EXAMINING THE OPEN MOVEMENT:

POSSIBILITIES AND IMPLICATIONS FOR EDUCATION

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ABSTRACT

This dissertation reports the results of a two-year long study focused on describing and coming to understand the perceptions and beliefs of a group of educators immersed in open source culture (OSC). The study was conducted using grounded theory methodology. Participants included teachers, educational administrators, educational theorists and technical experts who were distributed mostly throughout North America, and other parts of the world. Methods of data-collection included: online surveys, Internet telephony, telephone calls, face-to-face interviews, blog posts, email and discussion forums.

In preparation for the study, a comprehensive literature review was performed. It covered the origins of the free/open source movement, change theory, communities of practice and social capital theory. The literature review informed the theoretical framework which guided the study. Additional literature, where needed, was introduced through the data collection and analysis processes.

The study uncovered open activities and tools available and used by educators. In particular, the research focuses on the use of open source software, open publishing and open content. The identification of open practice (e.g., types, tools and methods) is an important feature of this study. Open source advocacy is also identified as an important characteristic/activity of most study participants.

The final three chapters of this study describe the benefits of and barriers to the adoption of open source tools, methods and philosophies. While many technical benefits and barriers are described, the study uncovers power relationships that affect the adoption of open source tools, practice and philosophies at all levels of implementation. In response to this discovery, I developed the concept *open thinking* as a critical tool to reveal and redistribute power/control structures. Additionally, I developed the CARES considerations, a tool for supporting open thinking and openness in educational environments. The dissertation ends with final reflections, a summative overview for supporting open thinking in education and topics for further study.

ACKNOWLEDGEMENTS

… to be continued …

TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.0 OPEN SOURCE CULTURE

This dissertation reports the results of a two-year long research study focused on describing and coming to understand the perceptions and beliefs of a group of educators immersed in open source culture (OSC). Open source culture in education, partially inspired by the open source software movement, describes a cultural condition where educational artefacts are produced and made generally available to other members of the community. Participants in an OSC have the right to use, modify and redistribute shared artefacts, but are usually required to redistribute these items back into the community if there are any changes or improvements. OSC inherently promotes a culture of collaboration and sharing, and the central hypothesis of this study is that *a thorough understanding of open source culture may benefit the collaborative practice of educators, and thus promote innovation and resource sharing in educational communities.*

Open source culture, nebulous in its boundaries, has begun to slowly penetrate mainstream education, especially those communities focused on the integration of technology into education. Thus, this dissertation explores a major shift in the field of educational technology. In this study, there appears a distinct evolution in the way that educational artefacts (e.g., essays, learning objects, software) are viewed as intellectual property, in the manner in which such artefacts are shared and distributed by participating individuals and groups, and in the methods used by educators to collaborate. This publication, released under a Creative Commons license[1], uses one of many emerging channels for shared distribution now available to educators.

[1] http://www.creativecommons.ca

In support of this perceived shift in the field, Leinonen (2005), a Finnish researcher, identifies five major phases in the history of information and communication technologies (ICT) in education (see Figure 1).

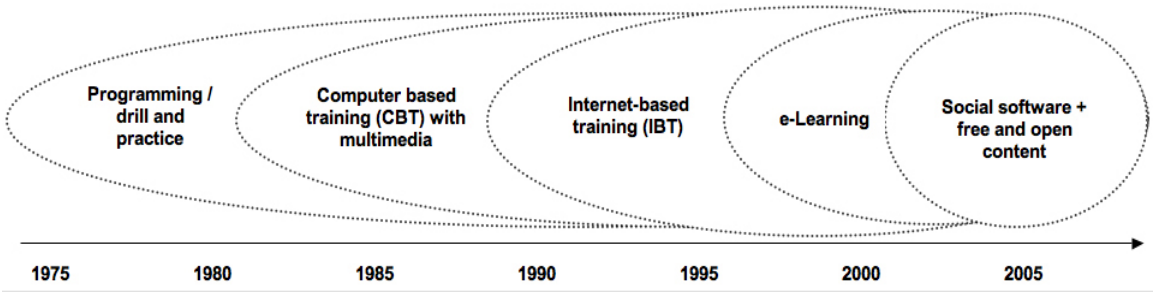

Figure 1. Five major phases in ICT education.

The first phase, programming/drill and practice, corresponds to the advent of the *personal* computer (PC) in the late 1970s. As we move from the era of the PC through the subsequent phases, the focus of technological innovations (e.g., software, network infrastructure) moves *increasingly* from individualized use to technologies designed for social interaction (e.g., email, listservs, blogs, wikis). While Leinonen's (2005) research focuses on this whole historical progression, the research reported here is limited to studying the activities, perceptions and beliefs of select individuals, myself included, who have apparently and in many respects entered this emerging fifth phase.

Finally, it is important to reveal my position (situation) in relation to the researched context, and therefore, my potential bias in the undertaking of this study. For several years, my own work has been strongly influenced by the literature and activities relevant to the open source software community. In July 1999, I read Raymond's (1997), *Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*. The essay contrasts two different software engineering and development

models. The first approach, labeled *the cathedral method*, reflects a structured hierarchical process where software source code is tightly held and made only available to an exclusive group of developers, at specific intervals of time (usually after each software revision release). This approach is common in the corporate sector where individuals are brought together through financial bonds or business pursuits. The second approach, labeled *the bazaar method*, is a process in which software code is developed in full view of the public (i.e., the Internet) by an ad hoc group of developers bound by similar goals and/or needs. Since Raymond's thesis, the latter approach has slowly gained prominence in software development communities and is seen to be a determining factor of success for Linux-based operating systems, and other recent open source projects such as the development of the Firefox[2] web browser (Weber, 2004).

While Raymond's (1997) essay was written in respect to his own experience in the software development context, it was apparent to others (including me) that the text was more widely significant. The essay's central thesis, "Given enough eyeballs, all bugs are shallow"[3], describes a socially-based theory of knowledge construction which resonates through dramatic new interest in weblogs, wikis, and other social software developments. The bazaar model, and what I will later describe as the *open movement*, has become much more than just a better way of writing software (Raymond, 1997). *It is my position that the open movement may be viewed as a culture, an ideology, and potentially, a better way for humans to work together on shared pursuits.*

[2] http://www.mozilla.org
[3] Cited as "Linus's Law," attributed to Linus Torvalds.

1.1 THE STUDY

In 1991, Linus Torvalds and a loosely knit community of Internet programmers developed the Linux operating system. While the development of smaller software programs had been previously achieved through relatively similar collaborative processes, nothing as complex as an entire computer operating system had ever been realized. Since this initial development, Linux, a free and 'open' operating system has become increasingly popular and adopted in various forms by home users and integrated into business models by large tech-leading companies such as Redhat Linux, Novell Incorporated, Sun Microsystems and Google Incorporated.

While the significance of Linux has been well documented by the technical community (Free Software Foundation, 2006, online), increasing interest in Linux and its underlying ideas/ideals has sprouted in the educational community. Such interests may be seen to include:

1. ***Linux as an alternative, free operating system to replace proprietary operating systems (Windows, Mac OS) in the educational setting***. A report from the British Educational Communications and Technology Agency (BECTA) (2005) concludes that open source software could provide a cost-effective, efficient solution in schools if effectively deployed. Previous to this strategic report, dozens of school systems in countries around the world had moved to Linux or to mixed-Linux environments (Linux and other operating systems). More specific case studies can be found at the Simple End-User Linux organization's website.[4]
2. ***Linux as the prime example of numerous open source tools that have recently been developed and thus are free to be used, modified, and distributed.*** There are

[4] http://casestudy.seul.org

now hundreds of developer communities producing open source alternatives to popular proprietary software packages (e.g., The GIMP vs. Adobe Photoshop, Open Office vs. Microsoft Office). Many such products can be found at the open source repository, SourceForge[5], a portal for collaborative software development.

3. ***Linux development as a "best practice" example of productive collaborative culture, which could potentially be adopted in educational communities.***

Hargreaves (2003) writes,

> It took just one man, Linus Torvalds, to get thousands of people to collaborate on the rapid development of Linux, an operating system good enough to challenge Microsoft. Teachers can do something similar. They can create a collectively-owned pool of innovation, offering their best practices as public goods, as an educational equivalent to the Linux phenomenon. (online)

The confluence of these three interests (i.e., open source as an economic model, the adaptability and productivity of the open source model, and the collaborative processes underpinning open source development) has nurtured the production of an educational "open movement" personified by the core philosophies of the open source software movement and moving into other knowledge sharing contexts. More specifically, a trend toward openness has risen in the areas of open content (e.g., MIT's OpenCourseWare Initiative[6]) and open publishing (e.g., IndyMedias, educational blogging, wikis as publishing alternatives).

