

Central Regional Hub-funded project

Project Report



Enhancing the Roles of Information and Communication Technologies in Doctoral Research Processes

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Executive Summary

Information communication technologies (ICT) have long been important in supporting doctoral study. But while ICTs are prominent in educational practices at most levels of formal learning, there is relatively little known about the skills and understandings that underlie their effective and efficient use in research higher degree settings.

This project aimed to identify doctoral supervisors and students perceptions of their roles in using ICTs. Data were gathered through participative drawing and individual discussion sessions. Participants included eleven students and two supervisors from 2 New Zealand universities. Focus of the thematic analysis was on the views expressed by students in their drawings and in discussion about their ideas, practices and beliefs, in relation to the drawings they made. Similar analysis processes were applied to data gathered from supervisors. Findings from the supervisors' data were used to discuss findings as they related to students' views, as there was only a small number of supervisor participants.

The major finding was:

Individuals hold assumptions about and expectations of ICTs use; they make judgements and take action based on those expectations and assumptions.

This finding was supported by the evidence from the study, which demonstrated that:

- (a) Some doctoral students perceive that it does not matter how ICTs are used, the end-point, that is, thesis completion, justifies whatever ways are used. In other words, ICTs are viewed as a means to an end. ICTs are seen to exist in order to support the completion of the thesis in ways that suit the individual student.

Relationships

- *ICTs and people are perceived as separate and separated entities.*
- *ICTs and individuals work alongside each other.*

- (b) Some doctoral students view ICTs as tools or mechanisms that prompt active thoughts on practices with respect to planning and managing thesis writing and project execution. For such students, decision-making features prominently; in which, how and why they incorporated ICTs into the doctoral research practices.

Relationships

- *ICTs and the person are in a complementary partnership.*
- *ICTs and the person are intricately linked through multiple active, practical, goal-oriented connections.*

Building on these bases the following statement proposes a conceptualisation of ICTs as they relate to the doctoral research process.

ICTs are not neutral: There is a two-way interaction between technologies as artefacts (ICTs) and the use of them to achieve ends (doctoral research).

In terms of **practice**, this means that knowing about ICTs and knowing about the research process separately form only part of the work of doctoral study. Just as supervision cannot be considered independently of the research project and the student involved, ICTs skills and the use of ICTs cannot be considered in the absence of the people and the project. What is more important in terms of

facilitating the doctoral research process is students getting their “flow” right. This indicates that individual students being enabled to embed ICTs within their research process.

- i. The research journey is as much about how it happens as what happens.
- ii. There is a need to recast assumptions about the doctoral research journey to embed ICTs within it.
- iii. It is not sufficient to focus on the research process only, because undertaking a research project involves more than a knowledge of a typical research process.
- iv. It is not enough to assume that students will work out how to go about their project for themselves with respect to managing their project and being efficient and effective.
- v. Supervisors have a role to play in encouraging and supporting openness/flexibility in thinking about making use of ICTs to improve effectiveness and efficiency.
- vi. Education/Academic Development for supervisors and students: instead of workshops only about the research aspects, include plenty of project management, scheduling et cetera. processes, techniques and strategies in how to work out one’s own “flow”; highlighting how to critique ICTs in the light of personal and project needs and requirements.
- vii. The supervisor/advisor role should include (explicit) responsibilities about the thinking and planning skills with respect to making the best use of ICTs to ensure efficiency and effectiveness of doctoral research processes.

Table of Contents

Executive Summary	i
Table of Contents	iii
Table of Figures	iv
Background to the project.....	5
Research into doctoral study and supervision.....	5
Research into supportive and well-planned ICT environments.....	6
Research into ICT use and study	6
The current study.....	6
Design and Methods	7
Setting	7
Participants	7
Data Sources	7
Analysis.....	8
Results and Discussion	8
Assertion 1: ICTs are impartial tools. It does not matter how ICT are used, because the end-point, that is, thesis completion, is the justification.	9
Assertion 2: ICTs are tools or mechanisms that prompt active thought on practices with respect to planning and managing thesis writing and project execution.	11
Assertion 3: Knowing about ICTs is only part of the thinking. What is more important is getting the “flow” right.	12
Assertion 4: ICTs are not neutral. There is a two-way interaction between technologies as artefacts and the use of them to achieve ends.	14
Summary	16
Implications for Enhancing Practice	19
For Institutions.....	20
For generic doctoral processes.....	20
For supervisors.....	20
For doctoral students	20
For ICT support	20
Conclusions.....	20
References.....	22
Acknowledgements.....	25

Table of Figures

<i>FIGURE 1: ICTS AND PEOPLE ARE SEPARATE AND SEPARATED ENTITIES</i>	16
<i>FIGURE 2: ICTS AND INDIVIDUALS WORK ALONGSIDE EACH OTHER</i>	17
<i>FIGURE 3: ICTS AND THE INDIVIDUAL ARE IN A COMPLEMENTARY PARTNERSHIP</i>	17
<i>FIGURE 4: ICTS AND THE PERSON ARE INTRICATELY LINKED THROUGH MULTIPLE ACTIVE, PRACTICAL, GOAL-ORIENTED CONNECTIONS</i>	18

Background to the project

From our work in academic development and doctoral supervision, we have encountered both staff and students talking about their experiences of using information and communication technologies (ICTs). Often, for many of them, ICTs can bring either joy or challenge to their well-versed academic practices, and either create barriers to their learning and development or be the answer to their needs. While some grasp and pursue opportunities to make use of various ICTs for study, research and teaching, others struggle.

Despite documented and anecdotal positive and enthusiastic urges to adopt ICTs to reap benefits for increasing and improving efficiency and effectiveness of academic work, staff and students who struggle experience ICTs as needless interruptions to their work and learning, and difficult to learn and use. There is often little need seen to change practices by introducing ICTs into their ways of working.

Being empathetic to the views such as those expressed by Castañeda and Selwyn (2018), we did not approach these encounters with staff and student experiences from a stance that assumes that ICTs are the natural and needed solution to problems related to improving and facilitating effective learning, teaching and research. Rather, we took a more neutral stance, wishing to explore the experiences of those involved, namely, students and staff, through discussion with them about their practices and views, and with a specific focus on doctoral study and supervision.

In looking to the literature, we identified three broad areas that would be of relevance to this exploration.

