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A qualitative investigation of the digital literacy practices of doctoral students

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Abstract

Academic libraries are currently part of a landscape where there is a rapid growth of digital technologies and electronic resources and they have responded to this by developing their research services. Some of the most specialised and complex research in higher education is conducted by doctoral students and the effective use of digital tools and skills is often crucial to their research workflow and success. The need for digital literacy has been further emphasised during the global pandemic of 2020-21 which has required the maximisation of online working and digital skills to ensure the continuation of education, services and research productivity. This paper presents the findings of a qualitative research study in a UK university exploring factors influencing differences in the digital literacy skills of doctoral students. The literature included has been updated as digital skills and technologies are a constantly changing area of research.

Due the complex nature of doctoral research, it was difficult to draw definite conclusions about the many factors which influence the digital literacy practices of research students. Students interviewed in the study discussed their approaches to and understanding of information, digital and media literacy (Jisc, 2016) but the influence of demographic factors such as age, discipline and gender could not easily be evaluated. All students in the study appeared to be under time pressure and required a high level of organisation and this was assisted by digital skills and proficiency and access to robust hardware and software. They believed they were largely self-taught and some required appropriate training at the point of need to increase their research productivity. This paper will explore how evidence-based practice and engagement may be used to understand the digital practices of doctoral students and to inform the development of research services within academic libraries.

Keywords

digital literacy; digital skills; digital tools; information literacy; interviews; postgraduate research students; qualitative research; UK

1. Introduction

Digital technologies, resources and skills are prevalent in higher education and are increasingly employed during the research lifecycle. Digital skills have become even more important to ensure continued productivity in the context of the global pandemic of 2020-21. Some of the most complex and specialised research is conducted by doctoral students, however there is not always a deep and clear understanding of their utilisation of digital skills and technologies (Dowling & Wilson, 2015). Information literacy often refers to the ability to retrieve, evaluate, process, manage and disseminate research in all formats (CILIP Information Literacy Group, 2018). This increasingly includes online content such as open access repositories, electronic articles, data and online archives which means that digital literacy is strongly inter-related to information literacy. Doctoral digital literacy may focus on the appropriate deployment of online resources (such as electronic journals and databases), technologies and digital skills to support

the entire research lifecycle. This paper is based on experiences of being a practitioner researcher and includes new and updated literature to complement the original empirical study in recognition of the changing nature of digital technologies. It includes findings from the author's MA Academic Practice dissertation entitled *Which factors may contribute to differences in the digital literacy skills of research students?* It will outline the research objectives, the methodology and approach employed, some of the insights and outcomes and how these may inform the provision of academic library research services.

2. Context

The research landscape is constantly changing and there is an increasing move towards open access content such as institutional and data repositories, providing a wider range of a digital content available to researchers. Digital skills and technologies are widely used in research, for example, to conduct literature reviews, to store and manage search results, and to disseminate research outputs and datasets. In higher education, many universities have increased their emphasis on research (Bent, 2016); for example by offering funding such as doctoral scholarships and graduate teaching contracts. In some disciplines such as Social Sciences and Humanities, students may have to fund themselves. In the past decade, the UK has tended to have a structured PhD programme, often between 4-7 years, which usually has an initial registration, an upgrade process, and the transfer to a full PhD route (Pyhältö et al., 2020). Employing research skills and conducting empirical research in an increasingly digital environment are important aspects of doctoral studies (Gouseti, 2017). While doctoral students may not be the largest cohorts, they produce specialised and unique research outputs and encourage innovative practices in universities (Jisc, 2020).

2.1 Institutional context

The research study was undertaken at a London-based university in the UK. Subjects taught and researched in the university include Arts, Humanities and Social Sciences, Health Sciences, and Business Studies. At the time of the study, the university had approximately 20,000 students, 700 of which were doctoral students, and some of their research was interdisciplinary, conducted across different departments and research centres.