As a teacher educator, a researcher, and a scholar in the area of educational technology, I find the open source phenomenon both fascinating and revolutionary. I am interested in many facets of the open source movement, including the economic savings potential in wide-scale implementations (e.g., school divisions), the quality and flexibility

[5] http://www.sourceforge.net
[6] http://ocw.mit.edu

of open-source software versus proprietary software in personal and/or enterprise applications, and the social spin-offs (e.g., blogging, Indymedia) of the open-source movement in academic, professional, and personal contexts. However, this study is focused on understanding collaborative practice in open communities (developer and adopter) and producing theory as to how educational communities may benefit from the adoption of open technologies, open practice and what I will define in Chapter 6 as *open thinking*.

1.2 PURPOSE

The purpose of this study is to gain insight into the adoption practices, activities, perceptions, and beliefs of a loosely tied group of educators who have begun to embrace and use open forms of information and communication technology (ICT). Within the study context, these open forms include free/libre and open source software (FLOSS), open content, and open publishing. While I had initially intended to base the study in the Saskatchewan context, I soon realized that because the open source movement is a globally distributed phenomenon, open source communities tend to extend well beyond any predetermined geographic boundaries. While some participants reside in my own province (Saskatchewan), most are located in distant locations.

The following questions guide the study.

1. What are the characteristics of the open movement that encourage and motivate members to participate in open communities?
2. Does participation in open communities encourage and/or support the development and adoption of (technological) innovation by teachers? If so, in what ways?

3. What perceived value is gained through membership and participation in open communities?
4. What educational activities and experiences result from a participant's membership in an open community?
5. Are there common values and beliefs held by members of open communities, and if so, what are they?

To reemphasize, these questions guide the study and are used generally through the data-collection phases. However, *these questions are not intended to form focused research outcomes*. Rather, these initial inquiries are designed to bring understanding of the research context and to provoke further questions and theories. As you will read in the final chapters, *the resulting theories support the idea that open practice and open thinking benefit community collaboration, promote sharing of educational artifacts and ideas, and therefore, are perceived to benefit educational communities as a whole.*

These guiding questions bring with them certain assumptions about what was not initially known. Particularly, these inquiries assume that the phenomena under study are characteristic of a unified, directed or purposeful movement. The contextual limits of this study are nebulous, and what I refer to as the *open movement* must be understood as a diverse, loosely connected chain of events, acquaintances, voices and interests which is unlikely ever to be understood as a homogenous body. A descriptive quote from Coleman (1999) is helpful in projecting the diversity and complexity of the open "community" and the context of the study.

> The meanings, aims, visions, and aspirations of the open source community are difficult to pin down …. closer inspection of the movement reveals a cacophony of voices and political positions: anarchic ideals of freedom, "tribal" gift-economy rhetoric, revolution, Star Wars imagery, web manifestos, evangelization

> to the corporate sector, the downfall of the "Evil Empire" (a.k.a. Microsoft), grass roots revolution, consumer choice and rights, community good, true market competition, DIY (Do it Yourself) culture, science as a public good, hacker cultural acceptance, functional superiority, and anti-Communist rhetoric are but a number of the terms, images, and visions promulgated by and attached to the open source community. (online)

1.3 RELEVANCE OF THE STUDY

Various authors (Hargreaves, 2003; Kim, 2003; Hannemyr, 1999) suggest that the communicative practices inherent within particular open source communities may represent a form of collaboration which may be useful for transforming school organizations. There has been very little research in this area, yet the following statements suggest that formal inquiry into establishing how such collaborative practice can benefit education is warranted.

> A key to transformation is for the teaching profession to establish innovation networks that capture the spirit and culture of hackers – the passion, the can-do, collective sharing. Teachers could create a common pool of resources to which innovators contribute and on which any school or teacher might draw to improve professional practice. (Hargreaves, 2003, p. 18)

> Open source software communities are one of the most successful – and least understood – examples of high performance collaboration and community-building on the Internet today. Other types of communities could benefit enormously from understanding how open source communities work. (Kim, 2003, p. 5)

This research responds to this call for greater understanding of open source communities and possible application of their methods and collaborative processes to the culture of education.

Theorists (Hannemyr, 1999; Berkman Center of Internet and Society, 1999) have also debated the presence of inbuilt beliefs and values seemingly revealed by the choices

made in the adoption of specific technologies. In other words, adopted technologies may provide insight into the value and belief systems of their adopters.

> Software constructed by hackers seems to favour such properties as flexibility, tailorability, modularity and openendedness to facilitate on-going experimentation. Software originating in the mainstream is characterized by the promise of control, completeness and immutability. (Hannemyr, 1999, online)

> The power of the new software movement stems from the "gift culture" that lies at the heart of the open code development model…. People are willing to enter into gift economies because they trust that they will someday share in the "wealth" that the community freely passes among itself – much as the academic community freely shares its knowledge among its members and disdains those who seek to financially profit from the community's shared body of knowledge. (Berkman Center of Internet and Society, 1999, online)

Open (source) communities are knowledge-sharing communities. Teaching communities are also based on knowledge sharing. Understanding open communities and the beliefs, values, and practices of their members may assist in improving communicative and collaborative practice in teaching communities and associated communities of practice.

While this study may be useful to any individual or group pursuing better collaboration in either temporal or online communities, this study most specifically responds to the needs and context of educational communities. The study participants, described to a greater extent in Chapter 4, are leaders in their respective contexts and actively contribute to educational change within their institutions, and the greater educational community. To illustrate, here is a portion of an email message I received from Peter Rock-Lacroix, a participant, who you will meet later in this study.

> In other news, I went into a technology committee meeting to propose that we move our entire teacher/student machinery (2 labs, a teacher work room, and classrooms) over to a free software platform (GNU/Linux). Going into the meeting, I knew I had a couple against the idea, a few not sure but skeptical, and a few already enthusiastically onboard due to previous conversations. By the time the presentation was over, the facts spoke for themselves. The advantages of such a change far outweighed the losses we would encounter by moving away from a

> proprietary platform. In the end, the committee unanimously agreed on a free platform and chose Ubuntu as the distribution to work with. (Email, Peter Rock-Lacroix, May 9, 2006)

When I read back and look ahead, I realize that this study is a compilation of stories about small victories by passionate educators; victories as the one described above. The study participants you will meet can all be seen as advocates and champions of open thinking in terms of infrastructure, pedagogy, content and publishing (ideas explained in Chapters 4 and 5). The research reflects the unique stories and experiences of these educators.

1.4 DEFINITION OF TERMS

Many of the more technical terms used in this study are supported by resources located in the footnotes of this paper. However, the following commonly used terms are important if the reader is to understand open culture. Descriptions and brief definitions are included in this section.

Free/Libre/Open-Source Software (FLOSS) is a combined phrase meant to bridge ideas from the open source movement (libre) with central ideas from the free software movement. While the term has not been wholly accepted by both communities, it is likely the most common term used when discussing software which is either freely available or available as open source. Close linguistic derivatives include FOSS (Free & Open Source Software) and FLOSSE (Free/Libre/Open-Source Software in Education).

The Free Software Movement (FSM) was founded by Richard Stallman in 1983. "The goal of the movement is to give freedom to computer users by replacing software which has restrictive licensing terms with free software (free as in freedom)". In this sense, the movement is really a move against the "immoralities" of proprietary

restrictions, although "not all proponents of the movement believe proprietary software to be strictly immoral." (Wikipedia Entry)[7]

Open Content is a phrase derived from the term *open source* and refers to any type of creative work (e.g., essays, poetry, photographs, audio, video) that is published in a format that allows, and often encourages, the copying, editing and sharing of that content. Prominent early examples of open content include MIT's OpenCourseWare Project[8] and the Creative Commons.[9] The term is attributed to David Wiley and his Graduate work at Brigham Young University in the late 1990s (Moody, 2006)

The Open Movement, as used throughout this study, refers to a tendency by individuals to work, collaborate, and publish in ways that reflect openness, sharing, collaboration and transparency. The movement also reflects a tendency and a preference by individuals to use tools that are available under FLOSS licenses.

Open Publishing is a method of publishing content that promotes transparency and supports the processes for publication, commenting, participation and redistribution. Blogging (content management) and wiki software (simple html collaboration) are the most common types of open publishing media today, however, many popular open publishing sites rely other open source software products such as Drupal[10]. Arnison's Law (cited in West, 2005) is helpful in drawing similarities between the underlying philosophies of open source and open content as it reads, "Given enough eyeballs, problematic content is shallow."

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[7] http://en.wikipedia.org/wiki/FSM
[8] http://ocw.mit.edu/
[9] http://www.creativecommons.org
[10] http://www.drupal.org

Open Source Culture (OSC) usually refers to a condition where cultural artefacts are made generally available to all citizens. Participants in an open source culture have the right to use and modify shared artefacts, but are usually required to redistribute these items back into the community if there are changes or improvements. Open source culture is unique in the sense that it is recursive; its basic tenet is that the culture itself is based upon the sharing and promotion of cultural artefacts.

Open Source Software (OSS) is software that has its source code (software code) made freely available to the general public. Open source software can be licensed under various licensing structures (e.g., GPL[11], BSD[12]) and, depending on the specific license, users have various rights to modify and redistribute the software, in some cases, even for commercial purposes.

