Scholarship before Technology: Re-thinking the Relationship between Technology and Scholars

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Abstract: This study provides a review of the literature concerned with some of the underlying implications of technology used by academic researchers. This is a growing area of academic research as a result of the fact that the increasing use of network technologies is rapidly changing many aspects of research activities. Among these changes, it is the qualitative (rather than quantitative) change that merits careful thought and investigation. The article maps the main themes of research on the scholarly use of technology using 106 articles, reports and books across varied disciplines. The review concludes that the current literature has been overshadowed by research with a strong technical emphasis, focusing on large-scale collaboration, and takes a quantitative approach to studying the quantitative impact of technology use in the distributed research of sciences. Empirical research into the qualitative implications of technology use in real-world interdisciplinary research settings (particularly in the social sciences and the humanities) is urgently needed to add conceptual depth to the current analysis of technology use in academia.

Keywords: technology, academia, qualitative impact, e-research, distributed research

1. Introduction

There is growing interest in issues connected with technology use in academia. All forms of scholarly practice have, to some extent, changed with the increasing use of new technologies in academia (Lynch, 2008). The worldwide web, for example, is providing academics with opportunities to access millions of pages of information, thus extending their knowledge based on the information at hand. Extensive resources are restructuring the way people live, work and learn, regardless of space and time (Bonk & Cunningham, 1998). The web has grown into a vast repository of information, with "over a billion interlinked pages created by the uncoordinated actions of tens of millions of individuals" (Kleinberg & Lawrence, 2001, p. 1849). Email has led to increased electronic global interconnectivity. By the early 2000s, its usage rates had nearly reached 100% in research: 95-100% for American biologists, mathematicians, physicists, and sociologists (Walsh, Kucker, Maloney, & Gabbay, 2000), and 99.7% for European astronomers, chemists, computer scientists, psychologists and economists (Barjak, 2004). In the 1990s, the development of the web led to a rapid growth in e-journals, which numbered over 8,000 by the year 2000 (Okerson, 2000). In the new century, blogging seems to represent a new means of publishing with unprecedented potential, as nearly half of Internet users (42%) (equivalent to one-third of all adults) have read blogs, with one-third of these doing so on a typical day (Smith, 2008). The use of Skype to hold video conferences with overseas collaborators is also continually expanding (Jankowski, 2009). Email, the web, blogging, e-journals, and Skype are but a few of these new technologies that affect virtually all forms of scholarly activities in academia (Nentwich, 2003). More distributed, networked, interoperable technologies are clearly changing the research world (Voss et al., 2007). The use of technology is ubiquitous in academia and has brought about significant change across the disciplines of education, sociology, and computer science.

2. Network Technologies

Academia is not simply a homogeneous community; it consists of distinctive specialities within varying disciplinary settings. Likewise, technology is itself greatly heterogeneous. In scholarly debate, there is no common way of classifying all technologies. Some of them are used in an inconsistent manner, and some are used interchangeably. Different terms, such as information technology, instructional technology, assistive technology and social technology, exist side by side. Although there are no satisfactory terms for all scholars, many of these terms that are widely used in scholarly debate have some implications for its capability. At the end of the 1970s, the term "information technologies" (IT) was commonly used among scholars to address new technologies, due to their capacity to process and store information. Through the 1980s, as interests turned to the communications function of technologies, many researchers used the term "information and communication technologies" (ICT) to refer to the dual functions of processing information and facilitating communication. In the 1990s, the Internet introduced the possibility of new technologies, which enabled interconnected personal computers to communicate via web servers using common Internet protocols. This led to the major technological shift from information and communication technologies to further new types of technologies. As new technologies are largely dependent on the network power of the Internet, some scholars (e.g. Castells, 2000) start to use the term "network technologies" to address them in their writings. Kling and McKim (2000) pointed out that the shift towards the use of network technologies in scholarly practice appears to be an inescapable imperative.

The use of the term "network technologies" does not merely reflect a choice in wording, but reflects on the capabilities of this kind of technologies to facilitate academic interactions in research. Central to the most recent literatures is the use of various technologies in connecting academics, in the sense that they communicate ideas and thoughts or exchange information and resources, etc.

