

Digital Information Literacy: Supported Development of Capability in Tertiary Environments

Executive Summary

Introduction and Problem Definition

Digital information is becoming essential to almost every aspect of modern life which means that there is a need as never before, for learners and teachers who are information literate in a digital context. Tertiary students require digital information literacy, and a degree of skill using computers and the Internet for many aspects of study at this level, for example, enrolment, accessing online course materials, preparing assignments, checking grades and communicating with teachers. The resulting tertiary graduates with digital information capability will be essential players in the workforce in a knowledge-based society.

According to the New Zealand Digital Strategy (Ministry of Economic Development, 2008), there is an urgent need for the key players in a digital future i.e. learners and teachers. This phenomenon was eloquently stated by Marshall (2006): "Critically, capability includes the ability of an institution to sustain e-learning delivery and the support of learning and teaching as demand grows and staff change" (p. 7).

This research project was an investigation of the strategies and tools associated with developing the digital information literacy capability of staff and students from four tertiary institutions in New Zealand. The components of digital information literacy essential for lifelong learning in the workplace, and a comparison of standards with other OECD countries were also anticipated as part of the outcomes. A primary outcome was the development of a definition of digital information literacy for Australasia. This definition was based on findings from the project and existing information literacy standards used by the Australian and New Zealand Institute for Information Literacy (ANZIIL). In addition it was informed by international research in the area of digital information: American Library Association (1989); the 21st Century Digital Information Fluency Model (2009); and the Seven Pillar Model for Information Literacy (SCONUL). The literature review which informed the research project has more detail on these and other relevant research and is published separately to this summary.

Definition of Digital Information Literacy

Digital Information Literacy (DIL) is the ability to recognise the need for, to access, and to evaluate electronic information. The digitally literate can confidently use, manage, create, quote and share sources of digital information in an effective way. The way in which information is used, created and distributed demonstrates an understanding and acknowledgement of the cultural, ethical, economic, legal and social aspects of information.

The digitally literate demonstrate openness, the ability to problem solve, to critically reflect, technical capability and a willingness to collaborate and keep up to date prompted by the changing contexts in which they use information.

Research Questions

Four research questions were framed from the areas for investigation identified in the call for proposals in line with the literature review and the expected outcomes for the research.

1. Investigate how staff and students access, and interpret digital information creating their own understandings, using purpose built modules which are customisable and/or Web 2.0 strategies.
2. Ascertain how personal online learning environments and membership in a social networked community can influence digital information literacy.
3. Indicate how important digital information literacy is for lifelong learning of staff and students (including Māori and Pasifika), productivity and innovation.
4. Determine the standard of digital information literacy in the New Zealand academic workplace compared with other OECD countries.

Methodology

The research design was action research with a case study (Halonen, 2008), and involved groups of participants located at each of the four institutions (two polytechnics, and two universities) taking part in the project. In total 42 participants, comprising academic staff, general (allied) staff and students were recruited, engaging in face to face workshops over a period of ten weeks. Many academics identified themselves as both staff and student for the purposes of the research because they were involved in study at the time.

Action research methodology was chosen because it creates the expectation that those involved will be researching a particular situation with the intention of taking action that will make a difference, bring about change or improvement, and solve problems while engaging in ongoing learning to improve practice (Riel, 2007; Coglán & Brannick, 2002). It was anticipated that the action research process to be used at each of the four institutions would bring about changes in participants' digital information literacy.

A mix of qualitative and quantitative methods were used to collect data within the action research framework including pre and post surveys, face to face workshops and participant reflections from weblogs (blogs). This multi-strategy or mixed methods approach (Bryman, 2000) was deemed to be the most complete method to allow fuller analysis of the empirical data. It also brought together the qualitative and quantitative aspects of the investigation, but supported separate quantitative data analysis from pre and post surveys. A mixed methods approach for handling data is also recommended for negotiating the complexity of digital systems (Reeves & Hedberg, 2003).

The Taxonomies

Key to the qualitative analysis were two taxonomies (DIL and Capability) which were adapted from others' work for the purpose of investigating participants' skills and capability in managing digital information. These two taxonomies informed the following:

- Processing of the material gained from the workshops;
- The focus group interviews;
- The participant reflections and action research cycles ; and
- The email discussions.

The qualitative data along with the quantitative data comprised the creation of the individual and institutional case studies. The case studies were compiled as a way to both analyse and present the findings. They were combined to produce an overarching case study from which to consider the research questions.