Research into doctoral study and supervision.

Over the past few years, doctoral supervision and the role, place and nature of the doctorate have received increasing attention in higher education research literature. A wide range of topics have been covered including, for example, the importance and types of support for students as they make their way through candidature (e.g., Jairam & Kahl, 2012; Zhou & Okahana, 2019); personal issues that doctoral students face related to well-being and coping (e.g., Cohen, 2011; Janta, Lugosi & Brown, 2014); teaching aspects of doctoral supervision (e.g., Cotterall, 2011; McAlpine & Norton, 2006); experiences of being a doctoral student (e.g., Pitcher, 2010; Vekkaila, Pyhältö, & Lonka, 2013; Wills & Carmichael, 2011) and student reported material concerning the framing of large research projects for doctoral investigation (e.g., Berman, 2013). Those with careers who decide to undertake doctoral study have also been given attention (e.g., Kiley, 2005), including academics themselves who study doctorates (e.g., Dann, Basford, Booth, O'Sullivan, Scanlon, Woodfine & Wright, 2019).

In addition, there are many guides for students completing doctoral research processes (amongst a plethora of related topics), how to go about research, what it means to undertake a research project the size of a doctorate, coping, resilience and well-being techniques, and practical project management strategies (e.g., Denholm & Evans, 2006; Thomson & Walker, 2010). For supervisors, there is a similar range of topics and advice documented in a variety of journal articles and books, all focussing on the interrelationships among supervision, research, projects, students, institutions and about connections between the supervision research context and the broader context of academia, and practice. Some examples include: practices that supervisors might implement to enhance doctoral success (e.g., Salinas-Pereza, Roderia-Cosano, Rigabert and Motrico (2019); the ways supervisors think about research and supervision (e.g., Åkerlind. & McAlpine, 2017; Kiley & Mullins, 2005; Lee, 2008);

provision of feedback during the thesis writing (e.g., Cordeiro, 2019; Bitchener, Basturkmen, East & Myer, 2011); and variations to traditional ways of organising supervision (e.g., Hutchings, 2017).

Research into supportive and well-planned ICT environments

With the advancements in, accessibility to, and development of, information and communication technologies within education settings has come a plethora of research into online and blended learning. These studies often highlight the capacity that ICTs present in facilitating teaching, learning and administrative activity within educational institutions. These cover numerous areas of importance from theoretical, practical, and philosophical angles and including a number of perspectives including those of learners, educators and institutions.

Ako Aotearoa has supported a large number of projects that have investigated related topics including online learning, e-learning, flexible and distance learning. These projects range from those that have a system-wide focus (e.g., Marshall, 2012; Marshall & Shepherd, 2016), to those that provide overarching guidance for e-learning development and use, such as the *eLearning Guidelines* (Ako Aotearoa New Zealand, TeLRG & New Zealand Tertiary College (n.d.)); to others that address student learning in a more focussed way (e.g., Heinrich & McDonald, 2018; Jeffrey, Milne, Suddaby & Higgins, 2009), and projects that have explored support for staff teaching in flexible and blended learning environments (e.g., Nichols, Anderson, Campbell, & Thompson, 2014).

Research into ICT use and study

Taking a more focussed look at specific skills used by students when they engage in study, there are, once again, many documented examples of research and practice that paint a picture of developments. There are studies on student use of ICTs, though not necessarily doctoral students, and these cover a wide range of topics including specific ICT skills (e.g., Oliver, 2011; Stensaker, Maassen, Borgan, Oftebro & Karseth, 2007).

Where postgraduate research students are concerned, some studies on ICT skill development and support provide some insights (e.g., Dowling & Wilson, 2017). An example by Aghee, Jobe, Karunaratne, Smedberg, Hansson and Tee (2016) considered ICT systems within institutions, and the gaps in interaction with PhD students. They highlighted that such systems can be improved in order to enhance interactions rather than cause barriers to communication.

Notable about the research that falls into this group of studies is the use of self-reporting tools as mechanisms for gathering data about student use and views about ICTs. While self-reports are valuable ways to collect such data, they do have limits. For example, it has been argued that when asked, learners from a variety of disciplines and learning settings will tend to overestimate claims about their performance and/or knowledge and skills (e.g., Mahmood, 2016). In online learning environments, the role of self-efficacy, for example, is still being contested.

The current study

All these studies help to 'map the territory' of ICTs, their use at individual and institutional levels and related practices. Much advice and guidance can be gleaned from the literature as well, although relatively little for the specific integration of ICTs within the doctoral research and supervision environment. Based on the literature that is available though, all indications are that (doctoral) students adopt educational practices incorporating limited ICT use, even though the use of ICTs has grown enormously in the last 10 to 20 years. With the current interest in ensuring success of students

and completion of doctoral degrees being closely related to high quality supervision, there is a need to improve supervision practices and within that, advance understandings about how to support students in their use of ICT for their doctoral research.

These bases (viz., literature about the nature of supervision and doctoral study; ICTs in tertiary teaching and learning settings; and ICTs use by students as part of research processes) provide the context of this project. The project thus aimed to explore doctoral student and supervisor views and use of ICTs within the doctoral process. The intention was to bring to light perceptions that could give clues as to how to make practical modifications to content and the scope of professional development support provided to supervisors and students, in order to help them to make the best use of ICTs within the doctoral research process. In addition, consideration was given to the way data would be collected in order to make sure that more than just the self-reported perspectives of the participants were included.

Design and Methods

An interpretivist research approach (Erickson, 1998) framed this study that explored perceptions about the use of ICTs to support doctoral supervision and study in a research higher degree setting.

Setting

The study took place in two New Zealand universities where the participants were either employees or students. Both universities are research-intensive, with strong histories of producing high-level research across many discipline areas. Both institutions have clear and well-formulated policies and practices governing doctoral study - both PhD and professional doctorates - and these include processes involved in supporting that study through supervision. A specialised unit exists in both institutions to manage the administration of the doctoral degree. Coaching “supervision” as essentially a (specialised) teaching activity, each unit also provides or coordinates professional development support for staff in the craft and art of supervision, and for students in the skills and processes of undertaking doctoral degree study.