3. Means of Investigation

There is a growing interest in meta-synthesis as a technique for generating new insights and understanding from qualitative research, as well as a means of enhancing the contribution of qualitative findings to the development of more formalised knowledge (Hannes & Lockwood, 2011; Thorne, Jensen, Kearney, Noblit, & Sandelowski, 2004). This study uses the technique of meta-synthesis to integrate results from a number of different but inter-related research studies examining the use of technology in academia. The technique has an interpretive, rather than aggregating, intent, in contrast to meta-analysis of experimental studies.

This research situates the discussion of technology use in the field of educational technology. The field began with an emphasis on the introduction of audio-visual communications media gradually became focused on the systematic development of teaching and learning facilitated by new technologies (Saettler, 1990). Scholars working in the field of educational technology are likely to migrate from other disciplines, as it has not been long since the field of educational technology was established. It is found that the publications were widely dispersed across a range of academic journals rather than contained in one or two discipline specific journals, as studies of technology use are carried out by academics drawn from several fields including sociology (social shaping, social organisation, group behaviour, and Internet studies), communication sciences (scholarly communication, CMC, learning sciences (HCI, and CSCL), and management studies (organisational behaviour). Each of these research fields has its own focus, relevant literatures, appropriate approaches, and methods. This richness, while possibly conducive to fostering new interdisciplinary research, has in actuality resulted in fragmented and often unsystematic approaches to studying technology. The studies, taking different perspectives to investigate the use of technology, remain isolated from each other. These studies rarely relate or connect to each others' findings. In each research tradition, an individual study will approach research questions from a different disciplinary perspective. Science and technology studies, for example, is

dominated by sociologists of all kinds. A truly interdisciplinary approach, one that highlights each research tradition, has not yet to emerge.

Considering the interdisciplinary nature of this area of studies, articles were identified by keyword searches across a wide range of different journals rather than by performing searches within one or two journals. Keyword searches were made via Oxford library catalogues and the following online article databases: Academic Search Premier, CSA Internet Database Service, ERIC, JSTOR, Google Scholar, Highwire, OAlster, OxLIP+, ProQuest and Scopus. The two main foci were 'technology' and 'academia'. Hence, the searching of databases incorporated words and phrases such as 'technology', 'computer', 'internet', 'web', 'ICT', 'email', 'e-journal', 'blogging', 'Skype' plus 'academia', 'higher education', 'research', 'university', and 'academics'.

The online databases produced hundreds of results, from which citation searches were performed to identify further relevant papers. The combined search strategies yielded 962 citations. In line with conventional systematic review methodology, the inclusion/ exclusion criteria (see table 1 below) were applied to these citations. Articles were excluded if they were about the usage of a standalone computer for research efficiency or productivity (e.g. to advance computing, to format research papers, or to run data analysis). Clearly network technologies can assist research work and are, to some degree, not separable from research process but they do not form the object of research in this interdisciplinary field of studies. Some use of technology for efficiency might be closely integrated with its use for communicative purposes in some circumstances. For example, some academics might use a web-based package to analyse their data in order to generate the same format of results to share with their colleagues overseas. In order to look at how they contact their overseas colleagues, there is a need to examine the impact of this web-based package. Thus, while indicating what is not included in this review, research papers including the uses of technology that are relevant, or perhaps indirectly relate, to the purposes of interacting with peers are carefully examined.

Table 1: Inclusion/Exclusion Criteria

Parameters	**Inclusion Criteria**	**Exclusion Criteria**
Language	Studies written in English	Studies not written in English
Publication Date	Studies published from 1994 (inclusive) onwards	Studies published before 1994
Outcomes	The uses of technology that are relevant, or perhaps indirectly relate, to communicative purposes	The usage of a standalone computer/ any data analysing tool/ any particular software developed for research efficiency or productivity
Study Type	Primary research	Book reviews, opinion pieces, literature reviews, policy documents
Citation Type	Journal articles, books, reports	Newspaper, Blog, Wiki

The final selection of 106 articles, reports and books were accessed as part of the literature review published in sources closely associated with educational technology research, and journals representing, variously, sociology, higher education, and information science and technology. Integrating findings across these studies enabled a set of recurrent and dominant themes to be identified.