The survey data were used to calculate a Digital Information Literacy (DIL) score for each participant. Survey responses were compiled from a series of questions such as:

- Digital skills for accessing and using information;
- Confidence in using technologies for information;
- Actual use of digital tools and confidence in using tools; and
- Scores of self-efficacy in using information communication technologies.

The DIL score for each participant was used for before and after project comparisons as well as for commenting on similarities and differences between the participants and within and across institutions.

Digital Information Literacy Taxonomy

Six aspects were used in this taxonomy to identify an information literate person in a digital context:

1. Recognition (of the information needed);
2. Access (obtaining the information);
3. Evaluation (of the reliability of the information and the effectiveness of the tools and strategies);
4. Management (of the information found);
5. Application (to create new understandings); and
6. Ethical use of information.

Additionally, a capable ICT (information communication technology) user is regarded as having particular dispositions (characteristics) including the ability to learn as opposed to knowing everything there was to know about technology. The characteristics associated with knowing how to learn include:

- The ability to “experiment or play” through “trial and error”;
- Be self-directed;
- Being able to “consult others” such as peers or a mentor (Phelps, 2002, p. 270).

Capability Taxonomy

This taxonomy utilized seven categories based on the dispositions of a capable ICT user within the digital environment:

- Confidence (in own ability - self-efficacy);
- Problem solving (identifies and works towards a solution);
- Motivation (positive attitude to explore and adopt new approaches - including risk-taking);
- Interaction (shares, collaborates and interacts);
- Reflection (examines practices and thinking of self and others - including evaluation);
- Technical aptitude (uses a wide range of tools and terminology); and
- Beliefs (values the ICT environment).

Key Findings

The results of this research project indicated that regardless of whether they were academic or general staff or students, the majority of participants made positive shifts in their digital information literacy skills and capability. For the majority this manifested as an increase in their DIL scores and changes to the way they used and managed digital information. This included a change in attitude towards more open sharing of information and a willingness to learn new technologies. The participants were primarily female and New Zealand European with a small number of other ethnicities, e.g., Maori, Samoan, Chinese, and Indian. Most participants had three years or more computer experience and Internet experience.

In the four groups were participants who demonstrated quite distinct characteristics or dispositions and skills for digital information literacy. However, they were remarkably similar in many areas. For example, they were willing to share information and collaborate in a group and explore new approaches to managing digital information. The groups were characterised by their diversity of participants. This fertilised imagination as well as providing complementary skills and enabling alternative approaches to understanding technological approaches and a digital world. Although differing in the extent to which they did this, the groups all appeared to create safe, collaborative learning environments. All groups reported improvements in technical skills, confidence and motivation. Additionally, participation in a group expanded participants' understanding of the available possibilities. Everyone explored tools and strategies beyond those defined in their individual learning objectives.

Several themes emerged such as the value of having time and permission to 'play' within a supportive environment and dynamic learning community. Participants created personal online learning environments (a term unknown to most). They used a wide range of tools, most of which they had never tried before, and which few had confidence in using at the beginning of the project.

Changes to Participants' Digital Information Literacy Skills

On entry to the project participants' self reported digital information literacy skills (measured as part of the DIL score) varied in comparison to their traditional literacy skills. For example, 32% of participants rated themselves as having a higher level of skill in using traditional methods when accessing and applying information. In comparison, 14% rated their level of skill using digital technologies as higher, and 55% regarded their skills for both traditional and digital approaches as the same.

At the conclusion of the project, when asked again to rate their use of digital versus traditional information skills to locate, retrieve, analyse and apply information relevant to their study and work, participants rated themselves more highly on both traditional and digital skills. There was likewise an increase in both the use of a range of digital information tools and strategies, e.g., computer conferencing, information sharing sites, online library databases etc., and confidence in using them to locate, retrieve, analyse and apply information. Self-efficacy in the use of ICT tools and methods for each participant was not measured separately; instead it was integrated within the overall DIL score.

Increase in Participants' Digital Information Literacy Scores

When overall digital information literacy scores were examined for individuals at each institution, 95% gained a higher level of digital information literacy by participating in the project. This finding is noteworthy and indicative that the model used in the project was successful. As would be expected, participants' overall confidence with computer-based and Internet-based communication and information methods across all institutions changed from a mean score of 3.3 to 4.0. The score for overall confidence was one aspect of self-efficacy. However, in a previous research project (Hegarty et al, 2005) scores of overall confidence were similar to the overall score of self-efficacy which was calculated from five categories of measures for self-efficacy:

- Personal feelings;
- Use of ICT methods;
- Confidence learning new technologies;
- Personal characteristics; and
- Overall confidence.

