solve. As such, it is often considered an essential component of
critical thinking, independent learning and lifelong learning (Association of College and Research Libraries, 2000; Bundy, 2004; UNESCO et al., 2006)”

2.2.2. Digital literacy

Digital technology has changed how people interact with information and with each other (Kietzmann et al., 2012; Zhao, 2006). The rapid evolution of digital technology has meant that the Internet, which was initially developed as a repository for information storage and retrieval, has become an interactive virtual environment. O’Reilly (2007) states that this form of connectivity has harnessed collective intelligence and facilitated interactivity, networking and shared learning. Using digital technologies such as blogs, wikis and online forums, people across the globe can interact with each other, build networks, collaborate (Reddy & Spence, 2008; Younger, 2010) and create communities around topics of shared interest (Eysenbach et al., 2004; Rainie & Fox, 2000; Reddy & Spence, 2008). Digital technology allows the development of both formal and informal connections between individuals, groups, students, practitioners, researchers and, most importantly, with healthcare consumers (Baker et al., 2013; Eysenbach et al., 2004; Gowen et al., 2012). The Internet has become integral to information management and knowledge transfer.

Alavi and Leidner (2001) state "...advanced information technologies (e.g., the Internet, intranets, extra-nets, browsers, data warehouses, data mining techniques, and software agents) can be used to systematize, enhance, and expedite large-scale intra-and inter-firm knowledge management" (p.108). Therefore, as information is now predominantly stored and shared in a digital space, digital literacy has become an essential skill for life in the 21st Century.

Skills in digital literacy can be defined simply as having the capacity to know which digital tools to select and use for information management and knowledge transfer activities. Skills in digital literacy, also referred to as “digital information literacy” by Jeffreys et al. (2011, p.2), enhance one's capacity to discover, organize and share information, and impacts one's capacity to access and use
information. Digital literacy represents the ability to use digital technologies, such as a computer or a smart phone, to perform tasks that include reading and interpreting media (text, sound, images), understanding and reproducing data and images through digital manipulation, interacting with others using language appropriate to the media, and evaluating and applying new knowledge gained from digital environments, (Hamilton & Penman, 2013, adapted from: Jones-Kavalier & Flannigan 2006, p.9).

Early adopters of digital technology in the healthcare industry have identified the need for healthcare practitioners and educators to get involved in creating digital resources for networking, education and research, and have been advocating the use of tools such as wikis, blogs, podcasts and social networking sites to achieve this outcome (Potts, 2006; Kamel Boulos & Wheeler, 2007; McLean et al., 2007). However several barriers exist for healthcare practitioners wishing to utilize digital technologies for information management and knowledge transfer. Barriers include limited access to reliable information sources, such as library databases (Rowlands et al., 2011), limited access to Internet-connected computers in the work environment (Reddy & Spence, 2008; Salbach et al., 2007; Younger, 2010) lack of knowledge of how to use ever-changing digital technologies (Kloda & Bartlett, 2009) and lack of time to learn how to use or access computer resources when they are available (Barnard et al., 2005; David et al., 2012). For those who are able to use Information and Communication Technologies (ICTs) to seek information many are reporting having a sense of burden or being overwhelmed by having access to too much information (Hall & Walton, 2004; Rebitzer et al., 2008; Wilson, 2001). Ho et al (2004) provide an excellent summary of the dilemma in saying:

"To date, in health care, neither KT nor the extensive use of information and communication technologies has made its full impact in health care research and delivery. The reason lies neither in the insufficiency of available new information nor in the inadequacy of information technology but primarily in the lack of appropriate integration of the two" (p.91).
Digital literacy has become essential for health care practitioners to be able to access, store, generate and share information using computer technology. Schaper and Pervan (2007) reported a concern that the health care sector was lagging behind other sectors in the uptake of ICT and stated that “Clinical information systems, the Internet, telemedicine, personal digital assistants, electronic patient records and other applications will inevitably become commonplace in health” (p. S214). Schaper and Pervan’s (2007) research found that occupational therapists did not fit the same profile of ICT adoption as other members of the healthcare team as they “are not significantly influenced by their peers and that their decisions to use technology are made independent from others in the healthcare team” (p. S219). It has become evident that occupational therapists require a framework to facilitate their understanding of ways to successfully navigate information and knowledge systems.

2.3 Knowledge management

Although knowledge management (KM) is difficult to define, Chatti (2012, p.830) states that KM revolves around two core views; "knowledge as a thing and knowledge as a process". Knowledge as a thing depicts knowledge as an object that can be captured, stored, used and controlled while knowledge as a process highlights the importance of the interaction between people and knowledge within a context for example in an organisation. Context factors include: "Human-oriented factors: culture – people – leadership; Organisation: process and structure; Technology: infrastructure and applications; Management process: strategy, goals and measurement" (Heisig, 2009, p.12).

In his in depth analysis of 160 knowledge management (KM) frameworks developed between 1995 and 2003, Heisig (2009) was able to distil the five essential components of KM activities. These essential components were "sharing, creating, using, storing and identifying" (Heisig, 2009, p.10). This list captures the notions of knowledge as a process and knowledge as a thing and indirectly highlights the contextual factors at play.
Dobbins et al. (2009), Heisig (2009, p.7) and Weber, Krieghoff and Katzung (as cited by Heisig 2009) all agree that identification of factors within the context of an organisation is essential to implementing KM effectively. Weber et al. (as cited by Heisig, 2009, p.4) state in particular that highlighting context has been critical to developing a better understanding of what leads to successful KM after the initial “technological euphoria and the KM hype, followed by the disillusion”. Therefore a transactive view of KM has emerged, which requires consideration of knowledge as a thing and a process, occurring within a changeable context. These factors should each be taken into consideration in knowledge management activities in any organization (Heisig, 2009, p.7).