4. Core Themes

4.1 Quantitative Approaches to Studying Scholarly Communication

In the literature, examining the scholarly use of technology is mainly concerned with the investigation into how scholarly communication is mediated by technology. Many of the studies in mediated communication have focused on traditional written communication channels (Tenopir & King, 2004), such as peer-reviewed journals and book publications (Alexander & Goodyear, 2000; Jankowski, 2009; Odlyzko, 1998; Rowlands, Nicholas, & Huntington, 2004). The vast majority of these studies have

emphasised analysis of co-authorship in e-journals (Kling & Callahan, 2003). In the humanities, the focus has been on the creation of networked repositories that serve as an intellectual framework for collective work in the humanities (Crane, 2008).

To investigate collaborative work using co-authored papers as the key measure, bibliometrics and sociometric approaches are often employed (Beaver & Rosen, 1978; Borgman & Furner, 2002; Laudel, 2002; Wouters, 1998). Some studies have involved quantitative analysis of survey data or secondary data collected from the Internet. Other techniques include social network analysis, and a number of social network analysis[1] tools, such as UCINET (Borgatti, Everett, & Freeman, 1999), have been used to construct sociograms and maps to clarify social forms of interaction. Because of its apparent ability to tease out the separate and conjoint effects of multiple variables, network analysis in social sciences tends to rely heavily on quantitative statistical models (Wellman & Berkowitz, 1988). It is typically positioned between the extremes of descriptive accounts and mathematical network orientations.

However, given the kinds of complex research practices it is often applied, the quantitative method has always been somewhat problematic. The quantitative approach to studying formal written communication seems not to be sufficient to capture a detailed picture of what is actually happening in scholarly communication. Bales'(2001) posits that if one can outline behaviours in a group as objectively as possible, it will be easier for people to accept what happened and change to improve accordingly. Yet, it is not always straightforward to categorise behaviours in the way indicated by Bales. The actual interaction of academics working together is an unstable, ever-changing process that is subject to all sorts of influences. The research world highly values "… face-to-face meetings, formally presenting ideas at conferences, exchanging views with old and new colleagues, taking field trips, and having fun" (Brunn & O'Lear, 1999, p. 299). Scholarly communication takes place via a number of written communication channels, in addition to conversational means. Many scholars (e.g. Becher, 2001; Trowler, 1998) stress the importance of formal modes of interchange, as well of as informal communication channels in research. Vidgen (2007) in his study also found it to be particularly useful in analysing the typically informal communication between academics who chosse to work together.

In the literature, nevertheless, there are limited studies of informal communication. As argued above, many of these studies tend to focus on documents and citation data rather than on the actual communication processes of researchers who do scholarly work. Little insight into underlying informal communication has been revealed (Lievrouw & Carley, 1990; Zuccala, 2006). On the one hand, as Borgman (2007) argues, perhaps the change to formal communication is the area where new technologies have irrevocably changed scholarship; hence, it attracts much more attention than other forms of communication. On the other hand, as Lievrouw (1990) claims, perhaps the structural component of scholarly communication rather than the interpersonal or social component is more likely to be tackled.

Many scholars have argued that it is more appropriate to employ a qualitative approach to investigate informal scholarly communication (Costa & Meadows, 2000; Gargiulo, 1993; Gersick, Bartunek, & Dutton, 2000; Lievrouw & Carley, 1990; Nentwich, 2005). These studies have clearly demonstrated that qualitative research methods, primarily by observation and interview, are capable of revealing detailed means of informal communication. In this research, there is also the suggestion that more

[1]Social network analysis, rooted in sociology and education, grew out of Harvard University in the 1920s; it has been applied in a wide range of cases since its inception (Liebowitz 2007). Since the 1940s, sociometry as proposed by Jacob Moreno has attracted a lot of attention among social psychologists for understanding small group structure. These methods, however, were not adopted widely because computers were not then sufficiently sophisticated. In the 1960s, the realisation of graph theory and the introduction of high-speed computers significantly increased the size of the groups that were researchable within the scope of mathematical methods (Wagner 2005). The study of networks pervades all of science, but the most fundamental issue is their structure. Researchers are only now beginning to unravel the structure and dynamics of complex networks.

explorative research into informal mediated communication in real-world research environments is necessary.