2.2 Framework used to inform the research

The research study was informed by some parts of the *Jisc Building digital capability: example researcher profile* (2016); this will be referred to as the Jisc Researcher capability profile (2016). Researchers can use the profile to consider their individual digital practices and development requirements. It was thought that the framework included certain online skills and capabilities which were relevant to doctoral digital literacy. In particular, three areas of the framework were used: information and communication (ICT) skills; information, data and media literacy skills; and online communication and participation. These informed the literature review and the qualitative interview aspects of the research such as the framing of some of the interview questions. The use of social media and the importance of an online research presence were discussed in the interview part of the study.

2.3 Rationale for the research

The rationale for the study was an attempt to reach a greater understanding of factors which may influence the digital literacy skills of doctoral students. Due to the intensity of their research, Barry (1997) believed that doctoral students have the greatest need for information and therefore they require high quality information retrieval and management skills. The research topic was selected as it related to the author's role in a university library which involves supporting research students and offering them training on areas such as literature searching, using reference management software and creating an online research profile.

Following informal conversations with doctoral students from various disciplines, it appeared that there were differences in how the students approached and utilised digital resources and technologies to support their research processes. The research study attempted to explore why this might be the case. The intention was to use the evidence-based research findings to inform professional practice in Library Services. This included developing training and online content to assist doctoral students with their research workflow. It was also intended that the study could contribute to knowledge and understanding of digital literacy in relation to research students in the fields of Library and Information Science and of Education.

3. Literature review

The literature review provided useful insights into digital literacy definitions, and previous research and frameworks such as the *Vitae Researcher Development Framework* (Vitae Careers Research and Advisory Centre, 2021) were useful in showing how this related to doctoral students. It was also insightful to consider types of digital tools and skills which can support different stages of the research lifecycle. It is, however, difficult to define digital literacy. Gilster (1997), as cited in Lankshear & Knobel (2008) wrote about digital literacy as an overarching approach and conceptualisation of the effective use of digital skills and technologies rather than a prescriptive list of core abilities. Martin (2006, p.151) further developed Gilster's concept and his definition is useful for this research study as it also applies to the concept of conducting research:

Digital literacy is the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources [...].

Digital literacy, in a wider context, may be defined as a skill set or a range of competencies which enable individuals to live and contribute to the digital society (Jisc, 2016; List, 2019). In the doctoral context, this may involve becoming effective online researchers through the application of tools, skills and workflows (Ince et al., 2018). It has also been described as a process of continuous change and improvement which is relevant to the doctoral context (Soltovets et al., 2020).

Research students often require many digital skills and tools to assist in the process of conducting their research. Information and communications technology (ICT) skills are useful to enable the researcher to identify and utilise appropriate tools and software to support their research lifecycle. Usage may depend on how much time the researcher has to explore tools, their awareness of suitable products, their previous experience, and perceived success in using certain technologies. Subsequent to the study, a researcher digital insights survey (Jisc, 2020) found that above all else researchers would like specialised training, support and access to appropriate software to support their digital skills.

In terms of factors which may influence the use of digital tools and skills by research students, Collins et al. (2012) identified firstly supply factors and secondly demand led ones. Supply in this context means the electronic journals, databases, apps, social media tools, software and online tools used to conduct and manage the research process. The demand-led factors were described as those such as age, gender, discipline, length of research career etc. These may contribute to learned and habitual methods of conducting research within a disciplinary context (Green & Macauley, 2007).

It is likely that researchers will use digital tools which save them time or enable them to work efficiently. While in many respects digital technologies provide many solutions to conducting online research, they also present challenges because they are constantly changing and can be disruptive to research processes (Laurillard, 2008). It is possible therefore through their

experiences, if students do not feel confident in mastering and, to an extent, experimenting with digital technologies, this may affect their digital literacy or capabilities.

Demographic factors such as discipline, age, gender were identified in the literature. Similarly digital factors such as access to training and support; confidence in using technologies, information, digital and media literacy, online communication and participation using social media were also identified. However, it was not possible to differentiate between factors in respect of their perceived importance or to measure the influence of aspects such as supervision, peer support and training opportunities. To address this, some original, empirical research was conducted. It was thought survey and qualitative interview data could provide a rich source of insight into individual and thematic digital practices.