1.5 ORGANIZATION

A review of literature is available in Chapter 2. Chapter 3 outlines the methods and procedures that were employed in this study and introduces the participants of the research. Chapters 4, 5 and 6 feature the data analysis and findings of the study. Chapter 4 highlights the activities of the participants and the current environment of the open movement, Chapter 5 focuses on the perceptions of participants related to the benefits and barriers of the open context, and Chapter 6 draws together collective projections for a collaborative educational culture. Chapter 7 includes a discussion and summary of the results, conclusions and recommendations for future research.

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[11] General Public License - http://www.opensource.org/licenses/gpl-license.php
[12] Berkeley Software Distribution - http://en.wikipedia.org/wiki/BSD

CHAPTER 2: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter features a review and discussion of literature relevant to this study. Section 2.1 begins with a historical review of the origins and principles of the open source and free software movements and describes how these movements may indicate an emerging societal shift toward openness (the open movement), at least in some contexts. Section 2.2 highlights key understandings of educational change theory as they apply to this study. Section 2.3 is a review of community of practice (CoP) literature about the characteristics of communities and strategies for community building. Section 2.4 explores social capital in the social networks that exist between individuals and groups. Section 2.5 provides a brief description of how this literature review supports the data analysis of this study. This final section is important as it briefly summarizes key thoughts from the preceding sections, and provides the theoretical framework built upon the literature review.

2.1 UNDERSTANDING THE PRINCIPLES OF OPEN SOURCE

If the term *open source* is to be understood as the foundational idea behind a sociopolitical movement, it should be first described at a fundamental technical level. It is my assumption that before one can begin to understand open source in the larger context, one must have a basic comprehension of the term *source* and understand other essential terms such as *hardware*, *software* and *programming languages*.

In acknowledging the technical characteristics of a movement originating from early electronic computing, there is an important distinction to be made between the terms *hardware* and *software*. Hardware typically includes the physical components of a

computer (e.g., keyboards, monitors, hard drives, etc.). These items are usually fixed and not modifiable by users. Software, in contrast, includes programs, codes and routines that give instruction to the overall operation of the hardware components. Software programs, which include subsets of codes and routines, are most easily written through the assistance of programming languages. A *programming language* is an artificial language that programmers (human software developers) use to write instructions or codes that, once compiled, will be executed by the hardware. Some examples of today's popular programming languages include C++, Java, Python and Perl.

The relationship *between* hardware and software is also important. Programming languages allow a bridge between the human developer and the control of the hardware, but written code from any programming language must be compiled or translated to binary machine code (0s and 1s) for the hardware to 'understand' and execute the commands. In other words, code written by human programmers must be converted to binary code, and once this conversion is complete, the code is only readable by computers.

Source or *source code* includes the actual text written by programmers in any number of programming languages. To other skilled programmers, this code may be readable and understandable. When code is in the source form, programmers are best able to understand how code works, how code may be improved or, as is often the case, how errors in code can be addressed. Once the source code is compiled to machine language, it is very difficult or impossible to work with the code to make alterations or improvements to software (see Figure 2).

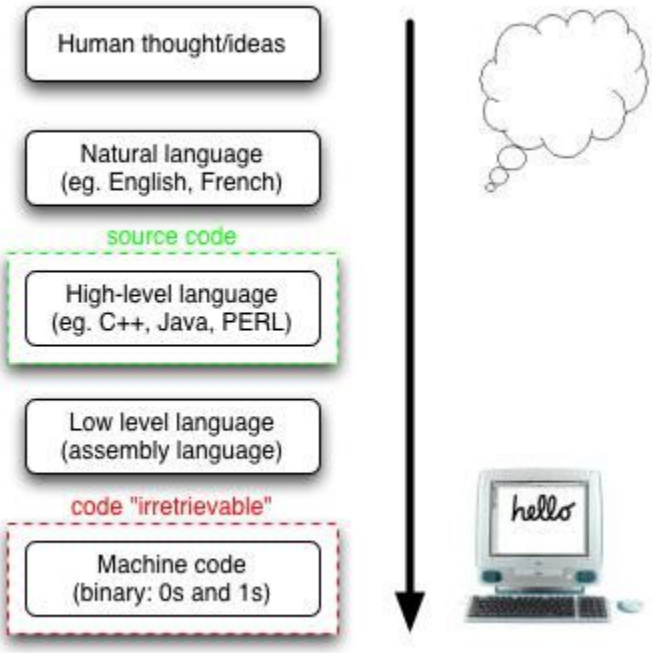

Figure 2. Steps in the conversion of human thought to machine code. Unless developers make source code available, the code is almost always impossible to retrieve, modify or improve.

Today, software is either developed as proprietary (closed source) or as open source. For instance, Microsoft Windows XP (and all other previous versions of Windows) is completely closed source.[13] Only developers at Microsoft (or Microsoft designated third parties) are able to make any modifications to this operating system (software). Alternately, many distributions of the increasingly popular GNU/Linux operating system are available free of charge by download from various Internet sources. Due to the potentially drastic reduction in cost of systems running open source operating systems (e.g., Linux) versus proprietary operating systems (e.g., Microsoft XP), the open

[13] Although there has been some movement in what Microsoft calls the Shared Source program where code is distributed to elite developers.

source economic model has begun to find favour with educators in both small- and large-scale initiatives (BECTA, 2005).

2.1.1 Origins of the Free/Open Source Movement

Although the term *open source software* has only recently claimed widespread use, this phrasing originates in the American 'hacker' culture of the 1960s and 70s. More specifically, the practices behind the term are attributed to key individuals working in the computer science laboratories of Stanford, Berkeley, Carnegie Mellon, and MIT. Some key individuals include Eric Allman, inventor of sendmail, Ken Thompson, creator of Unix, and Dennis Ritchie and Brian Kernighan to whom the development of the C programming language is attributed. While these individuals may not be household names, their work in computer science has paved the way for the modern-day connectivity we experience in our personal, academic, and business computing environments.

The above mentioned individuals made important contributions to modern computing and the field of information and communication technology (ICT). Yet, such advancements may not have been possible had it not been for the collaborative nature of the developing community. These names, and others, represent a pioneering community of programmers that was small and close-knit. Within this community, code passed freely among members working collaboratively on various projects. When an improvement was made to code, there was an expectation that this information would be passed along to other members of the entire programming community. The act of withholding code was considered gauche, because it was to everyone's benefit in the collaborative culture that

the code was improved (Stallman, 2000). However, by the end of the 1970s many developers were enticed to join commercial firms producing proprietary software.

Richard Stallman (2000) was an important figure in these early days of computing and continues to be a champion for the Free Software Movement[14]. Stallman began his computer science career as a graduate student at MIT in 1971. While Stallman's career began in an environment of collaboration, sharing and collegiality (as described above), his surroundings began to change in the early 1980s as many of his former colleagues began to work for commercial companies, which sold primarily proprietary systems. In an interview with David Bennahum, Stallman spoke about the origins of this practice as he recalled the actions of student programmer, Brian Reed, from Carnegie Mellon University in 1980. Reed, a computer science student who wrote a text-formatting program named Scribe, "surprised everyone by selling it to a company, instead of sharing it with the community. The company was very proprietary about it, and very obnoxiously put time bombs into it" (Bennahum, 1996, online). "The problem was that nobody censured or punished this student for what he did. He got away with it. The result was other people got tempted to follow his example" (King, 1999, online).

As ranks of programmers moved toward commercial pursuits, Stallman struggled to maintain a community of collaboration.

> I was faced with a choice. One: join the proprietary software world, sign the nondisclosure agreements and promise not to help my fellow hackers. Two: leave the computer field altogether. Or three: look for a way that a programmer could do something for the good. I asked myself, was there a program or programs I could write, so as to make a community possible again? (King, 1999, online)

Stallman followed his third choice and left MIT in 1985.

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[14] http://www.fsf.org/

Shortly after leaving MIT, Stallman formed the Free Software Foundation (FSF). The foundations' website hosts community-developed, freely available software. In 1985, Stallman authored the GNU manifesto[15], which called for other programmers/hackers to join a new project and champion the benefits of sharing source code. GNU, perhaps Stallman's most famous initiative[16], is the most revered/used software package available from the foundation. GNU, a recursive acronym, stands for "GNU's not Unix." GNU is not one program but a collection of many complementary programs (e.g., compilers, editors, text formatters, mail applications, etc.) created through the GNU project. GNU is the combined work of many programmers and developers and was developed to be upwardly compatible with Unix. However, GNU was missing one key component to make it a complete operating system - the kernel. To clarify, GNU had all the separate components of a complete operating system, but was missing the central component that would mesh these parts together. Enter Linus Torvalds and Linux.

2.1.2 The Rise of Linux and Other Open Source Giants

In 1991 Linus Torvalds, a 21-year-old computer science student at the University of Helsinki, posted the following message to the Internet newsgroup comp.os.minix.