4.2 Qualitative Change Matters

Many social studies about the role of technology in scholarly communication have been rudimentary. Their discussions have been frequently based on reporting technical progress, such as increasing access to different communication means, high-speed and remote communication, and inexpensive communication tools (Kling, McKim, & King, 2003). Some researchers have contributed to the view that the Internet has revolutionised formal academic communication (Ginsparg, 1995; Harnad, 1997; Odlyzko, 2002). Some have shown that recent technologies, such as email and electronic publishing, have profoundly changed patterns of communication(Tenopir & King, 2004). Some hold concerns that established communication conventions are altered with haste, as well as disrupting rigorous research traditions (Barjak, 2004; Kling & McKim, 2000). These studies on the use of technology have solely concentrated on the positive or negative perspectives of scholarly communication, leaving more profound changes to such communication unexplored. Our knowledge about what exactly has changed is, therefore, still fragmented.

In real-world research, the change to scholarly communication has not simply been related to the fact that technology advances or impedes communication. That is, the use of many new technologies does not only provide more, faster, and cheaper communication, as frequently assumed, but also has potentially led to more qualitative changes. Many researchers, such as Nentwich (2003), have stressed that many of the recent technological developments potentially lead to qualitative changes in the work environment of scholars, as well as changes to the content of their research. The use of technology has therefore entailed changes, some encouraging or disappointing, some invisible or influential, which have consequently created unique dynamics in research work. It is such qualitative changes that merit more investigations in scholarly debate. In contrast to quantitative changes as in degree (e.g. the speed of communication), qualitative change is understood as "to what extent" and "in what ways" in terms of the use of technology, such as in what research contexts technologies are used to facilitate research, and the role technologies play in some aspects of research activities.

4.3 Large-scale Research Collaboration

A great deal of research has explored the issues around large-scale collaboration with a new digital infrastructure, comprised of distributed and interoperable technology, which is generally recognised as e-research. This phrase refers to "a form of scholarship conducted in a network environment utilising Internet-based tools and involving collaboration among scholars separated by distance, often on a global scale" (Jankowski, 2009, p. 7). It is "the development of, and the support for, information and computing technologies to facilitate all phases of research processes" (JISC, 2008, p. 1). Traditional e-research, which is commonly known as e-science[2], is interested in how to advance scientific research by collaboration across disciplinary and geographical boundaries. It is closely associated with grid computer network architecture that enables global collaboration in the large-scale natural and biological science contexts (NeSC, 2010). The major contributions of e-research lie in the area of distributed access to large-scale datasets, the sharing of computational resources, and online environments for collaboration and communication (Jankowski, 2009).

Recently, there has been a major emphasis on adopting a social science approach in the development of e-research (Jankowski, 2009). The UK National Centre for e-social science (NCeSS) was established by the Economic and Social Research Council (ESRC) in 2004. The American Council of Learned Societies has also issued the Atkins report (2003) on cyber infrastructures for the Humanities and Social Sciences (ACLS, 2006). Alongside these policy developments, individual and small groups of researchers (e.g. Genoni, Merrick, & Willson, 2009; Halfpenny, Procter, Lin, & Voss, 2009) have begun to explore the emergence of e-research in the Social Sciences and Humanities. Researchers

[2]Cyberinfrastructure is an American version of the European term "e-science".

exploring e-social science commonly take two approaches: one with a development perspective, and the other with a social shaping perspective. Studies that focus on social shaping investigate technological change that is affected by the social context in which it develops, rather than developing the technical capabilities of technology itself (MacKenzie & Wajcman, 1985). The main focus of the development perspective is data infrastructure and integration. The research from a social shaping perspective (e.g. Woolgar & Street, 2003) is interested in how technology is being used and what its implications are for research practices.

Although these two approaches have been taken in e-social science, most of the projects nevertheless followed the e-science route (Jankowski, 2009). In examining the changes wrought by network technology, scholars tend to study advanced technologies, such as high-performance computing, advanced computer communication networks, sensor array, grid, mining and visualisation and large-scale simulation. They focus on the incorporation of grid computer architectures into the infrastructure of the social sciences. Many researchers study how content, in the form of digital and often very large datasets and databases, is made available by technology, such as the NCeSS-funded Modelling and Simulation for e-social science[3], grid-enabling quantitative social science datasets (K. Cole, Schurer, Beedham, & Hewitt, 2003), grid technologies (A. Anderson, 2003), and statistical analysis and modelling (Peters, Clark, Ekin, Le Blanc, & Pickles, 2007).