4. Methodology

4.1 Design and pilot testing

The aim of the research study was to identify and explore factors which may contribute to differences in the digital literacy skills of doctoral students. Prior to conducting the empirical research, ethical approval was obtained from the appropriate university ethics committee. This ensured that participants were aware of the research purpose along with their anonymity, data security and right to withdraw from the study at any time. Participant information sheets were provided and informed consent was also obtained before the interviews. Following good practice, the survey was pilot tested and feedback was sought from colleagues, academics, and a professional researcher. The pilot testing was very useful in identifying and rectifying potential technical problems with the survey. Pickard (2013) emphasises the importance of consistency and clarity in the survey design. Technical adjustments were made to allow multiple responses to some questions, other questions were reworded, and an indication of the number of questions and the approximate completion time were given at the start.

4.2 Participants

The study was a small scale one and doctoral students in two Schools (250 students from Arts, Humanities and Social Sciences, and 100 from Health Sciences) were invited to participate voluntarily via email. The survey response rate was approximately 8% (27 students) although because the email was forwarded by research administrators to preserve the confidentiality of participants, there was no control over the distribution. These Schools were chosen as it was anticipated that their doctoral students might have different disciplinary approaches to digital skills and tools. For example, Carpenter (2012) indicated 90% of doctoral students in arts, humanities and social sciences mainly researched independently and experienced a sense of isolation. Health students may be from a practitioner background such as the National Health Service (NHS) and some are mature students returning to education.

As their main discipline, respondents researched across 11 different subjects including International Politics, Music, Food Policy, and Nursing and Midwifery. 26% of respondents were researching Psychology and 15% Sociology. The respondents ranged from 24-30 and up to 50-59 years of age. 75% of the respondents were female and almost 80% were full-time students. The large range of subjects meant that these samples were too small to provide a basis for statistical analysis.

4.3 Research methods (survey and interviews)

The anonymous online survey (see Appendix 1) was adapted with permission from a University of Greenwich digital literacy survey which seemed to cover relevant themes. The survey was a mixture of multiple choice, Likert scale, and free text questions. These were adjusted to suit doctoral participants and the subjects they were researching. The survey was completed by 27

doctoral students in the university and was used to explore literature review themes such as demographic factors, digital tools used by research students, their confidence in using technologies, and their sources of support and training needs. The participants were at different stages of their research and 70% were in year three or above of their study.

Semi-structured interviews of 40-45 minutes were conducted with eight participants recruited from the survey (see Appendix 2 for the structured questions). The semi-structured approach meant that all participants answered the same core questions but the interviews were flexible with follow-up questions and discussion as appropriate. The interviews explored the themes of: defining digital literacy; exploring disciplinary research practices; student research methods; digital tools used in research; university, supervisory and peer support. The interviewees were aged between 24-30 and 50-59 and 50% were male and 50% were female.

4.4 Analysis

The survey and interviews tested whether factors such as disciplinary research practices, gender and age appeared to be more important than general factors such as access to training opportunities, ICT skills, digital, data, media literacy, and the online communication and participation of researchers. The survey was designed on and analysed using a subscription version of Survey Monkey and the data was analysed using the survey software and Excel to create tables, charts and graphs.

The interviews were recorded on a dictaphone and then transcribed manually thereby resulting in familiarity with the data. The transcriptions were then analysed thematically using a four stage quantitative analysis method (Bryman, 2016). This involved reading and searching the transcripts, identifying key themes, and coding and analysing the data. Responses were grouped and excerpts from each interview were used to provide evidence in support of the themes. The factors identified in the literature review were synthesised with the empirical research findings to address the research question.

5. Limitations of the study

The study was a small scale one and limited to doctoral students in Social Sciences, Arts and Health Sciences in a London University. The response to the survey was 8% (27 respondents) and 8 students agreed to be interviewed, therefore it was not possible to draw definitive conclusions from the small data sample. The anonymity of the survey meant it was not possible to clarify any of the answers further and 75% of the survey respondents were female so it was difficult to draw gender-based conclusions.

6. Research findings and discussion

Doctoral students face several challenges in regard to their digital literacy in a complex online environment. They are often under time pressure and conducting specialised research requiring them to have excellent literature searching and information management skills. Large volumes of research data may be generated and need to be collected, analysed and stored appropriately (research data management). Researchers may use a variety of research methods such as qualitative or quantitative, phenomenography or mixed methods for example. Due to their individual research processes and the length of their course, they might not have access to training at the appropriate point of their research.