> From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)
> Newsgroups: comp.os.minix
> Subject: What would you like to see most in minix?
> Summary: small poll for my new operating system
> Message-ID: <1991Aug25.205708.9541@klaava.Helsinki.FI>
> Date: 25 Aug 91 20:57:08 GMT
> Organization: University of Helsinki
>
>
> Hello everybody out there using minix -
>
> I'm doing a (free) operating system (just a hobby, won't be big and
> professional like gnu) for 386(486) AT clones. This has been brewing

[15] http://www.gnu.org/gnu/manifesto.html
[16] Free Software Foundation: http://www.gnu.org/

> since april, and is starting to get ready. I'd like any feedback on
> things people like/dislike in minix, as my OS resembles it somewhat
> (same physical layout of the file-system (due to practical reasons)
> among other things).

Seemingly an insignificant request, Torvald's posting, and others like it that followed, spurred the collaborative creation of what was to become the Linux kernel, the central component of the Linux/GNU operating system.[17] Although Linux, as software, is a viable (and free) alternative to Windows, what may be more significant is the collaborative manner in which Linux was developed. Raymond (1997) writes,

> The most important feature of Linux, however, was not technical but sociological. Until the Linux development, everyone believed that any software as complex as an operating system had to be developed in a carefully coordinated way by a relatively small, tight-knit group of people. This model is typical of both commercial software and the great freeware cathedrals built by the Free Software Movement in the 1980s. (p. 16)

Even those individuals closest to the "hacker" culture could not predict the great influence that Linux and the open source movement would have on the computing world. Raymond continues,

> Linux is subversive. Who would have thought that even five years ago that a world-class operating system could coalesce as if by magic out of part-time hacking by several thousand developers scattered all over the planet, connected only by tenuous strands of the Internet? (p. 17)

Only 2 years after the release of Linux, groups such as Red Hat, Debian, and SuSE[18] emerged to modify and improve, to give away, and in some cases, to sell their own distributions of Linux. Features continue to be added to Linux, including SAMBA[19] that allows Linux to transparently share files and printers over even Microsoft-based

[17] Note: Technically, Linux is not a complete operating system in itself, but refers to the kernel. The kernel is an essential part of the operating system, however, and is the core that provides basic services for all other parts of the operating system. Without the Linux Kernel, GNU was an incomplete operating system. For an excellent technical description of how Linux and GNU coexist, see Fink, 2002, Chapter 2.
[18] Now owned by Novell Incorporated.
[19] http://www.samba.org/

networks. On the desktop (consumer level), it is reported that Linux has reached almost a 2% market penetration. This may seem an insignificant proportion until it is compared to veteran Apple Computer's penetration that has been estimated to be anywhere between 2% and 11% (Fink, 2002). Today, Linux runs on at least 15 different computer platforms including IBM mainframes, Macintosh, PCs, Sun Systems, and Palm Pilots. Linux boasts over 10 million users and the number continues to grow (Wheeler, 2005).

Linux is certainly not the only success story of the open source movement. In January 1998, Netscape, in a shocking move[20], announced that it would release its popular web browser suite, Netscape Communicator, as an open source product. While there were various opinions about what seemed an irrational move by a corporate giant, the action introduced the idea of free and open source software as legitimate to the business community. Netscape Corporation believed that it could tap into a community of developers to improve its own product. By 2002, Mozilla[21] was released as the first open source, production version of Netscape's code. Now years later, the even more popular Firefox[22] browser, also based on Netscape/Mozilla code, has become a strong competitor to Microsoft's Internet Explorer web browser.

Other success stories include Apache[23] web server, another open source application, currently the most widely used web server on the World Wide Web. Other applications like Perl[24] and PHP[25] have become increasingly popular and essential tools for many web programmers. IBM, Dell, and Compaq now all provide servers that run

[20] This is sometimes referred to as the "shot heard 'round the world" (Raymond,1999, p.203)
[21] http://www.mozilla.org
[22] http://www.getfirefox.org
[23] http://www.apache.org
[24] http://www.perl.org/
[25] http://www.php.net/

Linux. Apple Computers has based its newest operating system on BSD, an open source Unix-like operating system developed at the University of Berkeley. There are literally thousands of applications that are available as open source, and many are designed for business, personal computing, or education. A comprehensive list of open source projects can be found at sites such as the SourceForge Project[26] and Freshmeat.[27]

2.1.3 Open Source Licensing Structures

The 'magic' which helped to establish Linux and, by now, countless other open source and "free" software projects would have likely not occurred without Stallman's (2000) unique twist on copyright and software licensing. In the motion picture documentary, *Revolution OS* (Moore, 2002), Torvalds described his relationship with Stallman stating, "Think of Richard Stallman as the great philosopher and me as the engineer." To give more breadth to this statement, it's important to understand the General Public License (GPL), the idea of copyleft, and Stallman's understanding of 'free' software.

The General Public License is a legal agreement that enabled various developers to work on the GNU project. The detailed GPL and its legalese can be found at the Open Source Initiative (OSI)[28] website (http://www.opensource.org/licenses/gpl-license.php). However, to summarize, the GPL is based on Stallman's following principles. When forming the Free Software Foundation, Stallman stated that for any software to be truly "free," every user must have the right to:

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[26] http://sourceforge.net/
[27] http://www.freshmeat.org
[28] **Open Source Initiative (OSI)** is a nonprofit corporation dedicated to managing and promoting the ideals of open source software definition.

1. run the program for any purpose.
2. modify the program to suit their needs (i.e., in most cases, this means that potential developers must have access to the source code).
3. redistribute copies free of charge.
4. distribute modified versions of the program, so that the community can benefit from your improvements.
(Free Software Foundation, 2006, online)

From the previous set of principles, it may seem contradictory to say that one can charge a fee for free software. To clarify, Stallman (2000) defines the meaning of the term *free software* by explaining that it refers to software that is "free as in speech, not as in beer" (Dibona, Ockman, & Stone, 1999, p. 3). In other words, Stallman is making a distinction between *libre* and *gratis*. Software developers of programs falling under the GPL have the liberty to make changes, share code, use and redistribute; however, they are not bound to "give away" any derived works thus the notion of *copyleft* becomes very important here. *Copyleft*, an essential part of the GPL, is the mechanism that keeps software free.

> Copyleft uses copyright law, but flips it over to serve the opposite of its usual purpose: instead of a means of privatizing software, it becomes a means of keeping software free. The central idea of copyleft is that we give everyone permission to run the program, copy the program, modify the program, and distribute modified versions – but not permission to add restrictions of their own. Thus, crucial freedoms that define "free software" are guaranteed to everyone who has a copy; they become inalienable rights. (Stallman, 2000, p. 53)

The GPL is not the only licensing agreement that applies to open source software. In fact, GPL is only one of many open source-type licenses. However, GPL is probably the most popularly referred to licensing structure due to Torvalds' decision to apply the GPL to Linux. Other popular open source licenses include Apache Software license (the licensing structure of the world's most distributed web server software), Artistic License

(applies to the Perl programming language), BSD (Berkeley Systems Distribution)[29], IBM public license (IBM's commercial copyleft license), and the Mozilla Public License (applies to the open source version of the colossal Netscape Navigator) (Fink 2002). While most of these licensing structures are similar, each handles intellectual property and the rights of the developers slightly differently. Developers have the right to choose which licensing structure (in some cases, more than one can be chosen) is most suitable to their work and to future modifications done by the open source community or by commercial enterprise. While there are certainly many variables in regards to the licensing of open source, both initial developers of open source projects and those who adopt open source software (e.g., schools) must be aware of the specific legalities in respect to open source and free software. (McGowan, 2001)

2.1.4 The Open Movement Today

When I first began thinking about the open movement, I knew only of the movement as it pertained to software. As I did more research, I realized that software, while perhaps the impetus, was merely the context. On closer scrutiny, I found that the open source movement nurtures a philosophy that values certain freedoms related to knowledge dissemination (e.g., sharing, reuse, redistribution, non-commercial) and favours unique collaborative processes and tools (e.g., digital repositories, open-access journals, blogs, wikis) in the creation of new knowledge. This basic philosophy has taken new shape today as the open source movement has emerged, most notably, in the forms of open content and open publishing.

[29] Derived from a version of Unix developed at the University of Berkeley, California.

Open content is an evolving term, but in a strict sense refers to traditional and nontraditional content (e.g., books, articles, images, websites, music, etc.) that is "freely available for modification, use, and redistribution under a license similar to those used by the open source/free software community" (Wiley, 1998, online). There has been the development of large open content initiatives over the past several years. Notably, the Massachusetts Institute of Technology (MIT) is currently developing the Open Courseware Initiative (OCW). The OCW is an open publication of MIT course materials which currently features over 500 separate courses licensed under a Creative Commons[30] license.