Recent studies show that these advanced technologies are perhaps not used as widely as appears to be frequently assumed in the literature. In one of the few qualitative studies designed to systematically explore informal communication in academia, Harley and his colleagues (2008) conducted explorative interviews with faculty (including those in the natural sciences) mainly located at the University of California, Berkeley. Their research suggested much less interest in and use of new technologies for scholarship than is presented in the majority of the literature. Many research studies are too ready to invoke the hyperbole that has commonly described the growth of advanced technology itself. What is needed are studies that investigate those technologies that are used by the majority of scholars in real-world research contexts.

4.4 Distributed Research

Distributed work over geographical distance is not new, but this century has witnessed a rapid extension of this kind of work (MacDuffie, 2008). The use of many technologies has been regarded as one of the key factors that encourages and enables an increasing geographic distribution of work (Hinds & Kiesler, 2002). “It is now possible for more people than ever to collaborate and compete in real time with more other people on more different kinds of work from more different corners of the planet and on a more equal footing than at any previous time in the history of the world” (Friedman, 2007, p. 8).
In academia, it has also been increasingly common for geographically dispersed researchers to work together (Haythornthwaite & Lunsford, 2006; Hinds & McGrath, 2006). In the past, physical distance not only reduced the likelihood of distributed collaboration (mainly among scientists), but also had a negative impact on possible distributed work (Cummings & Kiesler, 2005; Kraut, Egido, & Galegher, 1990), as communication at a distance used to be very costly and slow (Borgman, 2007).

Today, in contrast, advances in technology have made distributed research feasible, as new technologies allow researchers to exchange information and resources more frequently and rapidly (Finholt, 2002; Sonnenwald, 2003). As Atkins notes, “New technology-mediated, distributed work environments are emerging to relax constraints of distance and time” (Atkins, 2003, p. 9). When network technology is widely used in this digitalised world, people are “unlocked from the shackles of fixed and rigid schedules, from physical limitations” (Salmon, 2003, p. 11). Thus, advanced network technologies are allowing researchers to share ideas and expertise across distance and time.

These new issues arising in distributed research have gained considerable attention in scholarly debate. A large number of researchers (e.g. Armstrong & Cole, 2002; Schunn, Crowley, & Okada, 2002) have focussed their research on the distributed work that is made possible by technological advances. Many

[3]MoSeS: http://www.geog.leeds.ac.uk/projects/moses.html

of them (e.g. Kraut et al., 1990; Liang, Moreland, Argote, & others, 1995) have tended to study remote research collaborations that heavily relied upon technology in a distributed work environment. Cummings and Kiesler (2005) conducted a study of 62 scientific collaborations in 1998 and 1999, supported by a programme of the United States National Science Foundation, with a focus on the structure of such collaborations facilitated by technology at a distance. Sproull and Kiesler (1992) conducted field research in well-established electronic mail communities. Moon and his colleagues (2002) investigated an online work group whose members rarely meet if ever. It seems that these studies were often carried out based on the assumption that most of academic research today is conducted at a distance. Their studies seemed to imply that technology revolutionised the way scholars organise their research work and that academics working in the same office had already become a thing of the past.
Very few studies have taken a broader approach to study how distributed research may be occurring as part of the real-world research environment. For those who looked at both distributive work and collocated work, it seems that they made an explicit distinction between face-to-face communication and communication at a distance in their research. For example, Nardi and Whittaker (2002), in an ethnographic study, studied the place of face-to-face communication in distributed work. These studies shed little light on how distributed work fits into the main collocated research environments (Cummings & Kiesler, 2007).

In the real world of research, researchers constantly engage in varied research activities in multiple research contexts, neither exclusively at a distance nor just face-to-face. For instance, some research requires intimate interactions, which often occur opportunistically in collocated groups but may be difficult to generate in distributed groups (Nomura et al., 2008). These studies perhaps implied the importance of studying the use of technology in natural research settings. Research into distributed research should not be taken out of the real-world research contexts that it takes place within. The focus of research into technology use should be neither constrained by a purely distributed work environment nor excluded from what is happening at a distance.