Research students have complex digital literacy needs which makes it difficult to identify all of the factors which may influence these. Disciplinary practices may influence the research methods adopted. All of the interview participants researched in a cross-disciplinary environment and believed that this influenced their research methods and choice of digital tools

to some extent. The most popular technologies used by all of the survey respondents were email and online conferencing tools and the most popular electronic resources were online journals and databases.

Factors which seemed to influence all of the students interviewed were using ICT skills to assist with time management and organisational skills at the point of need, and experiences of and confidence in using technology. The largest debate in the interviews was around the use of social media tools. Half of the students found them very useful but half thought they could be distracting and time wasting. A lack of training on areas such as research data management, research methods, and data analysis made the students' research more challenging.

6.1 Discipline and interdisciplinarity

One finding from the interviews was that all of the students were conducting interdisciplinary research. Collins et al. (2012) concluded that in their use of digital technologies, most researchers continued to employ the tools and skills that they had used in their previous academic careers. One student interviewed described how the discipline influenced the choice of research methods:

'Yes, the discipline does actually affect things because I'm doing more qualitative research broadly speaking, so [...] I am just doing interviews and content analysis really' (Student 8).

In this context, the researcher may adopt a hybrid approach to digital technologies and employ elements from different disciplines. This increases complexity but may enrich the research experience:

'I think that makes your whole research richer as well when you know you can tackle various disciplines within one study' (Student 6).

The students viewed interdisciplinary research positively and believed it offered new possibilities, depth and collaborative digital approaches and they felt it was becoming increasingly common.

6.2 Access to training and support and peer learning

Another finding was that participants had no access to a university wide doctoral training programme meaning *'[...] structurally and institutionally there's not all necessarily the support there that we need.'* (Student 3). A lack of training was a challenge to all interviewees to some extent. They required training at appropriate stages of their research lifecycle to increase their productivity in areas such as research methods, research data management, and data analysis.

Only 7% of survey respondents strongly agreed they had been supported by their university in using digital technologies. This might be because of the individual and specialised nature of their research approach. Three quarters of the survey respondents and all of the students interviewed seemed to be in favour of having a general university doctoral training programme:

'I think it might be useful actually if the university did do training sessions on those kind of things because there is a wide range of PhD students who would benefit from that' (Student 1).

This correlates with a subsequent researcher digital experience survey by Jisc (2020) which indicated that above all respondents wished for specialised digital skills training, support and access to appropriate software.

Library Services support

Library Services within the university offered a programme of workshops aimed at research students and staff. Research by Gouseti (2017) indicated that doctoral students were open to using new technologies, especially when offered training and support from their university and from Library Services. Regarding training offered on digital resources and tools, Interviewees were all aware of these training opportunities. A high proportion of the survey respondents (63%) said they consulted Library Services about their digital technology enquiries although the nature of these enquiries was not clear.

'I know support is there for example managing your work, for example I think the Library has sessions on sort of managing the research process, managing your research sources' (Student 3).

Students valued Library Services support in workshops and individual, tailored appointments for literature searching etc. and felt Research Librarian roles added value and assisted with current awareness and search techniques and strategies.

'I think the support I have had from the Library has been very good [...], I have been able to bring my own issues and have been able to talk through my issues, I have been very impressed with the Library support' (Student 7).

The finding was an encouragement to provide individual library support for doctoral students and to be aware they research in specific contexts and use different research approaches.

Self teaching and peer learning

From the survey data, 85% of students believed that they mainly taught themselves digital skills and technologies through practice and experience (Sharpe et al., 2010). Allan (2010) emphasised the importance of the supervisory relationship but in the study supervisors were not necessarily the main source of digital literacy support. In the interview data outcomes, all of the students felt that they had to informally teach themselves to use technologies at certain points of their research. Student 5 spoke of 'self-discovery' and Student 4 of being 'self-taught'.

'My feeling is that I am mainly self-taught I can't remember that I really got teaching, that anyone ever taught me that this would be useful and this is how you use it' (Student 4).