2.3.1. Data, Information and Knowledge

One of the key aspects of knowledge management is to understand the difference between data, information and knowledge and how data can become information and information can become knowledge. In short, data is raw numbers and facts, information is processed data and knowledge is authenticated information (Alavi & Leidner, 2001 as cited by Liyanage et al., 2009, p.119).

Occupational therapists often receive data in a raw form. The data requires some level of interpretation within the practitioner’s specific context to become meaningful. If the interpretation of the data is successful, it becomes information (Jeffrey et al., 2011) and the information can be used to assist the practitioner to make decisions with their client. Information is therefore simply data that has been processed in a meaningful way (Liyanage et al., 2009). Information processing occurs within and between individuals when they are listening, thinking, problem solving, pondering, discussing, arguing and conversing (Liyanage et al., 2009).

For information to be translated into knowledge, information needs to be “internalized and becomes part of the recipient’s expectational structure... it affects the recipient’s belief structure, taken as
disposition to *act*” (Boisot et al., 2007, p.7). Knowledge is therefore “a fluid mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information” (Davenport & Prusak, 1998, p.5).

According to Alavi and Leidner (2001), knowledge may be:

- a state of mind;
- an object;
- a process;
- a condition of having access to information; or
- a capability

Liyanage et al. (2009, p.126) further suggest that; “acquired knowledge requires some kind of conversion of knowledge in order for it to become useful for the receiver where they can produce new knowledge, skills or capabilities”. This expert insight, also described above by Davenport and Prusak, is seen by Bender and Fish (2000) as the fourth dimension in the transformation process: data to information to knowledge and finally to expertise (see Figure 3). These authors share similar themes in their definitions. They clearly delineate between data, information and knowledge and describe processes of transformation occurring with and/or between individuals that changes data to information and information to knowledge.

**Figure 3. Knowledge Hierarchy (Bender & Fish, 2000)**

2.4. *What are we managing – knowledge or information?*

Although there is a clear delineation made in the KM literature between data, information and knowledge (Alavi & Leidner, 2001; Davenport & Prusak,1998; Liyanage et al., 2009) the term knowledge management appears to be an overall description of what is occurring. When the definitions of data, information and knowledge are examined more closely it is clear that the knowledge management process is a combination of information management and knowledge
Knowledge translation is defined by the Canadian Institutes of Health Research (CIHR) as “the exchange, synthesis and ethically-sound application of knowledge – within a complex system of interactions among researchers and users – to accelerate the capture of the benefits of research through improved health, more effective services and products, and a strengthened health care system” (CIHR as cited by Graham et al., 2006, p.15). Put simply knowledge translation is the process where information has been understood and transformed to knowledge for use in a specific context.

Knowledge transfer however is “a systematic approach to capture, collect and share tacit knowledge in order for it to become explicit knowledge” (Government of Alberta as cited by Graham et al., 2006, p.15). Knowledge transfer is about movement of information and ideas from one group to another. The differentiation between knowledge translation and knowledge transfer is important because knowledge translation occurs in the context of practice and knowledge transfer can be evident within the practice setting or externally, for example through publishing in scholarly journals.

Heisig (2009, p.15) writes “the understanding of knowledge, the core object of KM, still requires more research and practical experience in order to achieve a widely shared understanding”.

3. Exploring digital literacy within occupational therapy

The overall aim of the research reported in this paper was to explore the question "how can we improve the information literacy and digital literacy of the occupational therapy profession, in order to enhance evidence-based practice?" Therefore, to explore how occupational therapy stakeholders, clinicians, educators and students, can become more digitally literate this study addressed the following research question:
• How can digital technologies be utilized for information management and knowledge transfer to access and utilise best evidence in occupational therapy?

To be able to answer this question the following sub-questions needed to be addressed:

• For what purpose do occupational therapy stakeholders (students, educators and practitioners) use digital technology currently?
• What is the current level of use of digital technology by occupational therapy stakeholders?
• What are the barriers and facilitators to using interactive digital technologies in information management and knowledge transfer in occupational therapy?
• How can we overcome existing barriers to using interactive digital technologies in information management and knowledge transfer in occupational therapy?

4. Methods

A mixed methods approach was taken in this study. Mixed methods studies are chosen to provide a better understanding of the research problem by combining both quantitative and qualitative data gathering methods and are an appropriate methodological choice when the researcher seeks breadth and depth of understanding (Taylor et al., 2006). The use of both methods, in combination, provides a better understanding of the research problem than either method alone would provide and strengthens the research as a result (Creswell, 2007).

The study occurred in three phases and three data collection methods were used. The IM-KT framework, which is the focus of this paper, was developed and refined throughout the three phases of the research process. In phase I the focus was to develop a foundation conceptual framework through analysis of the literature. The aim of phase II was to take a 'snapshot' of the level of digital literacy in occupational therapy using surveys. In phase III the conceptual framework was further refined and experts were consulted using a Delphi method to explore how occupational therapy could advance as a digitally literate profession. Research ethics permission was obtained through the authors' academic institution at each phase of data collection.
4.1. Phase I: Development of a conceptual framework

The initial development of the conceptual framework occurred after examination of published literature and incorporation of the researchers’ existing knowledge. In order to uncover a broad range of information to build a conceptual framework the terms identified in Table 3 were searched for in the following databases; SCOPUS, Medline, CINAHL, ERIC, OTSeeker, Google Scholar, PubMed, the Cochrane Collaboration.