Therefore, participants' belief and confidence in their own abilities in using ICT (self-efficacy) did increase as a result of their participation in the research project.

Discussion of Key Findings

The findings under each of the four research questions are discussed in turn to highlight the main themes which emerged in the case studies.

1. Strategies and tools - access and interpretation of digital information

Under research question one, the way in which staff and students accessed, and interpreted digital information to create their own understandings was investigated. This involved both the use of purpose built online information literacy (OIL) modules which were customisable. The OIL modules were a resource developed specifically to support information literacy and provided a good starting point for the exploration of digital information literacy in this research. Additionally, the research investigated the use of Web 2.0 strategies and tools for organising a digital personal learning environment (PLE) or presence in a networked environment.

According to Wikipedia, "the term Web 2.0 is commonly associated with web applications that facilitate interactive information sharing, interoperability, user-centred design, and collaboration on the World Wide Web" (Wikipedia, 2010 - http://en.wikipedia.org/wiki/Web_2.0). As such, Web 2.0 strategies and technologies were regarded as integral to the investigation of digital information literacy in line with current trends in the educational sector.

1.1. Indicators of digital information literacy

As indicated in the definition of digital information literacy, several factors related to digital information, as well as a person's characteristics was found to influence the development of digital information literacy. These were detected in varying degrees by measuring the DIL scores of participants, and analysis of the focus group interviews and the qualitative material participants produced while taking part in the research. For example, by the end of the research the majority of participants had enhanced skills for accessing digital information as well as increased levels of confidence in using information technologies, and in the management of digital information. The dispositions required to obtain an adequate or minimum level of digital information literacy were found to include:

- Confidence and belief in own ability (self-efficacy);
- A demonstration of openness;
- The ability to problem solve and take risks;
- Technical capability;
- A willingness to collaborate and share; and
- The desire to keep 'up to date' driven by the changing contexts of information use and requirements.

In the Web 2.0 environment, sharing and collaboration are philosophically distinguishable attributes. For example, sharing is a term which describes a willingness to distribute resources, and support others, and collaborating implies working together in a networked community.

1.2 Supported exposure to a range of digital tools

The importance of support cannot be underestimated. This research has shown progress was made by individuals as a result of them being given the chance to explore a wide range of digital tools and their applications collaboratively in a supportive environment where it was 'safe' to make mistakes. Starting points varied in terms of both confidence and the range of digital tools with which participants were

familiar. However, by the end of the research project, there was a general shift towards using a greater range of tools. Participants demonstrated increased familiarity with technical vocabulary and a greater degree of confidence. Changes primarily occurred in the use of Web 2.0 tools new to the participants, for example, blogs, web feeds, social bookmarking, file sharing, web conferencing and photo sharing. Social bookmarking is a term to describe the way in which “bookmarks of web resources” are shared, organized, searched, and managed by Internet users (Wikipedia, 2010 - http://en.wikipedia.org/wiki/Social_bookmarking).

1.3 The Importance of the face to face environment in Digital Information Literacy

The face to face environment had a strong role to play in participants, in this research project, gaining confidence in accessing and using information in the digital environment. It became clear that in the face to face workshops, (a regular time which could be set aside) the participants were able to collaboratively enhance their digital information skills by engaging in technical conversations about materials and tools. This helped those participants in particular who were struggling to make their own understandings of the digital environment. The goals which participants set for themselves on entry into the project progressed as a result of the group interactions centred on areas of interest to themselves and the rest of the group. It would be interesting to further investigate whether it was primarily the blended format of the groups which accommodated DIL development, or the regular time allocation, or a combination of both factors, and this is an important area for research in the future. The issue of time is outlined further on.

1.4 Supported play

It is evident from the findings in this project that supported ‘play’ in a safe environment enabled and created new opportunities. When participants were assisted to explore and to experiment with applying their skills to real world contexts in which they were operating, they gained further skills in accessing and interpreting digital information. Through ‘play’ participants were permitted to make mistakes, indulge in trial and error, and to repeat the action until it was mastered while working in a low risk context. The project allowed participants to blur the boundary between work and play. Through their play they formed networks of knowledge from their experiences and interactions with a knowledge community, that is, their peers as an important source of information. Play appeared to be an important aspect of building an understanding of the digital world, giving participants the courage to explore and experiment as long as support was on hand. It was the supportive nature of the workshops and the sharing and collaborative philosophy of the model used in the research which enabled support to be provided by both facilitators and peers.