Peer learning was very important and 78% of the survey respondents asked fellow students for advice on digital technologies and valued their input and expertise.

'There is a sense of community, definitely [...] There is definitely a very, very strong willingness of people to share knowledge' (Student 7).

Interview participants all valued support from peers and colleagues (including those from other universities). This may be because they researched in specialised areas and wished to try new digital approaches learned from their peers (Jisc, 2020).

6.3 ICT, information, digital and media literacy and online communication skills

ICT skills

The Jisc Researcher capability profile (2016) refers to information and communications technology (ICT) skills. In the interviews, students expressed that they changed their approach to digital technologies based on specific needs such as collecting and managing research references, and data collection and analysis. Persistence and resilience in using technologies was a very strong theme mentioned by most students in that they experimented with new technologies within their time constraints.

IT skills and access to good quality equipment was regarded as useful. Student 5 believed '*a researcher is not just a gatherer but a hunter gatherer in a way but also a selector [...]*' and requires '*IT skills, a pathological attention to detail*'. A key theme for all of the researchers interviewed was time management and organisational skills. Digital technologies which assisted with these at the point of need are likely to be more popular. Generally, students interviewed perceived they were less busy at the start of the doctorate and this was a good time to learn digital skills and technologies but may not have done so.

One interviewee mentioned however, that using digital technologies may save time but were no substitute for being a competent researcher.

'The thing is technology is good if it's kind of time saving in terms of doing the analysis better. I'm not convinced that there are, if you like, software systems or processes will essentially make the thinking process better' (Student 8).

Overall, all interviewees regarded information technology skills and access to robust technology and reliable software as beneficial to their research process.

Information, digital and media literacy skills

Jisc (2016) highlighted the importance of information, digital and media literacy (using digital resources and software across different media) as a research and current awareness tool and also in building an online research reputation. In the research study, 93% of survey respondents felt confident or very confident about performing literature searches. It was quite reasonable to assume that research students would be confident in constructing a complex search strategy for their online literature searching.

Some students interviewed had attended individual appointments and workshops with Research Librarians and believed they had benefited from these and as a result learned new search techniques and literature searching skills. 73% of survey respondents would like research data management training. This implied that there was potentially a skills gap in that area. 78% of survey respondents were researching full time and 72% of respondents believed their digital skills could be improved. 100% of part time students believed their digital skills could be enhanced. They were likely to use electronic materials and tools and as they may have attended the university less frequently have had less face-to-face training opportunities.

In the area of data collection, there was a lack of confidence in using the data analysis tools SPSS and NVivo. Only 7.5% of survey respondents felt very confident about using SPSS and 15% of respondents in using SPSS. This may be due to the specific research methods being used or possibly a lack of training. Media literacy skills seemed generally of more importance to respondents who were researching subjects such as Journalism or topics requiring either a high level of current awareness or use of multimedia news or digital archival material.

Online communication, participation and reputation

Jisc (2016) referred to the digital communication and participation of researchers including the use of social media such as Twitter and blogs. In the study, attitudes to developing a social media presence as a researcher was one of the structured interview questions (see Appendix 2). Attitudes to social media in the interviews were very varied. Some students valued it highly and thought it was very useful, others did not wish to engage with it at all:

'But there is a whole PhD community going on on Twitter. Where people connect and follow each other' (Student 1).

Some students felt social media had benefits for employability and networking, especially LinkedIn. It was felt there was a certain pressure to use social media in academia to network and build a reputation.

'I would say in general to have a presence is very important because [...] in academia lots of things depend on contacts and how visible you are' (Student 4).

Sumner (2012) and Bennett and Folley (2014) identified a level of anxiety amongst researchers in using social media. From the interview transcripts, it seemed that this was for a variety of reasons. Twitter was regarded by some as distracting, overused, confusing and in some cases less prestigious and credible than academic sources. Facebook was sometimes used privately for social and emotional support. Lupton (2014) identified some of the barriers to using social media and these can be around prestige, clarity of purpose and a perceived lack of quality control. Gouseti (2017) emphasised the importance of critical thinking, digital identity and of long term networking in a doctoral context.