Table 3. Development of the conceptual framework search strategy

The search for information was an iterative process, i.e., the early searches led to a broadening of the researchers' understanding of search terms. This led to the exploration of a broader range of topics, as the understanding of the use of the terms within the literature evolved. The topics included:

- Diffusion of innovation (Rogers, 2003).
- Digital literacy (Jones-Kavalier & Flannigan, 2006; Kenton & Blummer, 2010).
- Evidence-based practice (Sackett et al., 1996; Greenhalgh, 1997; Dewey et al., 2006; Bennett et al., 2003; McCluskey & Cusick, 2002; McCluskey et al., 2006; Zimmerman, 2008).
- Information and communication technology (ICT) in occupational therapy education and practice (Schaper & Pervan, 2007; Hollis & Madill, 2006).
- Information and communication technology (ICT) in healthcare education and practice (Seeman, 2008; Boulos & Wheeler, 2007; Boulos et al., 2006; David et al., 2012; Eysenbach, 2008).
- Information literacy (Breivik, 2005; Marcum, 2002; Barnard et al., 2005; Salisbury & Karasmanis, 2011).
- Evolution and development of the occupational therapy profession (Gordon, 2009; Hooper, 2006; Shannon, 1977).
- Knowledge transformation (Boisot et al., 2007).
- Knowledge management sub-concepts such as data, information, knowledge, knowledge
transfer (Boisot et al., 2007; Graham et al., 2006; Alavi & Leidner, 2001; Davenport & Prusak, 1998; Liyanage et al., 2009; Heisig, 2009; Bender & Fish, 2000).

- Theory of Reasoned Action and the Technology Acceptance Model, Theory of Planned Behaviour (Aggelidis & Chatzoglou, 2009; Feng-Kuang et al., 2009; Darsono, 2005; Hu et al., 1999; Liu et al., 2010).

While investigating the literature the researchers also undertook a continuous process of reflection about the importance of and interrelationship between the emerging concepts, in the context of occupational therapy, and in light of the research questions. To facilitate the reflection process the first author used concept mapping to illustrate the factors influencing occupational therapy stakeholders’ use of digital technologies in information management and knowledge transfer activities. The maps were then presented to the other authors for discussion during regular research supervision sessions. The concept mapping process led to the development of a conceptual framework, which then guided the development of the survey focusing on digital literacy among occupational therapy stakeholders during phase II. The work of Alavi and Leidner (2001) was particularly useful in building the conceptual framework.

The conceptual framework enabled the researchers to clearly identify and define the problem being investigated and define the systems relevant to information management and knowledge transfer in occupational therapy.

4.2. Phase II: Survey of stakeholders

The aim of Phase II was to develop an understanding of how key stakeholders from the occupational therapy profession used online technologies in information management and knowledge transfer. As previously discussed the conceptual framework developed in phase I was used in conjunction with the research literature (Seeman, 2008; Graham et al., 2006; Hargittai, 2005) to design the surveys and build the question bank (Hargittai, 2005; Mancinelli, 2005; Schaper
& Pervan, 2007). As the literature suggested that stakeholders have access to different technology and have different information needs two separate surveys were developed for the two specific groups of stakeholders: educators and students; and practitioners.

The first survey was completed by occupational therapy students and educators from Australia, New Zealand, the UK, USA and Canada (n=257). The second survey focused on occupational therapy practitioners from the same countries (n=255). The five countries were selected as they historically share social, cultural, political and language ties (Egri et al., 2012).

The surveys were designed to explore the skill level of occupational therapy stakeholders in using digital technologies for information management and knowledge transfer. The aim was to collect baseline data that would give an indication of the digital literacy of the stakeholders and inform Phase III of the project. The full findings from the surveys will be presented in a subsequent paper.

**Figure 4. The conceptual framework presented to experts in the Delphi study**

4.3. **Phase III Delphi Study**

Phase III of the study utilized a Kantian, or contributory Delphi approach, which is a design that allows many informed individuals in different disciplines or specialties to contribute information or judgments to a problem area that is much broader in scope than the knowledge that each of the participants possesses individually (Linstone & Turoff, 1975, p.27). This approach is useful because it allows a conceptual framework to be examined, critiqued and revised by a panel of experts in an attempt to reduce bias and clarify the emerging picture. This was important as Vaughan (2008) warns that conceptual frameworks can be biased by the experience and knowledge of the developers. Furthermore, once developed the framework can influence the researcher’s thinking in an on-going way. This may result in some aspect being given prominence while others may move into the background,
Delphi is an iterative research approach designed to collect and distil the anonymous judgments of experts using a series of data collection and analysis techniques interspersed with feedback (Skulmoski et al., 2007). The Delphi technique can be applied to problems that do not lend themselves to precise analytical techniques but rather could benefit from the subjective opinions of individuals on a collective basis and when a group of experts cannot be easily gathered together in one place (de Villiers et al., 2005).

In this study the Delphi method, using open-ended questionnaires, was used to seek answers to two broad questions; "what processes are involved in information management and knowledge transfer in occupational therapy?" and "how can occupational therapy stakeholders better utilize digital technologies for information management and knowledge transfer to improve best practice in occupational therapy?". The focus of this paper is on the responses to the first question.

The first question was designed to obtain consensus of opinion about the ongoing development of the conceptual framework. The second question did not focus on seeking consensus but on bringing together a set of opinions that could be examined and reported so that they may be used judiciously in the recommendations being made as a result of the overall study. Responses were summarised and reported back to the expert panel in the subsequent round of the Delphi study.

The categories of experts for the panel were determined through brainstorming and reviewing the relevant literature to generate a list of characteristics essential for a participant to be included in the study. Keeney et al. (2010, p.48) identified generic criteria to guide selection of an expert panel. The criteria included: "Knowledge and practical experience with the issue under investigation; Capacity and willingness to contribute; Assurance that sufficient time will be dedicated to the Delphi exercise; Good written communication skills; Experts' skills and knowledge need not necessarily be accompanied by standard academic qualification or degrees". Each category of expert was labelled and given a descriptor (see Table 4).
After the expert consultant categories were determined, a list of potential participants was made. So that there would be an even selection across the five countries involved in the study and at least one but no more than two experts from each category, selection of the expert consultants was monitored closely and the participants were purposefully selected (see Table 4).