1.5 Support for different kinds of learning

All participants were encouraged to set goals for their learning from day one of the project. However, more often than not these changed over the course of the project. Partly the narrowness of their knowledge base on entering the project was responsible because they didn’t know what they didn’t know and so restricted their goals as a result. Also, when participants entered the research project, many had low self-efficacy with regard to digital information, and tended to blame themselves for poor technological capability. As the project progressed, however, and their confidence and persistence was fostered, their attitude changed and they adopted a more problem- solving approach. It was also observed that the nature of the exploratory and interactive environment in which they were immersed extended their learning through regular exposure to the activities and knowledge of the rest of the group. Additionally, all group members collectively engaged in reflection at various points in the project, examining their expectations, assumptions and perspectives in the workshops. They also reflected on an individual basis using action research cycles - planning, monitoring, learning, evaluating - by writing in

their blogs which were shared with the group, in journals, via email, in the workshops, and in individual sessions with the group researcher. This all contributed to their learning process. Consequently the researchers were required to support a range of approaches for the different participants regardless of where they began on the continuum of Digital Information Literacy. For example, some participants needed individual attention, some sought the expertise of the researcher and others in the group, some accessed outside networks, and some worked together in the workshops to explore digital technologies or services under the guidance of the researcher.

1.6 Fostering a range of communication techniques

Participation in the face to face workshops gave group members the chance to engage in technical conversations about materials and tools as they struggled to make their own understandings of the digital domain. Through sharing their experiences, participants extended their technical vocabulary not only in the workshops but also through the use of blogs, email groups and the social networking sites they encountered during the project. The researchers had intended to engage participants in an inter-institutional communication network, but the time spent on within- group interactions meant that the participants' time was fully committed. The researchers observed a high level of trust within each group, and noted the strength of having institutionally based learning communities for developing capability in the digital environment. Participants tended to use the form of communication which suited their starting level of digital literacy but often were encouraged to expand into less familiar, more public forms as well. Changes in the way they communicated online, necessitated the development of a digital identity, and this was challenging for some participants as explained further on.

1.7 Becoming comfortable with a digital identity

Comfort with acquiring a digital identity was another area where change was observed over the course of the project. Initially, participants differed markedly in their confidence levels in terms of both accessing and adding to digital information on the web. They were concerned about developing a web-based digital identity and about the privacy of their information. However, when they were supported while in the experimenting phase participants became increasingly comfortable with sharing material in the public domain. For example, the use of blogs for communicating ideas and information was taken up by most participants as they became more confident and more willing to share their progress and thoughts. Thus it was observed that familiarity gave confidence, as did a growing knowledge of the possible risks and expected consequences involved in the use of Web 2.0 tools. With this came a greater awareness of copyright possibilities, ethical issues and etiquette when communicating in the digital domain, as well as the creation and utilisation of material once these aspects were explored with the help of the researchers.

1.8 The importance of easy access

The level of access to digital resources and information varied at each institution, and this became apparent during the course of this project. Where access to the open Internet was restricted in the workplace, participants' development of digital skills was affected. This occurred because they were limited in their ability to practise the new skills they acquired during the workshops. It was also apparent that institutional infrastructure (such as bandwidth) and the technical support mechanisms available (e.g. from an IT Helpdesk) impacted on the level of access and comfort that the participants experienced.

If digital information literacy is to be fostered successfully, and the outcomes of the government's Digital Strategy (Ministry of Economic Development, 2008) – connectivity, capability, confidence and increased digital content - are to be achieved within tertiary institutions, then access has to be as easy and painless as possible, for both staff and students.

1.9 The role of the customisable Online Information Literacy (OIL) modules

Staff and students were shown OIL modules (created previously for a Ministry of Education eCDF project – <http://oil.otago.ac.nz>) in the project workshops and they made some use of the modules either individually or with their classes during their teaching. In the main, however, it was the student participants who reported an increase in confidence and ability as a result of completing a number of modules. However some access issues did arise in the use of the modules. For example, embedded video content was not permitted by some institutional firewalls, and some of the interactive Flash animations were not accessible.

No customisation of the OIL modules took place during the project. Although the exploration of ready made modules, such as the OIL modules, specifically about the topic of information literacy was one of many approaches used by participants, their primary interest was to work on issues associated with digital information which had personal relevance to them. Participants were more interested in the practicalities of accessing and using a broad range of actual digital information for authentic purposes, rather than spending all their time exploring information topics, such as how to search for information, evaluate information etc., and in any case they developed those skills while actively accessing and managing digital information. The OIL modules are a very useful resource for using in combination with a range of other strategies, and provide foundation knowledge in the area as well as practical skills for increasing information literacy including digital contexts.