One student had intellectual property concerns about putting unfinished, doctoral research on social media in case other researchers appropriated the ideas.

'With research I think it's actually different because you don't necessarily want to put your research into the public domain prior to actually completing because you might be worried about the contribution side of things' (Student 8).

Student 2 also expressed the idea of being careful online which correlated with the idea of digital well-being in the Jisc Researcher digital capability profile (Jisc, 2016). Overall, attitudes to social media use were the most polarised topic discussed in the interviews.

7. Applying the research to professional library practice

It appeared from the research that a bespoke, university doctoral training programme with specific departmental input as appropriate would be highly desirable. Suggestions included having a doctoral training centre at the university; having a cross university training programme to increase the breadth of possible opportunities; offering departmental research methods training. In the past year, City, University of London has established a new Doctoral College, online inductions, a university doctoral training programme and events during the year. Enhancing communication channels such as a university events, training and current awareness portal would be useful and time saving for doctoral students. General, informal events such as social events and inviting external speakers were thought to be useful from the point of view of networking, sharing expertise and socialising with other researchers.

Research methods, data collection and analysis are very important in research and university training on these and on research data management would be useful to researchers. Students indicated that they conduct multi- disciplinary research and employ different research methods (such as qualitative, quantitative), therefore a flexible approach is inclusive. Assisting students in the use of digital tools and skills to enhance their time management, organisational skills and confidence would benefit them.

Attitudes towards Library Services online guides, staff, workshops and individual appointments (for example, for literature searching and systematic reviews) were positive and appreciative. Students spoke of the need for space and time to ask questions in a non-judgemental setting and to learn new techniques, for example creating search alerts. This implies that continuing to develop a range of training opportunities to suit different research approaches is worthwhile. One student spoke of the perception that research library staff conducted research themselves and acquired expertise and then shared their tips and expertise (Pickton, 2013). The research-

informed expertise of library staff was regarded as positive in terms of enhancing student productivity and effectiveness.

It is clear that research student needs are complex, but in the training offered by university Library Services, it is useful to continue to offer different approaches such as individual appointments and workshops, and more use is now made of video-conferencing software to assist students. More recently, promoting library workshops through the Doctoral College and offering them online appears to have increased attendance. Potential topics for future training identified in the survey included reference management, using apps for research, impact factors, and citation searching. As students indicated they are largely self-taught in the area of digital skills, access to a range of online courses such as IT skills and data analysis software may assist them in training themselves at the appropriate points in their research lifecycle.

Read for Research, a patron-driven acquisitions scheme for book and e-book purchasing at City, University of London, aimed at doctoral students and researchers has proved very popular and is regarded as an example of good practice (Bent, 2016). Students appreciate a personalised service and feel valued by contributing to the development of research collections. Since the pandemic of 2020-21, e-book purchasing has been prioritised to allow equality of access.

The area which provoked most discussion at the interviews was attitudes to social media tools. Students tended to be strongly pro or strongly against using these tools. Awareness sessions of how the tools could be used to create an online research profile and demonstrating the potential academic or professional benefits to researchers would be useful. Since the study, such workshops have been delivered, for example with the School of Law.

Advocacy for doctoral students has been assisted by presenting the research findings at conferences, writing articles for publication in academic journals to raise awareness of doctoral students' digital skills, and their approach to digital technologies in their research process. Future plans include delivering workshops and content on the research process, incorporating video content covering research methodologies and looking at the user experience and journey mapping of doctoral students in this context.

7.1 Reflection

The study offered a unique insight into the use of digital technologies by doctoral students and the way they conduct their research, their training needs and supervisory arrangements. The research data has also informed the development of training and support for research students to enable them to develop their digital skills and online research presences in the future. Subsequently since the pandemic of 2020-21, there has been an increasing need for students to rely on digital technologies and resources to continue their research. As a practitioner, it was incredibly worthwhile to explore attitudes to digital skills and technologies and to have the opportunity to survey and interview some doctoral students. The students engaged really well with the survey and were generous both in offering their support for the research project and in giving their time to be interviewed.