4.5 Why the Disciplinary Framework Matters

The success or failure of technology use is largely dependent on the contexts in which they are used (Matzat, 2004). The discussion of the qualitative change in scholarly communication needs to be situated in the research practices to which technology is applied (Fulk, 1993; Kirkpatrick, 2004; Williams & Edge, 1996). In academia, the research contexts feature in unique academic disciplines (Lattuca, 2001). Disciplines are seen as "recognisable communities of scholars that develop conventions governing the conduct of research and its adjudication", relying upon "technical language", "methods of analysis" and "standards of evaluation" (Salter & Hearn, 1997, p. 20). They serve as the structures of knowledge in which their members carry out the tasks of teaching and research (Beyer & Lodahl, 1976).

Recently, research practice that is of an interdisciplinary nature is growing, for the current "demands of many societal, environmental, industrial, scientific and engineering problems that cannot be adequately addressed by single disciplines alone" (NSERCA, 2006, p. 1). The importance of interdisciplinary research also reflects the fact that since 2001 the UK Research Assessment Exercise (RAE) has explicitly stressed its importance (HEFCE, 1998 Paragraph 30-31). With this increasing growth in interdisciplinary research [4], the development of interdisciplinarity clearly challenges the way knowledge is understood, produced, and disseminated in research, as well as the way and extent to which academic researchers work (Shailer, 2007). This spotlights the importance of investigating the use of technology in support of research in such interdisciplinary settings.

However, in the studies of network technology use, much attention has been given to interdisciplinary settings that are usually dominated by the research culture of the hard sciences. A number of researchers have worked on science communication, and have claimed that new technologies are changing the ways

[4]It is worth noting that the trend toward interdisciplinarity is not against disciplinarity, as in the meantime the growth of knowledge has rapidly produced increasing specialisation of individual academics and research disciplines (Ziman 1994).

in which scientists discuss research ideas within scientific communities (Bates, 2000; Nowotny, Scott, & Gibbons, 2001; Schneckenberg, 2008). Price originally coined the term "invisible college" in reference to a communication network of scholars, and subsequently it is mainly (perhaps exclusively) used to describe communication relationships among scientists (Zuccala, 2006).

Fewer studies have looked into what is happening in the social sciences and humanities (Costa & Meadows, 2000). This is perhaps due to the fact that, in the past, social sciences and humanities research has been commonly perceived as an individual endeavour that requires little use of technologies for academic interaction. Nonetheless, this image is changing given the increasingly wider adoption of network technologies in these areas (Fry & Talja, 2007). The use of technology in research spreads out across every single academic discipline (Oblinger, 2008). Nowadays, social scientists and humanities researchers frequently interact with fellow researchers using various technologies. Nevertheless, the extent and ways in which the use of network technologies have impacted on scholarly communication (and on intellectual engagement, such as learning) in the social sciences and humanities is still not clear.

4.6 Technical Focus

The traditional approach to studying technology has been in itself somewhat technology driven. A large proportion of the literature on technology in support of research has been dominated by a series of technical reports advocating the capability of technology itself (e.g. Berge & Collins, 1995; Duggan, 2003). A number of discourses of technological understanding (e.g. Hiltz & Turoff, 2005; Mayadas, 1997) are only conceived of by extrapolating from the features of technologies. Researchers often look into the technical side of technology to support the use of technology, and overlooked the human aspects of technology that potentially affect and shape the use of it. A number of scholars (e.g. Birchfield & Megowan-Romanowicz, 2009; Larusson & Alterman, 2009; Lymer, Ivarsson, & Lindwall, 2009) have investigated computer support for shared knowledge, but they mainly focus on the practical design of technologies to support collaborative learning. Secondly, many studies (e.g. Lee, Girgensohn, & Zhang, 2004; Stolterman & Wiberg, 2010; Zhang, Ackerman, & Adamic, 2007) have tended to study the human factors of technology in so much as they could facilitate better design of future technologies from a technical point of view, which is usually conducted by researchers in the sub-field of computer science research. Thirdly, a number of studies (e.g. Gaines, Chen, & Shaw, 1997) have explored human discourse through technical infrastructure with regard to Shackel's (1991) basic human factors: utility, usability, and likeability. There is, perhaps, a general belief among scholars that the discussion of technology itself could lead to better use of technologies, meaning that far more attention has been paid to the design of technology than could support scholarly practice.