Participants

Participants included doctoral students and supervisors from the two New Zealand universities. As a result of an invitation to all students and supervisors, in total, 11 doctoral students and 2 supervisors responded to the invitation. The students were all PhD students at varying levels of completion. There was a mix of part time and full time students. A variety of discipline backgrounds were represented in the group from health sciences, sciences, commerce and humanities areas. The supervisors were experienced and were from humanities and sciences.

Data Sources

Data were collected as part of a 3-tier participative drawing process (Wetton & McWhirter, 1998). This strategy involved a series of two or three interview/discussions, along with participant-made drawings, which formed the focus of the interview/discussions.

This strategy generated two sources of data - interview transcripts and participant drawings – and involved the following (3-tier) phases:

- a) *Initial semi-structured interview/discussion*. The purpose of this initial individual interview/discussion was to ascertain from the participants, information about their background and other details they saw relevant to share about their experiences and views of undertaking a PhD or doctoral supervision. In addition they were asked about their use of

ICTs generally as well as within the doctoral process. It was a chance for the researchers to establish some level of rapport with each participant and to gain some understanding of their views and practices in relation to ICTs and their doctoral/supervision journeys.

- b) *Participant drawing.* The participants were then asked to make a drawing in their own time between the second interview/discussion. Guidelines for the drawing suggested that they think of a way to illustrate their research process first, then to add onto the drawing any ICTs (such as devices, websites, programmes, applications) that they make use of in the process.
- c) *Follow-up interview/discussion.* During this interview/discussion, the participants were invited to talk about the drawings that they had made. Each was asked to explain the drawing's features and how it made sense in terms of the project he or she was undertaking. This included discussion about how their supervision was working, how they worked with supervisors, and how the ICTs they had included in the drawing worked within the process. They were also asked about elements that were not in the drawing, for example, certain ICTs or activities that might have appeared in a typical account of a doctoral research process but were not included.

All interview/discussions were audio recorded and transcriptions of the recordings were returned to the participants for checking. The drawings were scanned and stored electronically.

Analysis

In line with the broad interpretive approach that framed and governed our approach to this investigation, the data were analysed shortly after they were gathered. Analysis of the data contributed to the development of ideas about the perceptions held by the participants, and these were refined progressively across the instances that researchers met with participants. The perceptions the researchers were identifying were thus checked and rechecked, and refined against each data set as it was collected.

This iterative and inductive approach (Thomas, 2006) involved thematic analysis (Silverman, 2001) and the capture of major and common ideas (Mayring, 2000) expressed by participants about how ICTs are perceived and used in doctoral research processes. This approach helped to operationalise a process of co-construction between the researchers and the participants. Through checking and rechecking, refining and confirming, the researchers were able to articulate their understanding of the perceptions held by the participants that matched the participants' expressed perceptions.

The outcomes of the analysis process were a series of assertions about the ways the students perceived and understood ICTs within doctoral study. Because there were only two supervisor participants, the data from the supervisors served to support the assertions we were more confidently able to make about student perceptions.

Results and Discussion

This section presents and discusses the assertions. Participants' perceptions that emerged through exploration of their thoughts, practices and behaviours while engaged in interview/discussions and drawing activities provided illustrations that support the claims. Assertions relate to both specific and broad areas of concern, and highlight participants' perceptions about the roles, places and uses of ICTs within the context of doctoral study. The relationships between people and ICTs are the focus of each assertion. Appropriately labelled quotations from the interviews/discussions, along with examples of participant drawings are used to illustrate the assertions.

Assertion 1: ICTs are impartial tools. It does not matter how ICT are used, because the end-point, that is, thesis completion, is the justification.

Students talked about how they worked in the process of writing and assembling materials that was contributing to their thesis document and to the process of the study they were undertaking. Comments focused on the various ICTs they were using and often on the skills they needed in order to use them.

Some students expressed the view that ICTs were tools, separate from the project and the person involved, to be used to achieve an end point, as with the two following examples,

So long as it's formatted – it shouldn't matter - that's their [editors'] responsibility, not mine.

There's probably a bit more about Zoom I could learn but again for me unless it's a problem, I'm not going to go looking for it... not just for the sake of it at the moment.

Motivation to achieve an outcome was a focus of comments that support this assertion. For many participants, the aim to complete the study and write a thesis was, naturally, a large driver for how they were managing their study. Time was seen as precious, and they would do what they had to do to reach their goal. To be motivated to learn about a new ICT needed to have a purpose that sharply focussed on achieving that end.

If the technologies are suddenly not available] I'm happy to sit down with a typewriter and learn it... If I'm not driven I won't bother.

Effort therefore was bound up with motivation. Students talked about their use of ICTs that was seen as not complicated, for example,

I don't use anything that elaborate – none of this is elaborate... I've never learnt NVivo...

and made reference to the effort that was required in order to be able to use 'more complicated' ICTs, as in

EndNote – familiar with but not using it; not confident to use it – manually adding refs (difficult to find time for workshop)

The quotation above also indicated that students, knowing what is needed, would work out their own ways of achieving the result, such as "...manually adding the refs". Ever-conscious of working towards achieving their goals, time spent learning how to use ICTs that were not familiar or that required some change in thinking and action was not seen as worth it. For example, one student said,

... I don't want to go down a rabbit hole. I don't want to be distracted. So sometimes things that work for you, just work for you.

On the other hand, effort is expended on ICT-related processes if there is certainty about how the ICT is working and surety about the result. For example, this student talked about how he was prepared to work hard on his self-designed process to manage his references within OneNote, after making a conscious decision not to use Endnote:

Because I have my own system... it's quite tedious but I get to see it clearly compared to having it done all automatic. You don't really know what's happening in some parts. This one I get to see clearly so I know this is my work. I know I'm not plagiarizing even though there are some typos there and stuff. I know it's clear and I'm not becoming lazy and just by copy pasting... because I have to really do it manually to transfer everything.

For this student participant, the work involved in devising his own system of managing his references was preferred over learning about and using Endnote, especially because he felt he could have control over what was happening in the background. This view also hints at a level mistrust in the accuracy of ICTs to perform.

Justification for not making use of ICTs beyond the usual collection of word processing and commonly used communication applications such as email was discussed also in terms of the inadequacy of online systems for supporting face-to-face interactions. For example, in this quotation, the student describes the differences experienced between communicating online and communicating with someone in the same physical space.