2. Personal online learning environments and the social networked community

For research question two, the researchers attempted to ascertain how personal online learning environments (PLE) and membership in a social networked community could influence digital information literacy. The development of PLEs and engagement in learning communities within each group was examined and is described under two headings: how participants set up or extended their PLEs and networks in the project, and the development of learning communities within each group.

2.1 How participants set up or extended their PLEs and networks in the project

The intention in the project was to assist participants to develop sufficient digital skills to be able to create individual electronic learning environments, as both a way to organize and keep track of what they were learning during the project. These environments would also assist participants to explore Web 2.0 possibilities for tools and networking with others. This objective was based on the definitions of a Personal Learning Environment (PLE) discussed in the literature review (Atwell, 2006; Lubensky, 2006), where a full description of PLEs and their use is described. Acknowledgment was also given to non-digital aspects of such a system (Anderson, 2009; Martin, 2007; Sims, 2007). Most of the participants in the research were informed about PLEs at the start of the project, but were not overly aware that they were developing a PLE, or that they even had one, until this was pointed out in the focus group interviews. This lack of awareness about PLEs was regarded as common and therein lays the strength of PLEs according to Clark (2007).

In this project, the researchers wanted to observe how participants developed their digital information skills as they organised a variety of digital technologies and information without specifically directing them to build a PLE in a formal or structured sense. When the concept was explained at the end of the project, they understood what they had been doing. The exploratory nature of the project acted as an enabler for participants not only to expand existing PLEs, but also encouraged them to construct PLEs of various kinds; PLEs with personal and professional relevance. The formation of PLEs, particularly in a virtual context was found to be beneficial for the majority of participants. This finding is supported by previous research by Schaffert and Hilzensauer (2008), and seven important factors they found associated with the use of PLEs, were similar to those observed by researchers in this project. For example through the use of PLEs:

- Learners became more active and self-directed because they were involved in creating their own content;
- Input and support from peers helped learners to personalise their knowledge;
- Learning material was (potentially) limitless;
- There was more choice;
- Opportunities for social learning were present;
- Participants had more ownership of resources;
- Learning became more self-directed and organised as the project progressed; and
- Exposure to a range of technologies and social software tools enabled participants to aggregate a range of information sources in one place.

Nevertheless, what the research findings cannot confirm is the extent to which PLEs or social networking increased participants' digital information literacy as demonstrated through an increase in their DIL scores. This aspect however, is illustrated in the individual case studies (Chapter Five). There is also discussion of some of the cases within the context of PLEs in Chapter Six.

2.2. The development of learning communities within each group

The creation of a dynamic learning community was critical in the development of participants' capability. The researchers are convinced about the significance of the interactions which participants in each group experienced as a result of taking part in the action research. The majority of participants certainly engaged in an exchange of information and knowledge with others in the workshops and online within their groups, and in some cases in the global community. In accordance with the definition of a social network used to describe social systems (Garton, Haythornthwaite & Wellman, 2006), participation in the research project had an influence in building a community of learners who engaged in peer discussion and supported each others' learning.

Additionally, the interactions which participants were observed in, whether online or face to face, equated to knowledge sharing, regarded as an outcome of social networking as well as a critical element in building organisational capacity (Lamoureux, 2006). Several factors promoted engagement in digital information environments for all participants:

- The relatively unstructured, yet supportive nature of the workshops;
- The facilitation provided by the researchers; and
- The support of peers.

This all stimulated capacity for digital information regardless of participants' starting skill level. When the definition of social networking was extended to include face-to-face interaction, as put forward by Anderson (2009), it was acknowledged that the research participants did form a social networked community at each institution. Each group was a dynamic learning community and demonstrated all the characteristics associated with such an entity, such as:

- Autonomy and responding to decentralised control.
- Commitment and willingness to create and share knowledge; and
- Engagement in flexible and negotiated learning activities.

Additionally, individuals interacted through dialogue and collaboration on shared goals and problems within a project which had a common focus and incentive to collaborate (Wilson & Ryder, 1996). Finally, even though most participants found the process challenging, the majority also found the experience worthwhile and motivating. They all left the project equipped with new digital skills and knowledge as well as strategies for learning about technology, albeit at varying levels of advancement. The majority of

participants had also discovered a new network of contacts on which some felt they could call for assistance outside the project.