The Creative Commons (CC) is an organization that was not only developed to help authors release content in a manner that protects the rights of the creator but also to encourage accessibility toward certain public uses of material. The developments of the Creative Commons were inspired by the open source software movement, and the organization has begun to redefine how authored content is to be released. An excerpt from the CC philosophy reads:

> We use private rights to create public goods: creative works set free for certain uses. Like the free software and open-source movements, our ends are cooperative and community-minded, but our means are voluntary and libertarian. We work to offer creators a best-of-both-worlds way to protect their works while encouraging certain uses of them — to declare "some rights reserved." (Creative Commons, 2002, online)

Hundreds of works including books, essays, photographs, songs and short videos have been released under Creative Commons' licenses in the past several years. The CC has become an attractive alternative to traditional approaches of releasing content. And, as the GPL licensing structure was significant in fostering the collaborative development

[30] http://creativecommons.org

of Linux, certain CC licenses can act to encourage and enable others to collaborate on joint projects, while protecting attribution rights of the initial author(s). (To better understand the CC licensing process, it's helpful to view their "Choose License" page at: http://creativecommons.org/license/)

Open publishing is a relatively new phenomenon that has grown under the influence of the open source movement, and has been encouraged by the interactive structure of the Internet. Arnison (2001) writes,

> Open publishing means that the process of creating news is transparent to the readers. They can contribute to a story and see it instantly appear in the pool of stories publicly available …. Readers can see editorial decisions being made by others. They can see how to get involved and make editorial decisions. (online)

Transparency is a key concept here. The creation of news becomes open to the eyes of the interested and the involved, much as source code is accessible through open source software projects. In the open publishing model, the relationship between news producer and news consumer has merged.

In some instances, open publishing networks (sometimes referred to as Indymedias) seem to have risen as an intentional departure from the news construction process at traditional media outlets. Many view the rise of open publishing as a reaction against special interest, government influenced, advertising-funded media empires (Hyde, 2000). In contrast,

> Indymedias are restructuring the traditional news hierarchy of publishers, advertisers, sources, journalists and readers. In the world of Indymedia news, the relationship between the sources, journalists, and readers is all that matters. In the Indymedia community, publishers, advertisers, and corporate interests are left out of the picture. (online)

There are dozens of examples of large open publishing ventures. Some of the more popular examples include:

- **The Independent Media Centre** (IMC)[31]. IMC is a collective of independent media organizations started in late 1999. There has been criticism of IMC, especially in regards to the anticorporate and leftist slant to many of its stories.[32]
- **TearItAllDown.com**[33]. An open publishing community for varied types of activists.
- **Kuro5hin**[34]**.** A community focusing on technology and culture, where daily users are able to vote for the day's top stories, and comment on each.
- **Slash Dot**[35]**.** Slash Dot's motto is "news for nerds, stuff that matters." Daily news, especially related to technology, is posted daily and commentaries are written by users.

Another important development in the open publishing spectrum is the recent emergence of weblogs (blogs). *Blogs* are usually personal websites that provide updated journal entries, commentaries, headlines, news articles or hyperlinks of interest to the user or to a somewhat specific audience. While blogs have been around since early 1999, their rapid growth was fostered more recently in part by the development of easy-to-use interfaces created by Pitas [36] (the first weblog specific software) and by Pyra Labs[37] (known as Blogger). Since then, dozens of content management systems[38] have emerged (e.g., Moveable Type, TypePad, Live Journal, Radio Userland) and there are likely several million active bloggers.[39] Blogging and content management systems seem likely

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[31] http://www.indymedia.org
[32] http://en.wikipedia.org/wiki/Independent_Media_Center
[33] http://www.tearitalldown.com
[34] http://www.kuro5hin.org
[35] http://slashdot.org/
[36] http://www.pitas.com
[37] http://www.blogger.com
[38] A content management system (CMS) is software that enables simple addition/editing/manipulation of HTML (website) content.
[39] Blogspot alone has over 1.5 million active bloggers as of May 2004 (http://www.dijest.com/bc/).

to have significant effects on the personalization and practicality of publishing to and with others on the World Wide Web.

2.1.5 Rationale for Open Source Adoption

In the last several years, open source and free software development have become popular with educators (see Linux Case Studies[40]). Reasons for open source advocacy vary. Dozens of informal articles by educators and 'techies' alike can be found on the World Wide Web eliciting varying rationales for open source adoption (see Canopener[41]). Many argue economic reasons, such as a lower total cost of ownership (TCO) in schools[42], and other, mostly economic, rationales (Lerner & Tirole, 2000). Others focus their arguments on social democratic ideals about intellectual property (May, 2000; Moglen, 1999; Newmarch, 2001; Sodenberg, 2002). To use the colloquial term, it seems that 'everyone and their dog' has an opinion about open source software and Linux. However, it remains difficult to find peer-reviewed publications on the topic, particularly related to how schools and educators are using open source in the educational setting. Inquiries in this area could lead to identifying what factors compel educators to use and or develop open source applications, and simply, what is being done with open source and free software in schools.

A few theorists have compared the Internet economy, and particularly open source communities, to the "Gift Economy" practiced traditionally by North American First Nation tribes and ancient Chinese societies (Cheal, 1988; Mauss, 1990). Partial gift

[40] http://casestudy.seul.org
[41] http://www.canopener.ca
[42] A list of articles regarding TCO is available at http://luminance.sourceforge.net/resources_archive.php

economies seem to exist, in contemporary forms, within academic cultures. Barbrook (1998) writes,

> Within small tribal societies, the circulation of gifts established close personal bonds between people. In contrast, the academic gift economy is used by intellectuals who are spread across the world. Despite the anonymity of the modern version of the gift economy, academics acquire intellectual respect from each other through citations in articles and other forms of public acknowledgement. Scientists therefore can only obtain personal recognition for their individual efforts by openly collaborating with each other through the academic gift economy. Although research is being increasingly commercialised, the giving away of findings remains the most efficient method of solving common problems within a particular scientific discipline. (online)

Here, Barbrook acknowledges and advocates for the collaborative benefits of a gift culture.

Raymond (1997) describes *hacker culture* as a true semblance of gift economy. In *Homesteading the Noosphere,* he argues that our contemporary society ties to classical exchange societies that are strongly interlinked with command hierarchies. Within contemporary society, humans continue to demonstrate drive for social status. Arguing from these premises, Raymond proposes that

> Gift cultures are adaptations not to scarcity but to abundance. . . . Abundance makes command relationships difficult to sustain and exchange relationships an almost pointless game. In gift cultures, social status is determined not by what you control but by *what you give away*. (online)

Although Raymond may present a simplistic analysis of open source culture through this lens, there are aspects of the gift culture analogy worth examining. In particular, gift economy theories help to explain motivations that may underlie the increased popularity of open source software and in related activities, such as the development of open content and open publishing in education.

2.2 INTRODUCTION TO CHANGE THEORY

Change Theory (CT) is an umbrella term that includes numerous subtheories that describe change within various contexts. Change theorists, in general, attempt to understand the change process and provide and build strategies to effect change (Ellsworth, 2000; Fullan, 2001). This literature is important in understanding the open source movement and its place in education. It is important to understand and describe the various assumptions underlying much popular change literature. These fundamental assumptions should be considered when applying CT to a particular context (e.g., the open source movement).

Educational change theory can be seen to be influenced by the following key assumptions:

1. **Change can be understood and managed.** The change literature that I have studied assumes that change can be planned, initiated and developed through leadership or administrative strategies. In this sense, the focus of much change theory is pragmatic; change is studied so that it can be managed. (Ellsworth, 2000; Rogers, 1995)
2. **Planned change is focused upon introducing innovation or innovations to individuals or within a system.** Planned change may be limited to implementing a particular technology into an instructor's classroom (e.g., use of PowerPoint or a data projector as an instructional tool) or can be focused on more encompassing and wide-scale school reform projects. (Bates, 2000; Ellsworth, 2000; Fullan, 2001; Fullan & Miles, 1992; Rogers, 1995)

3. **Planned change is value-laden.** When introducing change to an individual, group, or system, leadership[43] has made a decision that a particular innovation is valuable, or more valuable than conditions or processes that currently exist. Within this understanding of the change process, value is negotiated as individuals closely affected by change may be accepting, neutral or resistant to the innovation for reasons related to perceived value. Thus, leadership of change often involves the engagement of different sets of interests, interpretations and identities, which may or may not allow mutual adaptation and the 'success' of a proposed change project (Fullan, 2001; Gordon, 2002; Knight & Trowler, 2001; Ramsden, 1998; Zaltman & Duncan, 1977).
4. **Planned change requires people**. There is little debate that people are at the heart of the change process. In much of the classic literature the term *change agent* is used to describe the person (or persons) who is the initiator of the change effort. Change agents may be identified as officials hired by an institution to be responsible for particular changes (e.g., a school division's technology consultant). More informally, a change agent may be an influential person who causes change at a microlevel (e.g., the tech-savvy teacher next-door). (Fullan, 2001; Gladwell, 2000; Hall & Hord, 1987; Rogers, 1995)
5. **Planned change is complex and often requires multiple approaches and tools.** Theorists have gone to great lengths to develop models and checklists for change. Some attention has been given to the individual or potential adopters (Hall & Hord, 1987). Other theorists have developed broad strategies for promoting change within

[43] Leadership as used here is meant as a general term that can mean anything from an individual leader, to an entire administration.

larger environments. (Bates, 2000; Fullan, 2001; Havelock & Zlotolow, 1995) Change is acknowledged generally to be complex and even when strategies are combined, planned change is not always achieved.