Each potential participant was contacted by email to introduce the purpose of the study, and provided with an overview of the expert categories, identifying which category they were being asked to represent. Of the initial 18 individuals contacted 16 agreed to participate, two declined due to work commitments but were replaced by two new invitees, both of whom agreed to participate.

Eighteen participants commenced round 1 of the Delphi study. To the best of the authors' knowledge the participants did not interact at any time during the research process. Anonymity is a feature of the Delphi method that helps to avoid "group think" (Tersine & Riggs, 1976 as cited by Daniel & White, 2005, p.193) which can occur when participants are interviewed together. It was also important for the participants to remain unknown to each other as there was the potential for power difference to influence the outcome (e.g. university undergraduate student and university educator).

5. Results of the Delphi study

5.1. Round 1 of Delphi study

There were four rounds in the Delphi study. At the beginning of the first round the experts were given a link to a video where the author described the process of the development of the conceptual framework to date and asked them to contribute to refining the framework via an online questionnaire.
In round one of the Delphi study the goal was to start to work towards developing consensus on the conceptual framework that was developed by the authors during phase I and II of the research (to be published separately) and ask experts to identify online technology tools they use for information management and knowledge transfer in work and/or student life. Comments and suggestions made by the experts about the conceptual framework directly impacted the content and layout of the framework, and the subsequent changes after round one of the Delphi are summarised below:

- Information is not always sought, sometimes it is simply discovered - several participants used the term serendipity when describing how information can be discovered.
  - Therefore information seeking was changed to information discovery.
- Information literacy and digital literacy should be central to the conceptual framework as it is not the tools but the skills to know when and how to use the tools that is significant.
  - These concepts were moved to the central hub of the developing framework. This changed the focus from the function of online technology tools to information and digital literacy.
- The steps that occur between discovering information and then moving to organizing, storing, understanding etc. each take time and may not need equal amounts of time. Experts suggested that steps in the conceptual framework needed spaces between to represent time between each step.
  - Space was added between each step in the conceptual framework. The size of the steps and the size of the spaces do not indicate how much time is spent in each phase of the framework.

Figure 5. The conceptual framework emerging from Delphi – Round 1

5.2 Round 2 of Delphi study

After integrating comments and suggestions by the participants a revised version of the conceptual framework was developed for inclusion in round two of the Delphi study. In the second round experts were asked what they would add, change or like to have better explained in the emerging conceptual framework.
Experts were also asked to give more detail about how they had learned to use digital technology tools, what motivated them to use them and what strategies they used to teach others about these tools. Finally the experts were asked to identify ways that they had learned to overcome known barriers (Ho et al., 2004) to using digital technology tools for information management and knowledge transfer. The findings from those questions will be presented in a subsequent paper.

In round two of the Delphi study the researchers continued to refine the conceptual framework with input from the expert panel. Feedback from the second round of the Delphi study is summarised below:

- Information literacy and digital literacy are separate concepts.
  - The wording in the centre of the conceptual framework was refined to illustrate this.
- Information literacy and digital literacy are active in the process and depicting these concepts using a central circle does not represent an active process.
  - The central piece with the words information and digital literacy was returned to being depicted in the shape of a cog, to illustrate an active process. There are two cogs laying one on top of the other to illustrate that they are separate entities
- Information discovery does not necessarily start with questions and people do not necessarily learn information.
  - The words 'Questions' and 'Learning' were removed to illustrate that the framework does not necessarily start with questions, and people do not necessarily learn information they come across.
  - Removing the words 'Questions' and 'Learning' better highlighted the two key phases of the framework as Information Management and Knowledge Transfer.
- Several experts commented that they believed that a process occurs between each step of the conceptual framework. This illustrates that at times people need to work through things to get to the next step. At times it may feel that they are in a ‘holding pattern’ between steps or perhaps they are simply deciding what to do in order to move to the next step.
  - A small circle of arrows was added between each stage to illustrate the concept of ‘working through’ to the next step.
• One expert stated that sometimes information that has been discovered is not helpful for the situation so it is disregarded and the information discovery phase resumes.
  ° A line was added to illustrate this. The wording on the line was ‘disregard information’.

• Several experts suggested formatting changes such as colour and contrast to create clearer differentiation between the steps and the phases.
  ° Formatting changes were made to create contrast however colour was not used, as it would limit reproducibility of the image.

• One participant suggested that the conceptual framework would be better represented as a "whole ecosystem which interacts in a non-linear fashion".
  ° As it is very difficult to represent a 3D concept in a way that can also be printed in a thesis or a journal it was decided to include this concept in the explanation of the framework rather than to try to represent it graphically.

Figure 6. The conceptual framework emerging from Delphi – Round 2

5.3 Round 3 of Delphi study

In round three, the goal was to finalize comments on the conceptual framework, now called the IM-KT framework. Only one refinement was made from feedback received during round three of the Delphi study. Experts commented that information not used is not necessarily ‘disregarded’ simply more information may be needed. The wording on the line from information understanding returning to information discovery was changed to ‘repeat information discovery’.

In the third round of the Delphi the majority of the expert panel reported that they had no new suggestions to offer to refine the framework. Sixteen of the 18 experts felt that the IM-KT framework was detailed, gave lots of helpful information and depicted the framework of information management and knowledge transfer well. Two experts felt that the IM-KT framework was now too detailed and overwhelming and may be difficult to remember.

As 16 out of the 18 experts were satisfied with the format of the IM-KT framework during round three of the Delphi no further changes were made to the IM-KT framework. The final framework is
shown in Figure 7 and is described in detail below.