2.3 Goal-setting and Self-Directed Learning

Therefore, participation in a process of action research, through the active pursuit of individualised goals for developing skills in digital information, was clearly influential in increasing digital information literacy scores for the majority of participants. This process was used as a way of encouraging participants to take control of their learning and become more aware of themselves as learners. The action learning cycle was a strategy which encouraged metacognition, that is, it enabled participants to both monitor and reflect on their learning process. All groups reported improvements in technical skills, confidence and motivation in managing digital information. Additionally, participation in a group expanded participants' understanding of the possibilities available, and everyone explored tools and strategies beyond those defined in their individual learning objectives. Additionally, some advanced users with DIL scores which did not change to any degree, left the project with enhanced capability, and this was ascertained through the development of the individual case studies.

For example, Sandra came into the project with a high level of confidence and frequent use of a range of digital tools. She openly outlined her progress in the project on a blog, and interacted online with other participants in her group. Sandra's main goals were to become more proficient at accessing new technologies and information and also in managing information; she certainly achieved these goals. She was an engaged participant, who recognized her information needs, and was able to work in a self-directed, reflective and inquiring way towards finding solutions. She was also aware of the need to be more efficient in using information. Other dispositions which Sandra demonstrated emerged from the way she would 'play' with a range of tools until she found what she needed - logic, persistence and motivation. Sandra's overall DIL score decreased slightly, however her increase in knowledge and her change in attitude towards more flexibility and innovation were very evident.

It was evident by the end of the research that it was not possible for participants to develop finite digital information literacy skills in dynamic technological environments. Rather they needed to be equipped with more confidence and strategies for dealing with unfamiliar territory and new challenges; a pre-requisite for lifelong learning.

3. Digital information literacy for lifelong learning

When investigating research question three, answers about the importance of digital information literacy for the lifelong learning of staff and students (including Māori and Pasifika), productivity and innovation were sought. The participants definitely left the project better equipped to deal with technological challenges, and more motivated to utilise a wider and more diverse range of tools and strategies for life long learning. The discussion is summarised under the following headings: productivity and innovation; changing the approach to learning; attitude shifts, the need for time and future proofing.

3.1 Productivity and innovation

The results of the research demonstrate that even a relatively short and intensive period (with the right conditions) over which to develop digital information literacy was able to produce large changes to participants' digital information behaviour and the skills they used for tasks. Higher levels of digital information literacy were associated with both qualitative and quantitative changes to work patterns. Qualitative changes were the most evident as people identified creative uses of new digital tools to enhance their work. In this case, an educational setting where change manifested itself as the creation of more diverse and digitally enhanced learning environments for their students, or enhancing their students' digital information literacy skills. For example, when teachers and librarians improved their own digital

information literacy, they felt empowered to meet their students on a more 'level playing field' (in a technological context). They therefore felt better equipped to work with the students on improving their (the students') information literacy skills, particularly their critical, evaluative and searching skills.

Quantitative changes were apparent when existing work problems were identified, and practical digital solutions were found that improved efficiency and effectiveness in their everyday responsibilities. Participants changed their work patterns in a variety of ways from developing new skills such as effective search strategies, using new tools to organize work or materials, to developing more efficient problem-solving approaches. Although, participation in the study provided two hours per week in which people were able to leave behind work and study commitments and focus on developing their digital information literacy, this was not enough time and participants spent many additional hours exploring or practising on their own. Nevertheless, the strong feeling of time pressure was ever present, because developing new skills and embedding them in work behaviour takes time. Therefore, the danger of not providing adequate time in the workplace for this endeavour was that the time spent on initial learning of digital information literacy would be wasted.

3.2 Changing the approach to learning

As mentioned previously under research questions one and two, support for different ways of learning and the setting up of personal learning environments and social networking was critical for the development of digital information skills and capability. All participants realized that their old methods of learning were not appropriate for dealing with digital information, and they engaged in risk-taking, collaborative group learning and play, as well as using a wider range of learning strategies. For example, trial and error learning was previously regarded by participants as too time wasting and frustrating. However, participants came to value this approach in the context of developing new digital information skills. The group environment was important to the use of this strategy as others were on hand as a safety net if things went wrong. A major advantage of the strategy was the increase in confidence experienced from successful mastery.

3.3 Attitude shifts

Most participants in the study felt that they had experienced a shift in attitude. Many started from a position of feeling negative about technology; some were so fearful they had physiological reactions when confronted with it, others were proud of their technophobia. In time, participants came to view digital information skills as essential to being literate in the 21st century and even a source of enjoyment. Underlying this shift in attitude was a growth in confidence, motivation and persistence - aspects of self-efficacy - and a resulting greater belief in their abilities to take on new challenges.