8. Further research

Although demographic factors such as gender, age and research discipline were included in the study, it was difficult to evaluate these as 75% of the survey respondents were female. It is possible that the gender of a student may influence their choice of discipline and therefore indirectly their use of digital technologies. It might be interesting to follow this up in a future study. Further research could also be conducted on ways of assisting research students to use digital technologies to save time and increase efficiency in their research processes and to

increase their confidence. A larger study, possibly across multiple universities, would provide a more comprehensive data sample and any findings could be compared to this study.

9. Conclusions

The main conclusions of the research were that several factors might influence the adoption of digital technologies and skills by research students. The complexity of doctoral research meant it was not possible to generalise about these factors and the individual requirements, disciplinary practices and research methods of students were also relevant. The acquisition of research, information, digital and media literacy skills seemed more important than demographic factors such as age and gender. From the research findings it appeared that all students in the study were affected by factors such as IT skills, time management and organisational skills, and access to and competence with technologies. These skills are often associated with positive outcomes and completion (Lindsay, 2015).

Almost all of the study participants would have benefitted from training at appropriate points in their research, for example data analysis after data collection. Some students were influenced by disciplinary or multidisciplinary practices but it was not entirely possible to assess the significance of gender and age in the study. In the interview data, attitudes to social media use were varied; some students found it very useful, others believed it was a distraction from research.

The research study provided the opportunity to engage with individual researchers and to develop a greater understanding of the challenges of different stages of the research process. This type of research assists in providing a greater understanding of the requirements of doctoral researchers and therefore provide evidence and data for academic libraries to address those needs. It is recommended that an institution wide approach such as a doctoral training programme with specialist departmental input is likely to be the most beneficial approach.

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Appendix 1

Digital literacy survey questions

***1. I have read the information about this study and am happy to participate in this survey.**

Yes

No

2. Which is the main subject that you research?

Music /Journalism /Cultural policy /Translation/ Politics/ Economics/ Food Policy /Psychology /Sociology /Nursing /Midwifery /Health Policy /Health Management.

3. What is your age?

23 or under/ 24-30/ 31-39/ 40-49/ 50-59/ Over 60.

4. Are you?

Male

Female.

5. Are you studying?

Part-Time

Full-time

Distance learning

6. Which year of study are you in?

Year 1/ Year 2/ Year 3/ Year 4+

7. Do you consider yourself to have a disability?

Yes/ No.

8. Which of the following do you have and how do you use them? (Please tick all which apply).

| | Research | Work | Networking | Teaching | Other study | Personal life |
|---------------------|----------|------|------------|----------|-------------|---------------|
| Smart phone | | | | | | |
| Laptop | | | | | | |
| Desktop computer | | | | | | |
| Tablet device | | | | | | |
| Ereader | | | | | | |
| iPod/MP3/MP4 player | | | | | | |
| Digital camera | | | | | | |

| | | | | | | |
|---------------------|--|--|--|--|--|--|
| Digital pen | | | | | | |
| Other (Pls specify) | | | | | | |

9. Please could you rate the following?

| | Strongly agree | Agree | Disagree | Strongly disagree |
|--|----------------|-------|----------|-------------------|
| I believe digital technologies are crucial to my research | | | | |
| I know which digital technologies are required for my research | | | | |
| I know which digital technologies are important to future employers | | | | |
| I would find a university wide digital literacy programme useful | | | | |
| I have received support from the university in using digital technologies | | | | |
| I believe my digital literacy skills could be improved | | | | |
| I find it difficult to keep up to date with mobile technologies (eg, apps) | | | | |

10. Which of the following training would you find useful? (Please tick all which apply).

Building an online research profile (eg. ResearchGate)
 Social media tools (eg. blogging, Twitter)
 Using apps to assist in your research
 Reference management software tools
 Research data management
 Using mobile database apps (eg. EBSCOhost mobile)
 Data analysis tools (Please specify)

11. Which of the following do you use to manage references in your research?

RefWorks
 Mendeley
 Zotero
 Excel
 Word
 Microsoft Access database
 Card index
 Nothing in particular
 Other (pls specify)