I much prefer face to face – much prefer the person is in the same room – there are some subtleties about non-verbal communication you don't get through Skype – not so easy to pick up somebody's mood on Skype – more difficult to break, if it gets tense – you can leave the room, get a glass of water, etc.

The same student continues, by describing the differences when engaging in joint (supervision) activities online. In this instance, the student reveals a sense of discomfort and lack of knowledge of the ICTs and adds those to the reasons why ICTs are not preferred.

Joint activities [are] not so easy with technology, if you're not in the room together – work on white board, move sticky notes, write on paper, the physical action – not comfortable with the technology to do this - I haven't learnt how to use them ...

And similar to the mistrust hinted at by the earlier student, this student's comment suggests an assumption that using ICTs for say, communication and interaction, should be identical to interacting and communicating within the same physical space, and if it is not, then the experience is not easy or perhaps even inferior.

This view of the 'end justifies the means' was, according to this student, reflected the stance taken by their supervisors:

[My supervisors] show no inclination whatsoever to have a look at [how I am doing it] at all. Because their view of things is that it's worth it, if I produce in terms of potential publishable, reputable material in the thesis.

At the same time, our limited data from the supervisors' side reflected this assertion. Supervisors too, tend to focus on thesis production rather than the process of producing a thesis that includes the use of ICTs (as opposed to their very clear and explicit focus on the research process, that is). An example illustrating this is:

Generally, people think the standard of the people getting or earning a PhD is that this person should be an independent researcher. After all, we only examine a particular thesis [and] there are lots of inputs from supports and supervision from supervisors.

In summary, this assertion has a strong focus on the experience of doctoral study being about getting the project done within a research journey that gives minimal regard to the affordances of ICTs that are used within that journey. ICTs are framed as necessary but also fraught, especially due to the effort and time that draw attention away from the primary goal.

In this assertion, ICTs are viewed as a means to an end. *ICTs and people are perceived as separate and separated entities.*

Assertion 2: ICTs are tools or mechanisms that prompt active thought on practices with respect to planning and managing thesis writing and project execution.

Views that expressed notions of there being a close interaction and collaborating relationship came through in a number of the discussions with the participants. The focus on achieving goals and endpoints was strong, but the expression of how to achieve those goals, capitalising upon the affordances that ICTs present, was different from the way views were expressed in relation to assertion 1.

On a very simple and straightforward level, this student describes the checking he did when weighing up the merits of a piece of software to meet his needs.

I normally do a trial version... have a play with it. And if I think they are useful then I might try it on a project. And if then I feel it's definitely worth investing... then I'll go buy it. But yeah, I definitely start with a trial version. And usually trial versions do come with online help or some sort of... you can find guidance on the web. So you don't really need the full version straight away. It just helps you to give it a go and see. If it's not worthwhile I just uninstall it, so don't buy it. So it's an advantage.

Others simply liked to explore and see whether there was potential in any ICT they encountered, as in,

Sometimes I just like playing with stuff to see what they can do and then if they tick my boxes then I keep them and if they don't, I move on. So it's more kind of search and discover than kind of looking for something, you know... I might have an idea that I wanted an app that does something but I sometimes just see something I'm like, ooh I want what that does and just have a play with it and see if it's good.

Describing a deeper level of activity, a certain degree of critique and active reflection were indicated by another student when he said

...we tried an electronic version of putting together a programme for a New Zealand conference and I was surprised how long it took us. Whereas in the past I've worked with [colleagues] and we've just moved pieces of paper around on the floor for abstracts and we were done really quickly.

Not only did this student express a sense of understanding about ICTs as tools and mechanisms to achieve goals, more importantly, he also described reflection on possibilities and limitations. He followed up by saying,

... Sometimes analogue stuff is good but there are aspects of certainty about technology.

He acknowledged that in this circumstance, the manual process of sorting had been quicker than the electronic one, but there were merit in both approaches.

Whereas assertion 1-type expressions presented effort in a generally negative light, assertion 2-type expressions couched effort as an assumed part of learning something new. There was a sense expressed in comments that there will be a way to manage the "problem" that needed to be solved, which then generated the necessary motivation to engage effort. For example,

You just what you know when you start off; when you're unsure about what you need to do. There's a bit of a barrier in front of you. It feels a bit intimidating and overwhelming, and then you get into it and it just it just works. And you just kind of put all the pieces together and get something out at the end.

Exertion and timing of effort were also consciously monitored. Active thought was put into the type of effort needed and when it was necessary to expend that effort. This is well-illustrated in the following excerpt.

I focus on the technology that I need for the phase that I am in and thinking ahead to what I'm going to need, which is why I did that first NVivo training in January. But I'll do the second, intermediate training just as I am coming up to the analysis. So all of those things help you be clear about how you are organizing your data and what you are thinking about.

Making judgements, weighing up negatives and positives, examining and exploring possibilities and limitations were all features of comments that contributed to the development of assertion 2. The next excerpt is about knowing one's skills and making use of ICT applications in ways that capitalise on the person's skills in order to achieve the goal.

I'm very good with Excel ...So I started holding my qualitative information in NVivo and then it became confusing because NVivo would have so many clicks. So I said you know what? Everything would be easier if I just use Excel and put everything there and have my own system.

Sometimes, it appears that the supervisors' perspectives of ICTs might lead to this assertion. For instance,

[ICTs are] integral to everything now – there's no such thing as doing it without anymore – these are the tools with which we do all the things we do ...

In summary, this assertion thus captures the views of students who engage actively in making decisions about which, how and why they incorporated ICTs into the doctoral research practices.

This assertion is about active engagement and decision-making in relation to ICTs and their place within the doctoral research. *ICTs and individuals work alongside each other.*

Assertion 3: Knowing about ICTs is only part of the thinking. What is more important is getting the "flow" right.

Perhaps prompted by the nature of the drawing task, which was to illustrate how ICTs fitted within the whole process of doctoral study, a number of students described the challenges to bring everything together into one big process made up of many parts, sections and subsections. One participant focussed on her "workflow" in order to manage the multiple documents, tasks, and schedule involved in her doctoral research journey.

What systems do I use, what's my workflow? So I actually spent some weeks looking at ... getting ideas from other PhD students about their workflows and how they manage it.