5.4  Final Round of Delphi study

In the final round of the Delphi study the researchers did not seek further comment on the IM-KT framework. In this round the experts were shown the development of the framework across the first three rounds of the Delphi study and to use round four to talk about their experience of participating in research using the Delphi method and to give feedback to the researchers about the experience of being in this particular study. That information will also be summarised in the first author's thesis and in a subsequent paper.

6.  Emergence of the Information Management-Knowledge Transfer Framework

One of the outcomes of this research study was the creation of the IM-KT framework (Figure 7). The framework consists of two phases: 'Information Management' and 'Knowledge Transfer'. Each phase has three steps, the spaces between the steps depict time taken to move to the next step, the mini-frameworks represent the processes undertaken in order to move from one step to the next. The two phases and six steps are outlined here and explained in detail below.

Figure 7. The IM-KT framework

Information Management Phase:

I.  Information discovery
   a.  See, hear, read, reflect, discuss, find

II.  Information organization
   b.  Organize information internally and externally

III. Information processing
   c.  Information–Knowledge transformation

Knowledge Transfer Phase:

IV.  Knowledge creation in context
The IM-KT framework does not necessarily start at any point, however it is more logical to describe it as a framework commencing at ‘information discovery’ moving to ‘knowledge dissemination’. All steps do not necessarily occur during the process or can stop before knowledge dissemination occurs. When knowledge is disseminated or shared, others receive it as information. Those who receive the information then go through the IM-KT process themselves in order to transform information to knowledge for their own context. Different digital technology tools appear to have different applications at different phases of the framework (see Table 5 for examples).

An important point made by one of the experts in the Delphi study was that individuals could disseminate information without going through the process of information-knowledge transformation. An example of this is an individual who is teaching something developed by someone else, where they simply present information rather than going through the process of internalising the information, understanding it, and transforming it to knowledge in context.

The two phases and six steps of the IM-KT framework are outlined and explained in detail in separate sections below.

6.1. Information discovery

Holtham and Courtney (1998 as cited by Liyanage et al., 2009) suggest that the process of discovering information usually occurs in four main modes: informal, formal, personal or impersonal (see Table 5). Examples of informal information discovery include casual hallway conversations with colleagues or coming across an interesting journal article. Examples of formal
modes of information discovery include formal supervision, attending a conference or researching professional literature to answer specific practice questions (David et al., 2012; Kloda & Bartlett, 2009; Lynn et al., 1996). Both personal and impersonal communication occurs in formal and informal settings. When new information is being acquired it is usually technical, academic and described in formal language and is called explicit knowledge (Smith, 2001).

Table 5. *Modes of communication leading to information discovery*

Digital technology tools such as online scholarly databases, web conferencing tools, and moderated wikis are examples of technologies that can facilitate formal information discovery. Skiba (2006; 2008) gives examples about the use of social media in nursing education where social media tools such as blogs, micro-blogs (e.g. Twitter) and social networking sites (e.g.: Facebook) facilitate both formal and informal information discovery.

6.2. *Information organization*

Once information has been obtained it is important to be able to organise it in a way that makes it is easy to retrieve when needed. Information that is organised by way of being codified or categorised can be more easily retrieved and shared with others (Smith, 2001). Journal articles, blog posts, newspaper articles and even recorded conversations can be categorized using tags and filed in a way that they can be retrieved (Macgregor & McCulloch, 2006). Smith (2006, p.315) suggests that at this stage information is still at the level of “explicit knowledge” as people tend to know what the information is and can share it with others. Note that these authors use the term knowledge in its broadest sense, to also incorporate what is referred to as information in the IM-KT framework.

Digital technology tools such as reference management systems, social bookmarking tools, and file management systems using cloud computing, facilitate the capacity to organise information so that it can be more easily retrieved and shared (Cao et al., 2007).
6.3  Information processing

Information processing occurs when the individual makes sense of information in the context of his or her own situation, in other words that they are developing an understanding. Alavi and Leidner (2001, p.109) argue “information is converted to knowledge once it is processed in the mind of individuals”.

Digital technology tools, such as online discussion forums, mind-mapping tools, blogs and online journals facilitate information processing by providing tools to reflect on information (e.g. in a reflective blog where others can post comments), process information individually or in a shared environment (e.g. using mind-mapping tools) or discuss information with others (e.g. in an online discussion forum) and work collaboratively with others (Cao et al., 2007).

6.4.  Information-Knowledge transformation

In the IM-KT framework, the transition point between processing information and having knowledge that can be applied in context is described as the ‘information-knowledge transformation’ space (Boisot et al., 2007). This marks the point in the framework where the individual has understood and internalised the information and can start to move towards translating it in practice. During this phase of the IM-KT framework information is being transformed to knowledge within the individual or between individuals and it is mostly an internal process.

Digital technology tools that can assist this process include online reflection tools such as blogs or online journals, and online forums and social networks where people can meet virtually and discuss information, increasing their understanding as they work towards building knowledge.

6.5.  Knowledge creation and knowledge translation in context

The next two steps in the framework are knowledge creation and knowledge translation in context.
This is the stage where the individual has created knowledge within them and is able to apply it to their context. When new knowledge is created and translated into the context of practice it is evident to self and others through changes to, or confirmation of, attitudes, skills and/or behaviours (Boisot et al., 2007). As indicated earlier, Boisot et al. (2007, p.7) distinguishes between information and knowledge emphasising the transformation of information to knowledge has to be internalized by the recipient and “affects [their] belief structure, taken as a disposition to act”.