It seems that these researchers commonly think about how to harness the power of new technology for our research needs without critically engaging with an understanding of how technologies and academics interact. In this respect, the underpinning assumptions of how technology and academics interact are often unarticulated in discussions of technology in academia. Little concern has been paid to a comprehensive discussion of the relations between technology and human beings.

Recently, it is commonly argued that a social approach instead of a technical approach is needed to address research questions in order to understand how technology can be used to advance research (e.g. W. H. Dutton, Goldin, & Jeffreys, 2010; MacKenzie & Wajcman, 1985; Schroeder & Fry, 2007). What has changed is certainly beyond a purely technical perspective, such as "the expanded capacity to send, receive, and use information" (Ikenberry, 1999, p. 57) and "the capacity to bridge time and space" (Garrison & Anderson, 2003 p.xi). It has long been argued that the adoption of technology is less a function of technology itself than of the use of it by human beings (DeSanctis & Poole, 1994; Karsten & Jones, 1998; Menold, 2009; Orlikowski, 1992), as technologies are subordinate to actual uses and many other influences (Nentwich, 2003). Clearly, social studies into the use of technology in research are now, more than ever, at a premium.

5. The Challenge of Researching the Use of Technology in Academia

The challenge stems from the fact that technology is largely heterogeneous, and keeps changing all the time. Numerous terms have been used in the literature to address different technologies, such as information technology, instructional technology, assistive technology and social technology, not to speak of its countless applications (e.g. email, instant messaging, and video conferencing). These technologies vary, for example, from the capacity of carrying megabites of communication, to the speed of exchanging information, as well as to the way in which it used to facilitate different research activities. Technologies are commonly used for all sorts of purposes in different research settings. Apart from the numerous kinds of technologies, one technology can be seen as a different technology when it is used for different purposes (e.g. email is sometimes used for conversation, and sometimes used for exchanging papers). In a situation such as this, when new types of technologies rapidly alter scholarly practice, it is relatively difficult to identify which technology to study, what features to discuss, and in what field the discussion can be situated. This challenge requires this type of research to specify precisely what aspects of technology are being studied and how to study them. Perhaps, rather than trying to explore the use of all technologies as if they were the same, it is important to specify what kind of technologies are being used in research and for what purposes.

More importantly, these technologies continue to evolve, and new technologies rapidly become dated. Research studies that contain empirical evidence of technology use are out-dated the minute they are published (Nentwich, 2003). In many studies, there is an attempt to stay current and relevant by developing theories that equip scholars to understand the use of new technologies as they emerge (C. R. Scott, 2009). There is a clear expectation that theoretical accounts of technology that exist today can still be applied to future studies tomorrow. Nevertheless, the study of the scholarly use of technology is not rich in theory, in the sense of empirically testable propositions that have been around long enough to be able to adequately or explicitly solve research problems in the social

6. Conclusion

The increasing use of network technologies in research is changing many aspects of research activities, a situation which in itself draws attention to the importance of studying it. Among these changes, it is the qualitative (rather than quantitative) change that merits careful thought and investigation. In the literature, little attention has previously been paid to the interdisciplinary research settings (rather dominated by the hard sciences) where such qualitative changes occur. The current literature has been overshadowed by research with a strong technical focus, looking into large-scale collaboration, that takes a quantitative approach to studying the quantitative impact of technology use in distributed research of sciences. Qualitative research that attempts to investigate the use of technology in real-world interdisciplinary research settings is urgently needed. Empirical research into the qualitative implications of technology use in real-world interdisciplinary research settings (particularly in the social sciences and the humanities) is argued to be able to further add an additional depth to the current analysis of technology use in academia.

To investigate into this matter, there is a need to be aware of the connected challenges. Firstly, the attempt to research into the qualitative implications of technology use in academia situated itself in an interdisciplinary field, while offering various literatures, approaches, and methodologies, presents undeveloped, patchy and evolving research areas. Secondly, technology is largely heterogeneous, and keeps changing all the time. In this ever-changing context, the ways in which technology fits into real-world research contexts, where research endeavour can be continuously advanced, is the key question that that needs to be answered.

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Please cite as: Zhang, J. (2014). Scholarship before Technology: Re-thinking the Relationship between Technology and Scholars. *Journal of Communication and Education, 1*(1), 3-15.