As with assertion 2-type comments, 'getting one's flow right' involved exploration and an amount of reflective decision-making. For example,

So I did a play around with that and found it was quite useful ... So what I have done really is cross-reference by Zotero to Windows files because one of the limitations with Zotero is... I started off by storing all the documents and realized I was going to run out of space that way. So I'm trying to be quite disciplined about when I've got a document, entering it at the time, reading an article saying throw in heaps of tags rather than not, till you feel at the start. And I simply keep a note, cross referencing to the actual articles. I like to have the articles and for some key ones I like to make a note. So if it's a seminal paper that I know I'll be referring back to.

Thus, students talked about how hard they had worked to set up routines and processes to enable them to manage time and their research projects. As in the above excerpts, they referred to categorising documents, searching for resources, undertaking analysis, managing data, and producing the thesis itself.

Despite many references to attending training sessions to learn more about ICTs, their drawings highlighted routines and processes, showing how and when ICTs were used to undertake study and research-related tasks and activities. What was clear was that those who talked about feeling comfortable with their research journey had set up a flow to suit their personal study needs. In that flow, ICTs and their research journey were woven together, one complementing, supporting, facilitating and enhancing the other.

In working out one's system or flow, this student highlighted the need to know about the affordances of ICTs and how others had made use of them.

... you do need to know a bit about each of the individual capacity... capabilities of the different systems to know what's even possible... but alongside that you're kind of reading other people's ideas of how they did it, and you think that bit might work for me oh, but that bit won't... so then you can kind of mix and match a bit so kind of seeing other people's processes and learning a bit about the systems - both of those things together help you then come up with your own system that works for you.

In this way, the need to know oneself was prominent in a number of the comments made by students. Knowing how one works, learns and operates as a researcher and student, seemed to be highly important. The following quotation expresses the importance of the self within the bigger system of the task-at-hand.

If you kind of understand what your own learning needs are, and what your own organisational needs are, then you are looking for certain attributes within apps and programmes and stuff so you are looking for the system that meets that need rather than taking a system and trying to squeeze yourself into it....but you have got to understand how you work and what is natural for you, so you are not fighting against yourself all the time

These comments suggest a meta-cognitive level of thinking (Flavell, 1979), where self-regulation and control are important with respect to thinking, time usage, and management of the research project in the context of the capacity of the individual. For example,

So this is really all about how I organize and how I think and what do I need across the whole time. And some of this may change but I think these are the tools that I would use for the whole time. And it's better to have, in my view, two or three that you rely on and you are confident with because the transaction cost of learning can be quite high and you can lose the very thing that you wanted to capture by doing it.

Some doctoral students' comments suggested that supervisors do help in decision-making when it comes to ICTs use. One of the illustrations is as below:

And at the moment one of my supervisors is advising me on which programmes to use for example how to use R and SPSS. Mainly that kind of technology...

There was a hint that at least one of the supervisors saw the need for a workflow in this same vein.

So long as [the students are] happy with what they're using – they should use 'a' system

In summary, this assertion highlights that what is important with respect to ICTs and the doctoral process is how it all comes together within one's flow. That flow incorporates active effort on the part

of the individual in finding ICTs and practices that suit the individual's approaches as well as their project demands.

This assertion is about students actively seeking to understand the whole picture of their doctoral study in which a number of elements feature, one of which is themselves and one of which is ICTs. *ICTs and the person are in a complementary partnership.*

Assertion 4: ICTs are not neutral. There is a two-way interaction between technologies as artefacts and the use of them to achieve ends.

This assertion draws attention to the nature of technology as a phenomenon; that it is not an impartial tool that has no influence on the way humans act and react. This assertion presents ICTs as an artefact of a technological design activity, as a source of improving efforts to achieve an end-point but also as an influencer and even determiner of the thinking and practices of the person interacting with the ICTs (e.g., Baird, 2002).

On what could be argued as a superficial level, this student noted some active connection between the person and the software application, beyond simple use, when he commented:

I think it goes both ways, the product has to be intuitive and you've got to have a little bit of inclination to try out different things.

Others went beyond the superficial to describe more in-depth relationships between themselves and the ICT they were using. When discussing her use of software to help her manage her project and her time, this student talked about how the ICT she was using supported and enhanced her thinking.

... instead of being overwhelmed by the whole PhD ... instead of listing in terms of projects, I started to think of it terms of what do I have to do this week. I'll feel really happy if I can get that week's "bucket" emptied ... [Using the application] really changed the way I started to think about it. I started to be less worried about the big overwhelming long term stuff that was out there and just think, okay, this week, what am I going to do this week, how am I going to be really efficient and targeted, and I think that really helped me.

Another example of how the ICT helped solve a problem and at the same time had an influence on the way the person behaved, in this instance with organising notes, ideas and document.

... and it's the same with my note-taking because [the programme] that I use has a similar sort of functionality that it can search text that you've written but also search notes and PDF docs and those kind of things, so it means that when you've had a random thought and put it somewhere you can find it again. Which is huge for me, so I guess that ... the power of the search engine is probably the thing that drove me to become paperless so it helps me to organize myself much better. I'm not great at organizing paper. When I say I have no paper, my desk is full of paper that I haven't filed but none of it's related to my research really, so filing paper is a skill that I have not mastered whereas filing digital stuff is not as important because you can always just find it again so you can kind of just pop it in anywhere and you've kind of got it forever, so just... that, that I think is the driver for going paperless, really... that searchability and organization of stuff

Similarly, one supervisor identified ICTs as a complementary tool in doctoral research process:

I think a nice technology would be nice templates for articles and theses – they are templates - I could probably build them into my system but I just never have... Word, I'm quite happy using ... I wouldn't mind going to learn another statistical system but SPSS works fine ...

In summary, assertion 4 draws out the integral role that ICTs can be perceived to play in the doctoral research processes. This is more than the working alongside connection illustrated by assertion 2 and the complementary partnership characterised by assertion 3.

Assertion 4 describes a deep and entwined relationship between people and ICTs that verges on the symbiotic. *ICTs and the person are intricately linked through multiple active, practical, goal-oriented connections.*

Summary

The four assertions are repeated here by way of a short summary with examples of drawings from the student participants illustrating aspects of each assertion.