When information is transformed to knowledge and is then incorporated into daily routines it becomes tacit knowledge and is more difficult to explain to others. Polyani (1967, as cited by Smith, 2001, p. 314) described tacit knowledge as “knowing more than we can tell”. Tacit knowledge tends to be knowledge not found in manuals, books, databases or files (Smith, 2001, p. 314). Ho et al. (2004, p.92) state that health professionals "generate tacit knowledge through the sum of past experiences through encounters with different patients”. Also called clinical judgment or practical wisdom, tacit knowledge profoundly influences an individual’s decision-making process in each new situation. It is difficult to explain one’s own knowledge to others without careful reflection. Without reflection and careful explanation of the knowledge reasoning process, others can become confused by the complexity of the knowledge processes or in contrast, they may assume the processes are simple and believe that they can apply new information in their context without full understanding.

During this phase of the IM-KT framework, knowledge translation in context is evident through what people do: an example may be improved skills (tacit knowledge) or the development of new policies (explicit knowledge). Digital technologies that can assist this process include collaborative writing tools, communication tools and wikis. Tools that facilitate transformation of tacit knowledge to explicit knowledge include using reflective blogs or peer review processes.
6.6. Knowledge dissemination

The final stage of the IM-KT framework is knowledge dissemination, where knowledge is shared with others. It is important to recognise that at this stage one person’s knowledge is received by others as information, in the form of text, graphics, words or other symbolic forms (Alavi & Leidner, 2001, p.109). That is, tacit knowledge transforms to explicit knowledge that is codified and able to be shared as information. This occurs in the space depicted as the knowledge – information space, an expansion of Boisot’s earlier concept, information-knowledge transformation.

The framework starts again when others discover the information and progress through their own IM-KT framework to process the information and transform information to knowledge for their own context. An individual is likely to be cycling through the IM-KT framework on a range of topics at one time. Digital tools that bring similar information together into one virtual space, such as podcasting and digital curation tools, play an important role in knowledge dissemination and the transformation of knowledge to information for others to discover. See Table 6 for further examples of digital tools that are useful for this phase of the IM-KT framework.

Table 6. Examples of digital technology tools useful in each phase of the IM-KT framework

7. Discussion and areas for further research

The IM-KT framework was developed in order to create a foundation understanding of the factors involved in information management and knowledge transfer in occupational therapy practice today. The conceptual framework emerged from the research process and was then purposively refined through consultation with a group of experts using the Delphi technique. This framework will inform occupational therapists how they can use digital technology to overcome information overload (Green, 2011; Skinner, 2004) in their day-to-day work.
The IM-KT framework depicts the process of information management and knowledge transfer that occupational therapy stakeholders can use to access information in order to work in an evidence-based manner in health and social care settings. The IM-KT framework depicts a phase of information discovery and organization followed by information processing that moves to information-knowledge transformation and then knowledge creation and transfer in context. These steps occur in sequence as a transactive and re-iterative process, which is similar to the process described by Nonaka and Takeuchi (1995) in the spiral of knowledge creation, where tacit and explicit knowledge interact in the knowledge creation process.

In developing the IM-KT framework care has been taken to delineate between information management and knowledge transfer. The delineation between information discovery, information organization and information processing has been made explicit from knowledge creation and knowledge translation in context, as merely accessing information does not necessarily result in transformation to knowledge. The decision to clearly delineate information from knowledge was influenced by Boisot et al. (2007) who state that information becomes knowledge when information is “internalized and becomes part of the recipient’s expectational structure... it affects the recipient’s belief structure, taken as disposition to act” (Boisot et al., 2007, p.7).

Heisig (2009) stresses the importance of understanding contextual factors as facilitators or barriers to the knowledge management process. It is well documented that the context of occupational therapy practice has created significant barriers to accessing information to inform best practice. The barriers include limited access to reliable information sources (Rowlands et al., 2011) reduced access to Internet-connected computers in the work environment (Reddy & Spence, 2008; Salbach et al., 2007; Younger, 2010), lack of ability to keep up with ever-changing digital technologies (David et al., 2012), and lack of appropriate digital literacy skills (Barnard et al., 2005; David et al., 2012). Other research indicates that busy schedules, high workloads, lack of organizational support
and cost limit on-going professional development (Barnard et al., 2005; David et al., 2012). It is essential that healthcare practitioners are given the time, skills and resources to access information, to connect meaningfully with colleagues and to integrate information into the context of practice (David et al., 2012). The recommendations made by the panel of experts in this Delphi about overcoming barriers will be published in a subsequent paper.

Chatti (2012, p.830) describes the knowledge management process as "knowledge as a thing" and "knowledge as a process". The graphic representation of the IM-KT framework depicts information as a thing and knowledge creation as a process. Heisig (2009) identifies four contextual factors central to the knowledge management process:

1) Human-oriented factors: culture – people – leadership.
2) Organisation: process and structure.
3) Technology: infrastructure and applications.
4) Management process: strategy, goals and measurement

The description of the IM-KT framework highlights both process and contextual factors including human, organization, technology and management processes. In the description of the IM-KT framework there is a focus on the importance of the interaction between people and knowledge, people and technology and technology and information which is most likely to be due to the research question focusing on digital literacy, information literacy and evidence-based practice. This is a combination of process and context factors.

As Eisenberg (1995, p.1571) observed "there is no mental function without brain and social context." Digital technology provides a conduit between people and information which creates opportunities to learn, collaborate and share. The IM-KT framework illustrates how healthcare practitioners can work through the process of information discovery to creating new knowledge. The process is complex, and can take considerable time depending on the situation, and the amount of information that is readily accessible. It also depends on the individual's ability to network,
discover information, organize and process information, transform information to knowledge for practice and disseminate knowledge to others. Today this process is largely dependent on having information literacy and digital literacy skills.