Through a careful summary of change literature, it was evident early into the study that change theory, especially that related to planned or managed change, could not account for all theories emerging from the study data. In the following sections, promising change theories are presented. While these help to inform aspects of what was theorized from the study, deficiencies are evident and discussed throughout this chapter.

2.2.1 Diffusion of Innovation Theory

In trying to comprehend change theory, it is useful to trace CT research back to its modern historical roots. Change theory has been strongly influenced by diffusion of innovation theory (DIT), which first appeared at the beginning of the 20th century. Understanding these philosophical foundations of change theory is an important step in understanding current change theory. Ralph Waldo Emerson once said, "Make a better mousetrap, and the world will beat a path to our door." This principle that may have had merit in the early 1800s, might easily be dismissed in the postindustrial world. Theoretically superior technologies such as Betamax recorders, the Dvorak keyboard, and the early Apple operating system have succumbed to the VHS standard, QWERTY and the Wintel[44] monopoly, respectively. It is in general agreement that the adoption of technology is a more complex process than the technical superiority of a product

[44] Wintel is the common trade term used to describe personal computers based on the Intel architecture and the Windows Operating system. This has by far become the prevalent configuration for standard personal computers.

(Abrahamson & Rosenkopf, 1997; Reigeluth & Garfinkle, 1994; Rogers, 1995; Ryan & Gross, 1943).

Diffusion of innovation theory provides a useful, albeit incomplete, lens for assisting researchers in understanding the complexity related to the acceptance or rejection of innovation. In its basic form, *diffusion* is defined as the process by which an innovation is adopted and gains acceptance by individuals or members of a community. DIT comprises several subtheories that collectively study the processes of adoption. The first famous account of DIT research was done in 1903 by French sociologist, Gabriel Tarde. Tarde (1903) plotted the original S-shaped innovation curve because he believed that most innovations have an S-shaped rate of adoption. Through the slope of the S-curve, Tarde could identify those innovations with a relatively fast rate of adoption (steep slope) versus those with a slower rate (gradual slope). Since Tarde, the S-slope has become important for those studying the adoption of ideas, especially those found in business.

Several decades later, Ryan and Gross (1943) published their seminal study that described the diffusion of hybrid seed among a group of Iowa farmers. At the time of the study, U.S. farms were slowly becoming business enterprises rather than family subsistence units. As corporations entered into the business of agriculture, so did the concerns of higher productivity, efficiency, competitiveness and agricultural innovations. Ryan and Gross wanted to study the process in which innovations in agriculture were adopted. They discovered that diffusion was "a social process through which subjective evaluations of an innovation spread from earlier to later adopters rather than one of rational, economic decision making" (Valente, 1995). At the time, this was a novel

perspective on the diffusion process and emphasized the effect of social factors on adoption.

Ryan and Gross (1943) also noted that the rate of adoption among those studied followed an S-curve when plotted on a cumulative basis over time. This supported the work of Tarde, reported 40 years previously, and renewed interest in Diffusion Theory. Additionally, Ryan and Gross classified their study participants (Iowa farmers) into five adopter categories. These categories included: innovators, early adopters, early majority, late majority and laggards. Theorists since (Abrahamson & Rosenkopf, 1997; Gladwell, 1996; Midgley & Dowling, 1978; Rogers & Kincaid, 1981) have used and modified these basic categories to build upon this early work. What is also important from these studies is the distinctive characteristics of each adopter level. For instance, Ryan and Gross identified that those farmers most likely to adopt (innovator category) were more 'cosmopolite' and belonged to a higher socioeconomic status than members of the other categories (later adopters). While the work of Ryan and Gross began the next wave of diffusion research, the next seminal work in the area would not appear until almost two decades later.

2.2.2 Everett Rogers and Diffusion of Innovations Theory

Everett Rogers (1995) claims that his text, *Diffusion of Innovations*, is a synthesis of over 3800 DIT publications. While much of his theory originates in rural sociology, his established framework has been used in diverse areas such as business and marketing, anthropology, public health, and education. Rogers defines *diffusion of innovation* as "the process by which an innovation is communicated through certain channels over time among members of a social system" (p. 37**)**. Diffusion theory is a communications,

theory-based model. The process to which Rogers refers is mediated through the two-way process of communication convergence (Rogers & Kincaid, 1981), rather than a one-way linear act. Additionally, diffusion is a special type of communication in which the messages pertain to a *new* idea. This is important in that the diffusion process is inherently uncertain due to the *newness* of the idea and as to how the message (diffusion) will be accepted.

Key to Rogers' (1995) definition of diffusion is the presence of four elements in the diffusion of innovation process. These elements include the following:

1. ***The innovation.*** This is an idea, practice or object that is perceived as new by individuals or a group of adopters.
2. ***Communication channels***. The means by which innovations move from individual to individual, or group to group.
3. ***Time***. Time is the interval through which the diffusion events occur. These events include the innovation-decision process, the relative span of time for the individual or group to adopt the innovation, and the innovation's rate of adoption in a system.
4. ***A social system***. This is a set of interrelated units that are engaged in joint problem solving activities to accomplish a goal or goals.

Rogers (1995) identifies important characteristics of innovations as perceived by individuals. These are important because they are constructed as to the way in which potential adopters may (sometimes unconsciously) view the innovation. The characteristics, which forms the basis for what is regarded as perceived attributes theory, include:

1. ***Relative advantage*** is the degree in which an advantage is perceived as better than the idea it supersedes.

2. ***Compatibility*** is the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters.

3. ***Complexity*** is the degree to which an innovation is perceived as difficult to understand and use.

4. ***Trialability*** is the degree to which an innovation may be experimented with on a limited basis.

5. ***Observability*** is the degree to which the results of an innovation are viable to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it.
   (p. 34)

These elements are helpful in better understanding what factors make adoption possible or desirable. Additionally, although Rogers acknowledges the idea of reinventing innovation (e.g., an adopter adapting an innovation to a specific need), these characteristics do not fully account for this process. The idea of reinvention and what I would call 'personalization of innovation,' especially in regards to a teacher's use of technology, is an important feature for consideration. This personalization is something I have witnessed throughout my career as a teacher and a professional development leader.

Rogers (1995) distinctly separates diffusion of innovation from the adoption of an innovation. While diffusion permeates society and groups, adoption is most relevant to the individual. Rogers defines adoption as "the mental process through which an individual passes from first hearing about an innovation to final adoption" (p. 35). The five steps in this process are regarded as (a) knowledge (awareness), (b) persuasion (interest), (c) decision (evaluation), (d) implementation (trial), and (e) confirmation (adoption). Throughout the adoption process, the individual seeks knowledge and skills that will ultimately affect adoption. A potential adopter will proceed through various steps and be led to adoption or, alternately, rejection of the innovation.

Rogers (1995) also offers a scientific approach to understanding the rate of adoption. Rogers has developed five variables that affect the adoption rate of any particular innovation. These include (a) perceived attributes of innovations (discussed earlier), (b) types of innovation decision, (c) communication channels, (d) nature of the social system within which the change may take place, and (e) extent of change agents' promotion efforts. Rogers' model helps us theorize about factors that may affect adoption and the factors that may lead to the rejection of an innovation. However, the simplicity of his explanation that may be its strength, is also a limitation when one wishes to explain more complex human systems, such as power relationships.

Several of Rogers (1995) theories are relevant to this study. Most specifically, key ideas from his theories include:

1) **The importance and nature of the social system in the change process is vital to open source communities**. In fact, innovation in open source communities would not happen without sophisticated, yet often informal communication channels.
2) **Perceived attributes of innovations are important, but not entirely in the way Rogers (1995) intended**. While potential adopters may favor a technology for perceived technical advantages (e.g., ease of use, interoperatability), participants of open source communities may favour socio-economic or philosophical attributes (e.g., is it free?, can it be shared?, can it be freely modified?)
3) **Time and trialability are key factors in the adoption of technologies by users (i.e., educators in this study).** Learning almost any new technology requires time. Trialability in education is often required when educators experiment with new

technologies for educational purposes. (e.g., setting up a blog for course communication).

4) **The role of change agent is important in the spread of open source software and open practice.** While Rogers (1995) depicts change agent as a formalized institutional role, participants of the study share change agent attributes. Participants act as advocates for open source software, practice, and what I later define in Chapter 6 as "open thinking".

2.2.3 Gladwell's Tipping Point

Diffusion Theory has become popular in business and marketing literature. A prominent writer is Malcolm Gladwell. Gladwell (2000) has popularized the phrase 'tipping point,' first in a 1996 *New Yorker* article and, later, in his subsequent book, *The Tipping Point: How Little Things Can Make a Big Difference*. The 'tipping point' is described as the "culmination of a build-up of small changes that effects a big change" (online). Gladwell adopted the term from the study of epidemics where it describes the point when a virus reaches a critical mass.