3.4 The need for time

Most participants felt they didn't have enough time to 'play', and some felt guilty about 'wasting time' doing this, yet recognised that nurturing new skills takes time. Recognising the importance of developing these skills and balancing that against the urgent demands of work or home was an ongoing issue for most people. Although, participation in the research provided dedicated time to explore digital information sources and strategies for managing them, justifying the time needed for practice away from the workshops was harder.

3.5 Future proofing

Most participants recognised that the value of their new skills was in the way they prepared them for the future. A common metaphor used by participants, described the project as the start of a lifelong journey. Others viewed their digital information literacy as a seed that needed to be nurtured. Many characterized their new literacy as personal growth that they expected to continue well into their retirement. Others felt

that the experience had opened new worlds to them, describing how they were becoming more fluent in a language that enabled them to interact in different ways with new people, or even in different ways with people they already knew.

There was much evidence to suggest that digital information literacy was very important for lifelong learning of participants in the study as part of being a productive and innovative member of society. Unfortunately, due to the small numbers of participants who identified as Maori and Pasifika, no definitive conclusions could be made for them, or for ethnic-related preferences for developing digital information literacy. Also given the limited range of ethnicity, gender and age of participants it was not possible to draw any conclusions as to the wider applicability of this project across other ages, gender and cultures. However, the approach used in the project is sufficiently robust to warrant its use in a wide range of contexts and tertiary environments.

4. The New Zealand academic workplace and other OECD countries

Research question four was formulated to determine the standard of digital information literacy in the New Zealand academic workplace compared with other OECD countries.

This research study could not determine the overall standard of digital information literacy in the New Zealand working age population. However, it has described findings from a small number of purposeful cases from across a small subset of NZ tertiary institutions.

This combined with the variety of digital tools and environments, and the highly contextualised way in which participants in this study engaged with these tools means there is little opportunity to make predictions from our findings. It is possible, however, due to the robust nature of the research, for others to develop an understanding of the model in use, and anticipate the outcomes of its use within a particular context.

This problem of ICT use being highly contextualised was addressed in the OECD Programme for the International Assessment of Adult Competencies PIAAC initiative. With regard to the ICT component, the emphasis of PIAAC was on the cognitive processes underlying literacy, such as dealing with dynamic and interactive problems as well as non-linear information structures, rather than on aspects of the use of specific information technologies. Indeed, an in-depth assessment of technology aspects would be difficult to undertake given the high context specificity in which technologies are utilised. (Schleicher, 2008)

The findings from this research, used in conjunction with other sources, if and when they become available, (note - the PIAAC data is no longer going to be available), is needed to provide a resource for planners and policy-makers who are looking to improve the ability of New Zealand adults to understand the potential of technology and make informed choices about when, and how best to use it.

Conclusions

The overarching message from this research is that capability, rather than a standardised literacy, is key to success in dynamic technological environments. This capability integrates strategies for learning, and takes into account particular dispositions for handling digital information and change in digital environments. The data gathered from staff and students in four different tertiary organisations, using a mixed methods approach, provided a broad and diverse body of evidence for the use of flexible and individualised methods to support the development of digital information literacy in the tertiary sector. The robustness of the research findings makes the outcomes generalisable because others can easily interpret them and apply the model in different contexts and situations.

The research findings confirmed that Digital Information Literacy (DIL) is an evolving concept. In this research, the definition of DIL did not assume an linear approach to seeking and finding information, as its precursors did, but in contrast and most importantly, it incorporated both the skills needed for accessing and using digital information, and integrated them with the dispositions needed to be successful in this endeavour.

The survey instruments used for this research are a first attempt at measuring change in the level of digital information skill, and indicated there were positive shifts for almost all participants. The changes in digital information skills were underpinned and increased by shifts in attitude towards the use of digital technologies and strategies. This led to a growth in confidence, motivation and persistence - aspects of self-efficacy - and a resulting greater belief in their abilities to take on new challenges. The case studies which were developed from the whole range of available data yielded rich material. A number of key aspects emerged which can be used to inform future programmes for developing DIL capability in tertiary staff and students. These aspects are included in the recommendations for the project.

This research has shown there is no one size fits all model. Instead users of digital information are more likely to increase their level of skill and capability if supported to work within an environment which they have created for themselves. In this research project, flexible programmes and strategies were used and they were successful in enabling learners to set their own goals based on personal and professional relevance.

Most of the outcomes anticipated for the research project have been met. For example, a definition of digital information literacy has been developed and is regarded by the researchers as a starting point for further discussion with others in the tertiary sector. Whether the definition is appropriate for Australasia is yet to be determined and once the findings of the research are disseminated, further discussion can continue about this. The inclusion of digital information literacy standards in the ANZIIL framework is probably not necessary, but findings from this project may influence a change in this area.