Knowledge is the cornerstone to best practice in today’s knowledge based economy (Liyanage et al., 2009). The IM-KT framework demonstrates the central role of information literacy and digital literacy in the knowledge era. Digital technology does not just connect people with information; it connects people with each other. A growing number of healthcare professionals are discovering, exploring and using interactive digital technologies to discover, organize, process, create and share healthcare information (Seeman, 2008). This means that in order for healthcare professionals, such as occupational therapists to share information, viewpoints, opinions and experiences, more focus needs to be placed on improving information literacy and digital literacy skills.

Digital literacy is a new core skill for occupational therapists in the 21st century, and development of this skill needs to be fully integrated into occupational therapy education programs. In addition, strategic approaches are required to assist occupational therapists already practicing in health and community care settings to overcome barriers to using digital technology to access best evidence for practice. Learning about and adopting the IM-KT framework can be a first step to help occupational therapists to better understand the processes involved in information management and knowledge transfer and identify areas for improvement. Further inquiry, using action research, could examine the effectiveness of strategies implemented to overcome process-based and context-based barriers to information management and knowledge transfer in practice (Heisig, 2009).

Epilogue

In spite of the glitches, the difficult programs, needing multiple passwords for each search engine, the fortress firewalls, and continually updating programs, I'm NOT quitting. I love it! I keep up to date everywhere and constantly! Mobile digital tech
allows me to put together my work and life on the run, I am able to fit this in between a split shift system. I use my laptop pretty much as a desktop and my phone is the "PA". If I need to do some writing then I will use the local library. Although I do most of my work online, I still print some key articles to keep with me because I'm trying to infuse an evidence-base. The IM-KT framework highlighted some downfalls in my day-to-day practice and now I can plan to overcome them. I now tag journal articles and store them in an online reference manager, I have started my own online support group in Facebook and I'm even considering applying to do a fully online higher degree!

(Leigh, OT Private Practitioner)

Acknowledgements
Thank you to eighteen individuals who gave their time and expertise as participants in the Delphi study. The primary author would like to thank the secondary authors, her PhD supervisors, for their continual support and encouragement in the process of research and writing.

About the authors
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Dr Jo Coldwell-Neilson is Associate Head of School (Teaching and Learning) of the School of Information Technology. Jo first adopted ICT to support her teaching in 1997 and has been teaching wholly online units since 2000. Jo has completed extensive research into the impact of technology on teaching and learning which has equipped her with special capacities in the design and operation of learning management systems.

Dr Annemieke Craig is an Associate Professor in the School of Information Systems in the Faculty of Business and Law (Geelong campus). Her research interests include the student learning experience, the use of technology in teaching in higher education and gender and computing.
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Ferrell, M. J. (1988). The relationship of continuing education offerings to self-reported change in


doi:10.1111/j.1083-6101.2006.00038.x

Figure 1. *Publications in Occupational Therapy by Topic and Era*

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Figure 2. *Publications in Medicine by Topic and Era*

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Figure 3. Knowledge Hierarchy  Reprinted with permission from Bender & Fish, *The transfer of knowledge and the retention of expertise: the continuing need for global assignments*. Journal of Knowledge Management. 2000 Copyright Emerald Group Publishing Ltd
Figure 4. The conceptual framework presented to experts in the Delphi study
Figure 5. The conceptual framework emerging from Delphi – Round 1
Figure 6. The conceptual framework emerging from Delphi – Round 2
Figure 7. The IM-KT Framework
Table 1. Search terms used in SCOPUS to examine trends in publications in occupational therapy

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Table 2. Search terms used in SCOPUS to examine trends in publications in medicine

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Table 4. *Delphi expert category and distribution across countries*

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<td>1 Health care educators using online technology (HCE-UT)</td>
<td>Needs to be successfully engaged in using online technology for professional development and/or delivery. One must be an occupational therapist.</td>
<td>Will bring expert opinion about which online technology tools are useful in health care education and how they are already successfully using them.</td>
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<tr>
<td>2 Health care educators using online technology minimally (HCE-MinUT)</td>
<td>Needs to be successfully engaged in teaching and or researching with minimal to no use of online technology. One must be an occupational therapist.</td>
<td>Will bring expert opinion about modes other than using online technology to health care education and how they are successfully working without online technology tools.</td>
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<td>3 Social media experts (SoMeEx)</td>
<td>Needs to be cognizant of the capacity of online technologies to enhance knowledge management and also researching this topic in some way.</td>
<td>Knowledge of the range of technologies available is needed in order to anticipate potential use and benefits of using them.</td>
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<td>4 Knowledge management expert (e.g. librarian) (KMEx)</td>
<td>Needs to be aware of the range of online tools available to students and practitioners both through formal and through informal channels. Expert in information literacy.</td>
<td>An understanding of the role and importance of information management and how this can be supported through technology.</td>
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<td>5 Education technology expert (EdTechEx)</td>
<td>Needs to be able to comment on the capacity of online technologies to enhance knowledge management in higher education and also researching this topic in some way.</td>
<td>Provides the expert opinion from the perspective of the use of technology to support educational processes.</td>
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<td>6 Current occupational therapy student (undergraduate) (OT-UG)</td>
<td>Currently studying occupational therapy in one of the 5 countries identified in this study. Bachelor’s level.</td>
<td>Will provide input into their expectations about use of technology in formal education and in professional development after graduation.</td>
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<td>7 Occupational therapist undertaking postgraduate studies (OT-PG)</td>
<td>Occupational therapists, currently studying at a post graduate level in one of the 5 countries identified in this study.</td>
<td>Will provide input into their expectations about use of technology in formal education and ongoing professional development.</td>
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<td>8 Recent occupational</td>
<td>Graduated in the past 5 years and now practicing occupational</td>
<td>Will provide input about their experience of trying to access, store and share</td>
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<tr>
<td>Therapy graduates (OT&lt;5yr)</td>
<td>Therapy in one of the 5 countries identified in this study. Using online technologies regularly.</td>
<td>Information for practice at work and their visions for the future use of technology in occupational therapy.</td>
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<td>9 Occupational therapists in practice for over 10 years and supervising junior therapists (OT&gt;10yr)</td>
<td>Needs to be interested in improving knowledge management activities by occupational therapy practitioners, and aware of day-to-day barriers in achievement of this goal.</td>
<td>Will bring expert opinion about the necessity for occupational therapy practitioners to access information to improve knowledge for practice. They will have an awareness of the barriers occupational therapists face in accessing information.</td>
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Total per region 6