Assertion 1: ICTs are impartial tools; it does not matter how ICTs are used, because the end-point, that is, thesis completion, is the justification. *ICTs and people are separate and separated entities.*

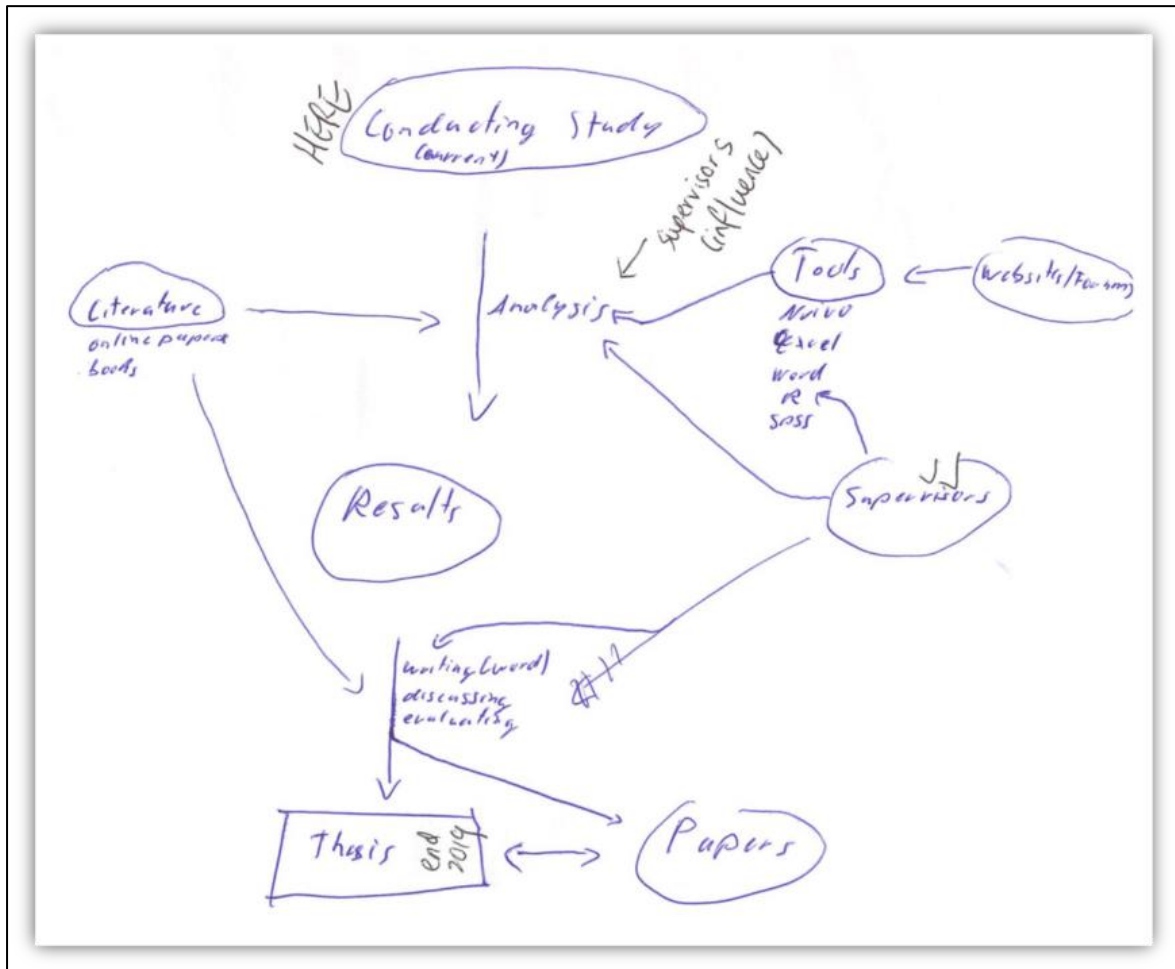


Figure 1: ICTs and people are separate and separated entities

Assertion 2: ICTs are tools or mechanisms that prompt active thought on practices with respect to planning and managing thesis writing and project execution. *ICTs and individuals work alongside each other.*

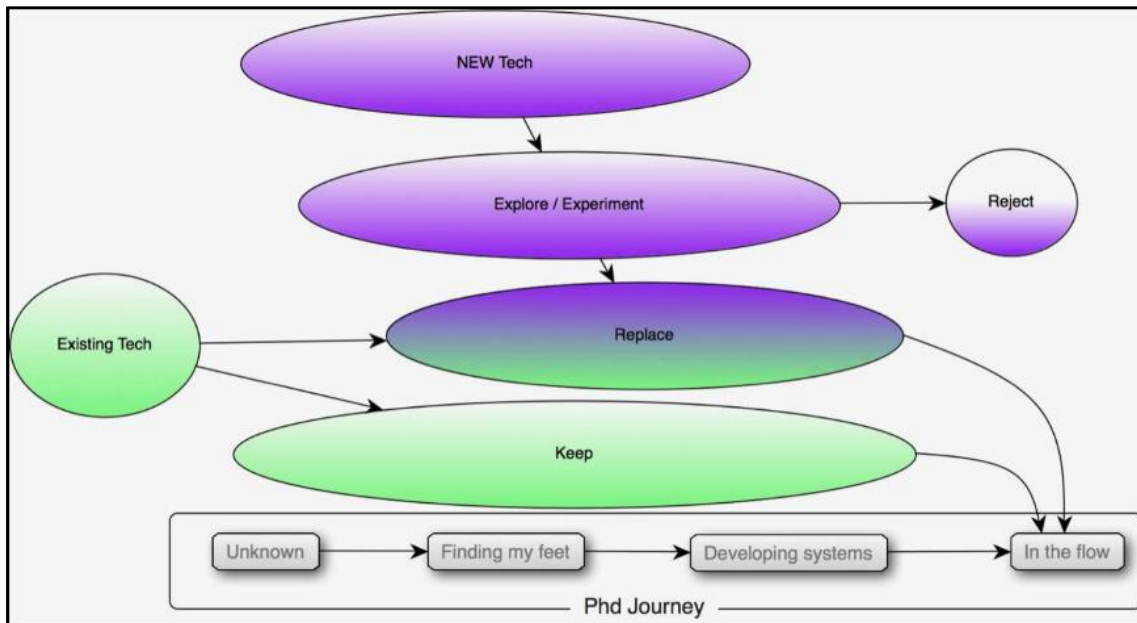


Figure 2: ICTs and individuals work alongside each other

Assertion 3: Knowing about ICTs is only part of the thinking; what is more important is getting the “flow” right. *ICTs and the individual are in a complementary partnership.*