12. Which of these technologies/ applications do you use and in which context?

| | Research | Work | Networking | Teaching | Other study | Personal life |
|---|----------|------|------------|----------|-------------|---------------|
| Email | | | | | | |
| Online conferencing (Skype, Facetime..) | | | | | | |
| Instant messaging (eg. WhatsApp, Messenger) | | | | | | |
| Facebook | | | | | | |
| LinkedIn | | | | | | |
| Twitter | | | | | | |
| Blogs | | | | | | |
| Slideshare | | | | | | |
| Virtual learning environment (eg. Moodle) | | | | | | |
| Photosharing media (eg. Flickr. Instagram) | | | | | | |
| OneDrive | | | | | | |
| Google Drive | | | | | | |
| Dropbox | | | | | | |
| Evernote | | | | | | |
| Wikis | | | | | | |
| Podcasts | | | | | | |
| Video sharing media (eg. YouTube) | | | | | | |
| iTunes/ Windows Media Player | | | | | | |

13. Please could you list any other digital technologies you find useful in your own research?**14. Which of the following online resources do you use in your research? (Please tick all which apply).**

| | Very often | Quite often | Sometimes | Rarely | Never |
|--|------------|-------------|-----------|--------|-------|
| Online databases (eg. EBSCOhost, Medline) | | | | | |
| Electronic journals | | | | | |
| Electronic news sources (eg. Nexis, Factiva) | | | | | |

| | | | | | |
|---|--|--|--|--|--|
| Online citation databases | | | | | |
| Impact factor databases | | | | | |
| Online reference management tools | | | | | |
| Online theses databases | | | | | |
| Online current awareness & alerting resources | | | | | |
| Multimedia/film/audio-visual resources | | | | | |
| Digital collections or archives | | | | | |

Other resources: Please specify name and frequency of use.

15. How confident do you feel about the following?

| | Very confident | Quite confident | Unconfident | Very unconfident |
|---|----------------|-----------------|-------------|------------------|
| Constructing & using a complex search strategy | | | | |
| Conducting a general literature review using online resources | | | | |
| Conducting a systematic literature review | | | | |
| Exporting your search results to a reference management software | | | | |
| Setting up search alerts/RSS feeds | | | | |
| Using advanced features of databases | | | | |
| Conducting impact factor/ citation searches | | | | |
| Using apps or storage software in your research (eg. Evernote. Dropbox) | | | | |

| | | | | |
|--|--|--|--|--|
| Creating an online research profile for yourself | | | | |
|--|--|--|--|--|

16. How confident do you feel about using the following for data collection/ analysis?

Digital camera, audio recorder/ Digital audio visual conferencing software/ Transcription software/ Quantitative data analysis software (eg. SPSS)/ Qualitative data analysis (eg. NVivo)/ Digital archives, records/ Field, lab recording tools/ Survey software (eg. Survey Monkey).

17. Who do you ask for help with using digital technologies? (Pls tick all which apply).

Your supervisor/ Your department/ Library Services/ IT Services/ The Graduate School/ Learning Enhancement and Development Team/ Your workplace colleagues/ Fellow research students/ Online, self taught/ Other (please specify).

18. I would be prepared to be contacted to discuss attending a follow up interview (of no longer than an hour) about digital literacy. This would be semi-structured but flexible and allow you to reflect on your own digital literacy.

Yes

No

Please give your email address if you are willing to be contacted about a possible follow up interview.

19. Please leave your email address if you would like to receive a copy of the findings.

Appendix 2

Digital literacy interviews: structured interview questions

Additional follow up questions were added depending on the responses given making the interviews personalised and semi-structured.

1. What is your main discipline/ area of research?
2. Which electronic materials and tools do you mainly use in your research?
3. How would you define digital literacy in the context of your PhD research?
4. How has/ have your supervisor(s) encouraged you to develop your digital skills? Which technologies do they recommend that you use?
5. What support is available in the University to help you develop your digital skills?
6. What kind of training/ support would you find useful and do you have views on who should provide it?
7. Which research methods (eg. qualitative, quantitative, mixed methods) do you use in your research? Which technologies do you use to support them?
8. How has your approach to digital technologies changed during your PhD?
9. How do you learn about and access new digital technologies for your research?
10. Which skills do you think you need to use digital technologies?
11. How have you developed a social media presence as a researcher? How important do you feel it is to have this?