In *Tipping Point*, Gladwell (2000) focuses on the growth and acceptance cycles of trends and ideas. He develops three general themes which, he posits directly affect the development of trends. The three themes are The Law of the Few, The Stickiness Factor, and the Power of Context. Using these ideas, Gladwell begins to explore the creation, spread, and control of intellectual and sociocultural epidemics.

The Law of the Few describes the formation of self-organizing networks that foster the spread of ideas through the work of key individuals. He identifies various players within such networks and also identifies three important roles: the Connectors,

the Mavens, and the Salesmen. *The Connectors* are defined as those individuals who are typically very social and outgoing, have access to diverse social networks, and possess a significant ability to spread information. Gladwell (2000) uses Paul Revere as an example of a Connector, as Revere's large number of social contacts and his relative position in the social network of colonial America was critical in raising resistance against the British colonizers. *Mavens*, who likewise possess a great number of social contacts, are significant because of their early acceptance of new ideas or trends and their willingness to spread such ideas through working with others. *Salesmen* work within the social network to explain to potential adopters why they must/should participate.

Gladwell's (2000) theories of self-organizing networks has roots in the work of Stanley Milgram. Milgram (1967) was a social psychologist at Harvard who hypothesized that members of any large social network are connected to each other through short chains of intermediate acquaintances. Eventually Milgram developed his hypothesis into what would be known to the scientific community as *the Small World Phenomenon*. Milgram's research is the foundational idea behind the now famous phrase, *six degrees of separation* (Milgram, Sabini, & Silver, 1992). This implies that, in most cases, any one individual is connected to another individual through a chain of acquaintances usually no longer than six links.

The second trend that Gladwell (2000) identifies is known as the *stickiness* factor. Stickiness is essential if an idea is to gain prominence - it must have staying power, must be generally easy to understand and, most importantly, must be packaged in a format that is appealing to the intended recipients. In explaining this premise, Gladwell cites children's television, including the classic Sesame Street and the more recent Blues

Clues. Such shows were designed with (the idea of) stickiness in mind. Research with young viewers identified what children pay attention to when they viewed short skits. Gladwell claims that if you can find that "certain something" that one will pay attention, you may have found that stickiness factor. Of course revealing what people will pay attention to is certainly not as simple as Gladwell attempts to make it seem. Goldhaber (1997), in *The Attention Economy*, proclaims "Attention, at least the kind we care about, is an intrinsically scarce resource (online). He argues that the term *Information Economy* is inaccurate because the Internet economy's greatest commodity is, in fact, *attention*, not information.

Gladwell's (2000) second theme, stickiness, is an approach to the rather complex world of *memetics*, *meme theory*, and *thought contagion* (Lynch, 1996). Richard Dawkins (1976), a zoologist, sought to describe cultural evolution using biological terms through his invention of the word *meme*. The meme[45], the metaphorical equivalent of the gene, is an information particle that replicates itself as individuals exchange information. In fact, a meme can be transferred through individuals in a number of possible of ways: inventions, fashion, recipes, songs, art, literature, etc. Reflecting a social Darwinist twist, Dawkins argues that information which is naturally selected by our brains as most relevant (or, as Gladwell may suggest, most sticky) is replicated and passed along. Other information or behaviours may be lost. Dawkins' ideas are furthered in the work of Susan Blackmore (1999). In *The Meme Machine*, she hypothesizes about cultural replication and ties memes to acts of mimicry and imitation of ideas and behaviours.

[45] The most accepted definition of the meme is "a unit of information residing in the brain" (Milgram et al., 1992)

Gladwell's (2000) third theme is known as *The Power of Context*, and his treatment of the topic is insightful. To illustrate, Gladwell tells the story of the New York subways in the late 1980s. They had become chaotic, crime-infested systems of transportation. George Kelling, a consultant with the New York Transit Authority at the time, set out to change the subway environment. He cleaned the subways and stopped minor crimes that had been previously thought as too insignificant to deal with. The resulting order and subway cleanliness established a new context. The power of context, in this case, helped to establish the *tipping point* which apparently led to a dramatic decrease in crime.

Gladwell's (2000) work is important to this study for several reasons. First, his argument reveals that significant changes rely on a culmination of smaller factors and events that occur over time. These factors and events cannot be easily planned, and therefore, the resulting changes are not easy to predict. In light of the development of open source practice (as evidenced early in Chapter 2) and its spread into the educational context (as presented in Chapters 4-6), it is clear that many, often independent events have contributed to the rise of the open movement. Second, Gladwell recognizes the importance of key individuals in change processes. Certainly, individuals like Richard Stallman and Linus Torvalds have influenced the development of open source software and alternative licensing structures (e.g., The GPL). However, the open movement (as presented through the study data) is a phenomenon where the efforts of individuals are greatly distributed and potentially influential. In other words, while an open movement participant may be influenced by key voices from the field, equal or greater influence may come from other not-as-well-known individuals. Finally, Gladwell's point regarding

the power of context is relevant to this study. While there seems to be trend toward openness in the educational practice of study participants, this trend can be seen (as revealed in the data) as a reaction to an increasingly restrictive socioeconomic environment.

2.2.4 Final Thoughts on Educational Change Theory

Educational change theory, in its most popular variations, focuses on planned change. Change theory is especially helpful in understanding how change and, more specifically, how the adoption of particular innovations can best proceed within educational institutions. In the case of open source, in some contexts, wide-scale implementation is wholly planned. One can look to wide-scale open source (inspired) implementations such as the thin-client installation in the Northwest Catholic School Division[46] or the provision of Star Office in all Ontario K-12 schools[47]. However, in many cases, the use (and acceptance) of open source is not wholly planned but the result of other factors. It is important to look to theories that will account for the more nebulous aspects of change.

2.3 COMMUNITIES OF PRACTICE LITERATURE

While there are many definitions of *Communities of Practice* (CoPs), I find the definition from Hildreth and Kimble (2000) useful as it informs the description of the open community revealed through this study. The authors define CoPs as "a group of professionals informally bound to one another through exposure to a common class of problems, common pursuit of solutions, and thereby themselves embodying a store of

[46] http://www.canopener.ca/article.php?story=156
[47] http://www.itbusiness.ca/index.asp?theaction=61&sid=55732

knowledge" (p. 3). Another useful definition comes from Wenger et al. (2002) who define CoPs as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p. 7). While the use of the term *communities of practice* has become widespread, the term actually stems from classic theories based on the idea of learning as social participation (Wenger, 1998a, 1998b).

In *Communities of Practice: Learning, Meaning, and Identity*, Wenger (1998a) argues that today's educational institutions are largely based on the assumption that "learning is an individual process, that it has a beginning and an end, that it is best separated from the rest of our activities, and that it is the result of teaching" (p. 3). Within the context of social learning theory, the idea of learning in this sense is displaced. Learning becomes, fundamentally, a social phenomenon and is placed in the context of our lived experience and participation in the world. Wenger starts with four main premises:

1. We are social beings. Far from being trivially true, this fact is a central aspect of learning.

2. Knowledge is a matter of competence with respect to valued enterprises – such as singing in tune, discovering scientific facts, fixing machines, writing poetry, being convivial, growing up as a boy or a girl, and so forth.

3. Knowing is a matter of participating in the pursuit of such enterprises, that is, of active engagement in the world.

4. Meaning – our ability to experience the world and our engagement with it as meaningful – is ultimately what learning is to produce. (p. 4)

Here Wenger argues that learning is part of a more encompassing process that places individuals as active participants in the practices of social communities.

Wenger (1998a) also presents components that are necessary to characterize social participation as a process of learning. These include:

1. ***Meaning*** **-** a way of talking about our (changing) ability – individually and collectively – to experience our life and the world as meaningful.

2. ***Practice*** **-** a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action.

3. ***Community*** **-** a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence.

4. ***Identity*** **-** a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities.
(p. 5)

These elements are deeply interconnected and mutually defining. Wenger also provides a visual representation of his model (see Figure 3).