Figure 3: ICTs and the individual are in a complementary partnership

Assertion 4: ICTs are not neutral; there is a two-way interaction between technologies as artefacts and the use of them to achieve ends. *ICTs and the person are intricately linked through multiple active, practical, goal-oriented connections.*

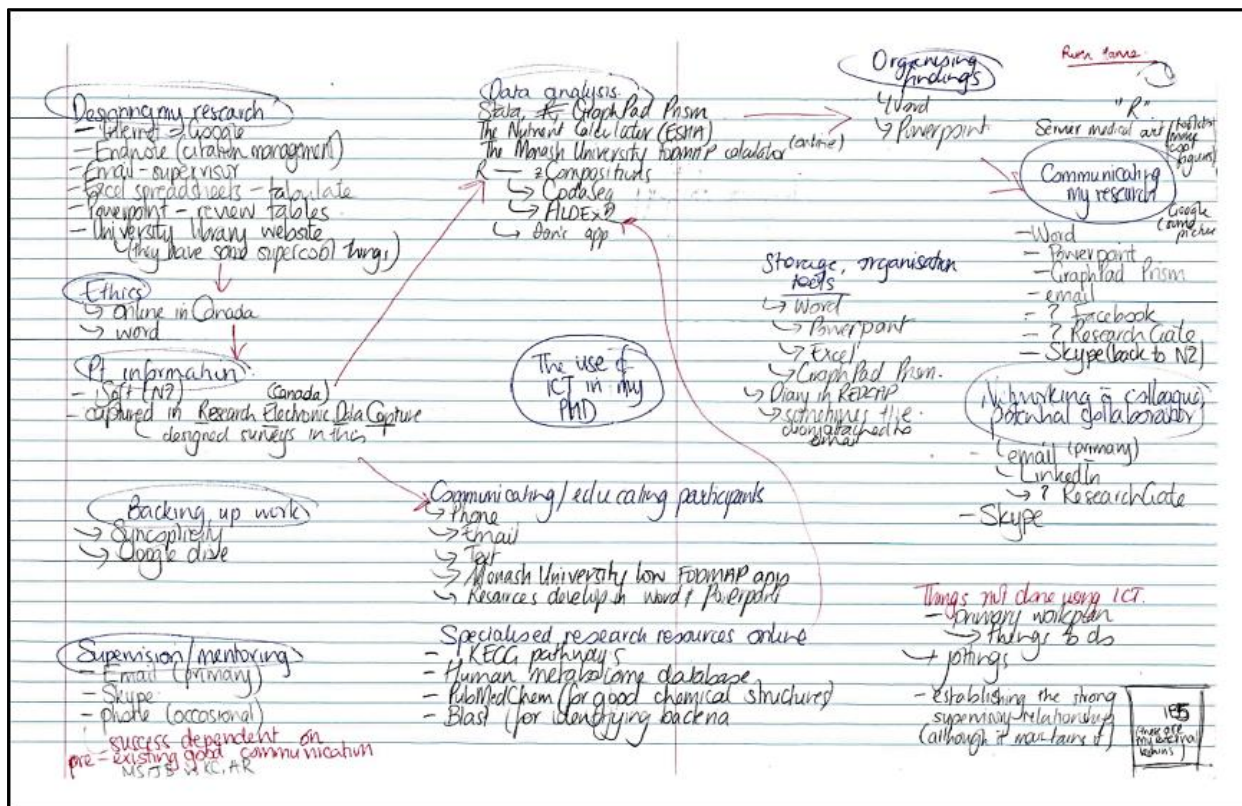


Figure 4: ICTs and the person are intricately linked through multiple active, practical, goal-oriented connections

Assertions 1 and 2 highlight that individuals hold assumptions about, and have expectations of, ICT use; and those expectations and assumptions influence and determine their judgements about ICTs and their use of ICTs. The assertions point to connections between perceptions and practices. Assertion 1 describes a perception that ICTs are separate from the person and the task-at-hand, while Assertion 2 presents a perception in which the person and the ICTs are working alongside each other in harmony or at least in a partnership. Both assertions focus on end-points, but the end-points vary according to the perception of where ICTs fit into the journey towards their achievement. For Assertion 1-type expressions, there is one major end-point. For Assertion 2-type expressions, there are multiple, shorter-term end-points that build towards achieving the major goal of completing the thesis.

Building on Assertions 1 and 2 are Assertions 3 and 4, which highlight what may be argued as more complex levels of perceiving and working with ICTs within the doctoral research process. Both assertions give some focus to inter-connections, where people and ICTs partner or collaborate. Assertion 3 depicts a perception that is about complementarity; where ICT affordances are seen as worthwhile when they support and enhance the work of the individual in ways that make sense to that individual. Assertion 4 builds on the Assertion 3 perception by bringing to light the relationship in which the person alters and changes thinking or practices because of the influence that ICTs affordances can have. No evidence was found to support a possible additional claim that as well as

ICTs causing individuals to alter and modify thinking and behaviours due to their existence, ICTs, in turn, are perceived to be able to alter their ways of responding to the people who use them. This is not out of the realms of possibility of course, with ICTs increasingly being designed and built to be able to respond to users' needs.

The four assertions can be used to provide some guidance to those supporting and participating in doctoral research processes. Students and supervisors do possess a vast array of skills, knowledge and abilities. They have a variety of experiences as well as varying reasons and levels of motivation for being involved in a doctoral research process. Their skills and capacity to make use of ICTs to support their roles in the research process vary as well. The assertions that have emerged from this study will inform the planning for support activities to enhance supervisors' and students' professional development, whatever their background and needs.

Implications for Enhancing Practice

This study reveals the tensions and the debates where ICTs in doctoral research process are concerned. The findings raise questions for discussion with respect to the nature of doctoral education and the explicit roles that ICTs do, and could, play in supporting and enhancing doctoral research processes. These provide the bases for developing practical approaches to information and training provision for supervisors and doctoral students to encourage reconceptualising how ICTs are viewed in relation to doctoral study.