The dissemination and active use, including customisation, of existing online information resources such as the OIL modules was not definitive in this project, nevertheless, they can be part of the digital toolbox of strategies for digital information development. Strong evidence for using Web 2.0 strategies and technologies to enhance key digital information literacy competencies was found.

It was not possible to fully determine the importance of digital information literacy for lifelong learning in New Zealand, though there were signs that some inroads were achieved in this area. Lastly, it was not possible to rate the digital information literacy of New Zealanders within the OECD due to a lack of measures for DIL in the OECD. Nonetheless, findings from this project can be used to provide a baseline for developing such measures for future research.

Several recommendations for achieving optimal digital information literacy skills and strategies for lifelong learning have resulted, as well as a model of social networking which facilitates a high level of digital information literacy relevant to tertiary environments. The recommendations are outlined below.

Summary of Key findings

1. Participants rated themselves more highly on several aspects of digital information literacy at the conclusion of the project, and demonstrated an increase in:
 - Both traditional and digital information skills;

- The range of digital information tools and strategies used, e.g., computer conferencing, information sharing sites, online library databases etc.;
 - Confidence in using tools and strategies to locate, retrieve, analyse and apply information;
 - Digital information literacy (DIL) scores (95% of participants);
 - Overall confidence with using ICT methods (mean score changed from 3.3 to 4.0).
 - Belief and confidence in their own abilities in using ICT (self-efficacy) ;
 - Aspects of capability associated with DIL (as indicated by the list of dispositions).
2. The dispositions required to obtain an adequate or minimum level of digital information literacy were found to include:
 - Confidence and belief in own ability (self-efficacy);
 - A demonstration of openness;
 - The ability to problem solve and take risks;
 - Technical capability;
 - A willingness to collaborate and share; and
 - The desire to keep 'up to date' driven by the changing contexts of information use and requirements.
 3. Working collaboratively in a supportive environment as part of a learning community, to explore a wide range of digital tools and their applications, enabled progress in DIL.
 4. Dedicated time and supported 'play' (provided by facilitators and peers) with a range of ICT tools in the workplace and for study, and permission to continue the endeavour outside formal workshops was essential for developing digital information literacy.
 5. Action learning, and the setting of individualised goals for developing skills in digital information, was influential in increasing DIL scores for the majority of participants.
 6. Large changes to participants' digital information behaviour and the skills they used for tasks occurred as a result of a relatively short and intensive period of professional development (with the right conditions).
 7. A shift in attitude was demonstrated by the majority of participants and this included growth in confidence, motivation and persistence - aspects of self-efficacy - and a resulting greater belief in their abilities to take on new challenges.

8. The overarching message from this research is that capability, rather than a standardised literacy, is key to success in dynamic technological environments.

Recommendations

There are four main recommendations arising from this research. It is recommended that:

1. Learning programmes intended to develop digital information literacy in tertiary education settings must:
 - Have personal relevance for individuals and be integrated into everyday, work and study contexts;
 - Allow learners the opportunity to 'play' and engage in supported exploration, as well as exposing them to new tools and strategies for organising a digital PLE or presence in a networked environment (Web 2.0);
 - Recognise the importance of allocating time for regular face-to-face, (or possibly where appropriate, synchronous online) small group, learning opportunities that provide support for diverse self-directed goals and flexible and collaborative approaches to learning;
 - Facilitate participation in dynamic learning communities to encourage sharing and collaboration regarding digital information resources and knowledge;
 - Encourage meta-cognitive awareness of the learning process, through reflective practice and peer communication;
 - Provide support to allow learners to become comfortable with a digital identity and become familiar with ethical behaviour and etiquette in the digital networked environment; and
 - Consider the dimensions of digital information literacy, and foster personal capabilities, conducive to success in an ever changing digital environment, as outlined in the definition of DIL developed for the project. (The actual dispositions and skills required are described fully in the project taxonomies, Chapter Three & Appendix 2).
2. Infrastructure at tertiary education institutions should be continually reviewed, in order to capitalise on the benefits of consistent access for staff and students to the latest web technologies, while recognising the ongoing need for security.
3. Educators and information services personnel should continue to engage in discussion and debate with the intention of reviewing and redeveloping a definition of DIL, based on the work done in this project, to underpin future programmes for developing and maintaining the digital information skills and capability of staff and students.
4. Further research is undertaken to clarify some of the key findings and gaps in this project – as outlined in the Conclusions chapter.