* Denotes that although this expert worked in Australia at the time of research opinions were based on career in the UK.
Table 5. *Modes of communication leading to information discovery* (adapted from Holtham & Courtney 1998 as cited in Liyanage et al., 2009)

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<tbody>
<tr>
<td><strong>Personal</strong></td>
<td>Discussing information with a colleague</td>
<td>Participating in a moderated scholarly discussion</td>
</tr>
<tr>
<td><strong>Impersonal</strong></td>
<td>Reading the newspaper</td>
<td>Attending a presentation at a conference</td>
</tr>
</tbody>
</table>
Table 6. Examples of digital technology tools useful in each phase of the IM-KT framework

<table>
<thead>
<tr>
<th>Program/tool</th>
<th>Description</th>
<th>Information discovery</th>
<th>Information organization</th>
<th>Information processing</th>
<th>Knowledge creation in context</th>
<th>Knowledge translation in context</th>
<th>Knowledge dissemination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blog/ Weblog (e.g. Blogger™, Wordpress™)</td>
<td>A website where items are posted on a regular basis with the most recent posts at the top. Usually a blog is about a single topic or theme.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bookmarking: Social bookmarking (e.g. Diigo™)</td>
<td>A tool to bookmark (save) Web URLs in a virtual/online environment rather than on an individual computer. The user’s account can be public, semi-public or private.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cloud Storage (e.g. DropBox)</td>
<td>Cloud storage provides digital storage space on a remote server to store files, which can be accessed using the internet.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Collaborative writing (e.g. GoogleDrive™, ZohoWriter®)</td>
<td>An online program to store documents by one or more people. Facilitates editing and reviewing of a document by multiple individuals, either in real time or asynchronously.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Content curation service (e.g. Learnist, PaperLi, Storify, Scoopit)</td>
<td>Curation services are programs that collect and organize topics of interest. They facilitate creation of theme-based digital publications (e.g. newsletters).</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Discussion forums (e.g. phpBB™)</td>
<td>An online discussion space for people who share a specific interest to interact with others. Unlike online chats in which participants communicate synchronously, most discussion forums are asynchronous.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Learning management systems (e.g. Blackboard, Moodle, Desire2Learn)</strong></td>
<td>A software application for administration, documentation, tracking, reporting and delivery of education courses or training programs.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Microblog (e.g. Twitter)</strong></td>
<td>An online program where users can submit text, hyperlinks, video or pictures. Text entries are restricted to 140 characters.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multi-user Virtual World (e.g. Second Life™)</strong></td>
<td>A virtual world where the user is represented by an “avatar” and can interact with other avatars in a 3-D virtual environment (Avatar: a graphical image that represents a person).</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Online journal (e.g. Oh Life, penzu)</strong></td>
<td>An online space to write and record private reflections</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Online reference manager (e.g. Mendelay, Zotero, Refworks, Endnote)</strong></td>
<td>An online space to manage and share academic resources. Using tagging and filing these tools can help organize research, facilitate collaboration and discover research evidence.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personalised home page (e.g. Netvibes)</strong></td>
<td>An online page that uses widgets to allow the user to assemble favourite, feeds, social networks, email, videos and blogs on one customisable page.</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Photosharing (e.g. Flickr®)</strong></td>
<td>The publishing or transfer of a user’s digital photos online, thus enabling the user to share them with others (publicly or privately).</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
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</tr>
<tr>
<td><strong>Podcast/Video cast (e.g. YouTube™, iTunes™)</strong></td>
<td>A series of audio or video digital-media files that is distributed over the Internet by syndicated download (RSS), through Web feeds, to portable media players and personal computers. NB: users can download or upload to YouTube, iTunes etc.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>RSS Feeds and Readers (e.g. GoogleReader™)</strong></td>
<td>RSS feeds send updates to the user (e.g. News). RSS requires a place to access and store updates, such as on a “Reader” or on a personalized homepage.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Scholarly Databases (e.g. Pubmed™, Google Scholar)</strong></td>
<td>A freely accessible Web search engine that indexes the full text of scholarly literature across an array of publishing formats and disciplines.</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Social network sites (e.g. Facebook™)</strong></td>
<td>Online communities of people who share interests and activities, or who are interested in exploring the interests and activities of others.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Survey tools (e.g. SurveyMonkey™)</strong></td>
<td>An online survey system to deliver surveys, collect and analyze results all through one central system. Many also include interpretive graphics and charts.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Voice over Internet Protocol (VoIP) (e.g. Skype™, Google Hangout)</strong></td>
<td>Enable users to talk in real time using the Internet. Can be audio, video or both. *Can be recorded and replayed using supplemental computer programs.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Virtual pinboard (e.g. Pinterest)</strong></td>
<td>A content sharing service that allows members to ‘pin’ images, videos and other objects to their online/virtual pinboard.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Virtual presentation (e.g. Slideshare, Prezi)</td>
<td>A platform for business documents, videos and presentations. Anyone can share presentations and video and both allow for users to find relevant content and connect with other members who share similar interests.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Wiki (e.g. Wikipedia, PBWorks, Mediawiki)</td>
<td>A wiki is an interactive Web page designed to enable anyone who is allowed access, the ability to contribute or modify content.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>