Depending on the perceptions held about ICTs and the relationship between ICTs and the person in the context of the task and its goals (i.e., the doctoral study) within the doctoral research process as depicted in the four assertions, ICTs tend to be seen as a challenge, a change or an opportunity in doctoral research processes. Awareness that in the context of ICTs use, doctoral students and supervisors may:

- assume that if they do not already know how to use something it was not worth learning or exploring as that learning is accompanied by risk to quality, efficiency and effectiveness of the doctoral research process;
- avoid assuming that doctoral students will work the research process out for themselves: supervisors have a role to play in encouraging and supporting openness/flexibility in thinking about making use of ICTs to improve effectiveness and efficiency;
- challenge their existing comfort zone especially in the use of ICTs as it does not mean one has to remain their practices without any change even if they think there is no reason to change;
- demand thinking technologically as well as making use of ICTs for the best possible process as well as outcomes;
- embed ICTs into their practices as per described in the findings that the ICTs-student use is more of a collaborative arrangement which sparks ideas off one another or even learning from each other rather than master and servant relationship;
- include (explicit) responsibilities about the thinking and planning skills with respect to making the best use of ICTs to ensure efficiency and effectiveness;
- not focus only on the research outputs;
- realise that the research process is as much about how it happens as what happens;
- recast assumptions about the doctoral research process to embed ICTs within it;

- reflect on the meaning of effectiveness and efficiency and what they mean in terms of the doctoral candidature and undertaking a research project; and along with that the effects of the use of ICTs to support and facilitate the process;
- seek the possibilities of ICTs affordances in the doctoral research process;
- understand that there is a link between ICTs and practices – using ICTs can enhance or raise ideas that were never thought of before.

For Institutions

In order to achieve a shared sense of ICT use, institutions could articulate a vision about the role of ICTs and ensure that the vision is communicated clearly and embedded in institutional practices. This may include the need for supervisors and students to focus on a process of undertaking doctoral research as well as the outcome of the process; one that integrates ICTS within the core research process.

For generic doctoral processes

Address the barriers to effective and efficient ICTs use to not only support and facilitate the doctoral research process, but also improve and enhance it.

For supervisors

Include (explicit) responsibilities for supervisors to guide PhD students in making the most efficient and effective use of ICTs in their doctoral research practices.

For doctoral students

Be proactive by taking up opportunities to learn using various ICTs effectively and efficiently during the doctoral research process whilst not neglecting the outcome (the thesis production).

For ICT support

Education for supervisors and doctoral students: instead of workshops only about the research aspects, it could include plenty of project management, scheduling et cetera. processes, techniques and strategies in how to work out one's own "flow" through the use of ICTs.

Conclusions

This study explored doctoral supervisors' and doctoral students' perceptions of the role and place of ICTs in supervision and study. It generated four assertions, which characterise perceptions about the use of ICTs in doctoral research process and the relationships among people, ICTs and the task-at-hand, that is the supervised research process.

A series of suggestions for action and guidelines for practice were also in the development as per represented in the previous section. As Castañeda and Selwyn (2018) argued, it is important that we have an active commitment to 'think otherwise' about how ICTs might be better implemented across higher education settings" (p. 8). We should not assume that ICTs are not important enough to make assumptions about, not let them fade into the background as they become normalised without questioning the interrelationships that are happening between the person and the ICTs. In the doctoral research setting, as one example of a higher education context, ICTs do have a role to play. They cannot and should not be ignored. But seeing ICTs in relationship to the person and to the setting is essential.

Doctoral education that takes this perspective into account may result in more informed supervisors and doctoral students about the way ICTs, humans and research practices are embedded and entwined. Concurrently, just as Kandiko and Kinchin (2012) argue that supervision cannot be looked at in the absence of the research work that it occurs within, we argue that doctoral students' understanding and use of ICTs cannot be considered independently of the work that they are involved in; and that work includes their relationships with their project, their supervisors, with the ICTs they do and could engage with and within the context of the institution.

It is clear that the supervisors need to look beyond their own experiences and promote ICT use actively. They ought to be aware that doctoral students should be given support to optimise their use of ICT. For example, supervisors could bolster doctoral students' positive thinking about ICT use or even take the initiative to introduce research-related software to their students without any prior assumption or expectation during supervision. At the same time, students ought to realise that their justifications for not using certain research-related application software does not present themselves as being smart or innovative, but an indication of their lack of confidence to learn the advanced ICTs. In order to achieve this, the supervisors who work closely with the PhD students could play a major role in supporting students' use of ICTs in their day-to-day research practices. Alongside this, academic departments in the various disciplines could run workshops/seminars on ICT use for research practices. While not a focus of this study, there was some indication that the role of supervisors and departments in supporting students' ICT understanding and practices may warrant further exploration.

This project has provided insights into the doctoral students and supervisors' perceptions of the roles played by ICTs during doctoral research process. There are complex human factors, including assumptions, attitudes and conceptions about academic practices, influencing and determining perspectives as well as how ICTs are incorporated into doctoral research process, behaviours and practices.

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Sim, KN. & Stein, S. (2019, November). Is ICT Use in Higher Education Transforming Lives and Societies? World Conference on Online Learning, Dublin, Ireland.

Stein, S. & Sim, KN. (2019, July). *ICT: Challenge, Change or Opportunity in Doctoral Research Processes?* Higher Education Research and Development Society of Australasia (HERDSA), Auckland, New Zealand.

Sim, KN. & Stein, S. (2018, December). *Exploring Perceptions about the Role of ICT in Doctoral Research Processes*. University College of London (UCL), London, UK. (INVITED)

Sim, KN. & Stein, S. (2018, November). *Enhancing the Perceptions of the Roles of ICT in Doctoral Research Processes*. Ako Aotearoa Projects in Progress Colloquium, Palmerston North.

Sim, KN. & Stein, S. (2018, December). *Exploring Perceptions about the Role of ICT in Doctoral Research Processes*. Society for Research into Higher Education Conference (SRHE) 2018, Newport, South Wales, UK.

Sim, KN. (2018, July). *ICT Use in the Doctoral Research Process: Whose Call?* 2018 Quality in Postgraduate Research, National Wine Centre, Adelaide, Australia.

Stein, S. & Sim, KN. (2018, July). Exploring student and supervisor perceptions of the role of ICT in doctoral research processes. *Higher Education Research and Development Society of Australasia (HERDSA)*, Adelaide, Australia.