According to Wenger (1998a), a community of practice defines itself along three dimensions. The first is ***mutual engagement***. Practice does not exist in the abstract, therefore CoPs develop around people engaged in certain common actions or ideas. This is important because it means that CoPs can be formed from members of different social categories or from different

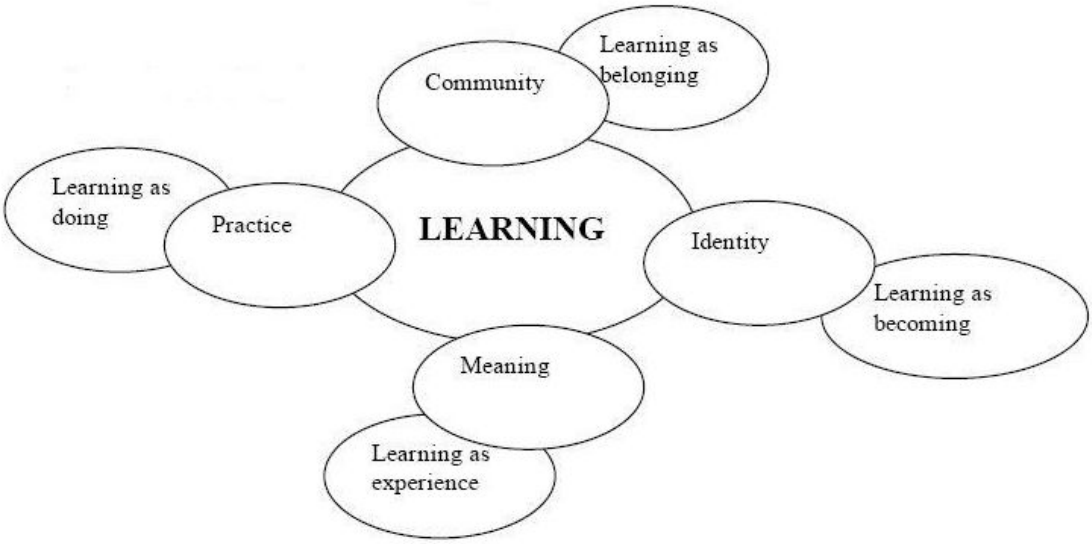

Figure 3. Components of social theory of learning, an initial inventory.

geographic regions. Wenger's second component is ***joint enterprise***. The importance of the joint enterprise is constantly renegotiated by the community members. The concept of joint enterprise goes beyond stated goals (e.g., mission statement, objectives) and creates mutual accountability among participants. The third component is a ***shared repertoire***. "The repertoire of a community of practice includes routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has produced or adopted in the course of existence" (p. 83).

The above ideas are related to the works of Brown and Duguid (1991). In their seminal study, they argue that the creation of knowledge within communities of practice is characterized by three key elements. These include:

- ***narratives*** - used for diagnosing problems and representing repositories of existing knowledge
- ***collaboration*** - fuelled by participants engaged in and sharing common practice

- ***social constructivism*** **-** participants develop a common understanding of their practice and of how to solve problems.

Brown and Duguid base their findings primarily on ethnographic studies undertaken by Orr (1987a, 1987b, 1990a, 1990b). These studies, according to Brown and Duguid, help to illustrate how organizations depend upon complex relationships between groups. Such relationships (as far as organizations are concerned) do not formally exist, but may be most responsible for community performance. Through these informal relationships, knowing is validated and shared and evolves through processes by individuals who engage in the negotiation of meaning and through sharing insights and narratives.

Another important idea related to the notion of communities of practice and social learning theory, is what Lave and Wenger (1991) call *legitimate peripheral participation* (LPP). LPP is a type of situated learning. Learning is seen fundamentally as a social process rather than solely psychological. Lave and Wenger support their theory through stories about different apprenticeships (i.e., Yucatec midwives, Vai and Gola tailors, U.S. Navy quartermasters, meat-cutters, nondrinking alcoholics in Alcoholics Anonymous). In these situations, people initially join communities and learn from the periphery. As they become more competent, they move closer to the centre of that particular community. Thus, learning is not seen as an individual's acquisition of knowledge so much as it is a process of increasing social participation. The nature of the situation - as the social context – has a significant impact on learning and participation in the community.

2.3.1 Cultivating Communities of Practice

The previous section provides definitions for communities of practice. These definitions, indirectly, describe basic characteristics of the communities served by participants of this study. In this context, it is also important to better understand how communities of practice can be developed and sustained. Luckily, much of the latest literature regarding CoPs focuses on nurturing and cultivating such communities. While it may be difficult to understand how organizations can promote something as informal

and voluntary as CoPs, Wenger, McDermott and Snyder (2002) use examples to show how community structure can be encouraged:

> Communities, unlike teams and other structures, need to invite the interaction to make them alive. For example, a park is more appealing to use if its location provides a short cut between destinations. It invites people to sit for lunch or chat if it has benches set slightly off the main path, visible, but just out of earshot, next to something interesting like a flower bed or a patch of sunlight. (p. 7)

While, this may seem simplistic, the example is meant to show how building communities differs from contemporary organizational design traditionally focused on creating structures, systems, and roles toward achieving specific organizational goals.

Wenger et al. (2002) provides seven principles for cultivating communities of practice and for helping these communities gain what they call 'aliveness.' These principles, with paraphrased descriptions, follow.

1. **Design for evolution.** As CoPs are dynamic in nature, design should reflect adaptability (or the computer lingo term, scalability). The key to this point is to combine design elements that help to catalyze community development. "Physical structures – such as roads and parks – can precipitate the development of a town. Similarly, social and organizational structures, such as a community coordinator or problem-solving meetings, can precipitate the evolution of a community."
2. **Open a dialogue between inside and outside perspectives.** Good community design requires the perspective of an insider, familiar with the types of activities within. However, the perspective of an outsider may help members see the possibilities within their own mechanisms or in adopting other tools or procedures.
3. **Invite different levels of participation.** In any community, there exist different levels of participation. While those on the periphery may not participate in the same ways as those in the core, the peripheral members

gain insights and knowledge through their participation. All members, regardless of participation levels, should be valued.

4. **Develop both public and private community spaces.** Members of communities interact with each other in both public and private functions. Thus, the public and private dimensions of a community are interrelated. "The key to designing community spaces is to orchestrate activities in both public and private spaces that use the strength of the individual relationships to enrich events and use events to strengthen individual relationships."
5. **Focus on value.** As communities are voluntary, value is key. Communities must offer something of value as the incentive for participation. Value may not always be explicitly apparent and should grow over time as the community evolves.
6. **Combine familiarity and excitement.** Familiarity, like the comforts of a hometown, is important for a CoP. Excitement is also important, but in other ways. As communities mature, they settle into familiar ways of meeting and conduct. These communities also need challenge and spontaneity to provide a break from everyday occurrences. Otherwise, participation in communities can become mundane and individuals may lose interest.
7. **Creating a rhythm for the community.** As individuals' lives have a rhythm, vibrant communities also have a rhythm. "At the heart of a community is a web of enduring relationships among members, but the tempo of their interactions is greatly influenced by the rhythm of community events." While alive communities have a particular overall

> rhythm or tempo, it is also important to find the 'right rhythm' at each stage of a community's development. Individuals drive community participation and the tempo of a community must be well suited to the real needs of membership.

2.3.2 Communities of Practice in the Online Environment

Much recent literature focuses on the emergence of online communities. In this literature review, I have outlined some of the current thought related to temporal communities. I also examine current thought regarding online community development and communication. As the open source communities I have studied are mixtures of both temporal and online environments, there is much to be gained through interrogations in both of these areas.

I found that much of the recent literature does not specifically target CoPs, but looks at virtual communities (VCs) or virtual learning communities (VLCs), communities that are built upon distributed, digital connections. Regarding the term 'community', Brown (1999) writes:

> Community is quite possibly the most over-used word in the Net industry. True community – the ability to connect with people who have similar interests – may well be the key to the digital world, but the term has been diluted and debased to described even the most tenuous connections, the most minimal activity. (online)

It is important to understand the distinction between *online communication* and *online community*. I believe that Wenger (1998) and Wenger et al. (2002) help researchers make these important distinctions.

Two important ideas closely related to virtual communities include the concepts of *virtual learning communities* (VLCs) and *distributed communities of practice*

(DCoPs). One definition of a VLC is "a group of people who gather in cyberspace with the intention of pursuing learning goals" (Daniel, Schwier, & McCalla, 2003, online). Alternately, a DCoP refers to a group of geographically distributed individuals who are informally bound together by shared expertise and shared interests or work. Table 1 helps to identify characteristics of such communities and to distinguish between the concept of a VLC and a DCoP.

Table 1

Key Features of Learning Communities and Distributed Communities of Practice[48]

Virtual Learning Communities (VLCs)	**Distributed Communities of Practice (DCoP)**
- less stable membership - low degree of individual awareness - more formalized and more focused learning goals - more diverse language - low shared understanding - strong sense of identity - strict distribution of responsibilities - easily disbanded - low level of trust - life span determined by extent in which goals or requirements are satisfied - preplanned enterprise and fixed goals - domain specific/interests	- reasonably stable membership - high degree of individual awareness - informal learning goals - common language - high shared understanding - loose sense of identity - no formal distribution of responsibilities - less easily disbanded - reasonable level of trust - life span determined by the value the community provides to its members - a joint enterprise is understood and continually renegotiated by its members - shared practice/profession

This distinction between VLCs and DCoPs is relevant to this study in that it demonstrates that there can exist a wide-range of social relationships in online communities. Whereas VLCs seem to invoke tenuous connections between participants, DCoPs are characterized by stronger social connections between community members. The strength of ties in open source communities will vary from community to community.

[48]. Daniel et al., 2002.

The characteristics constructed (see Table 1) relate closely to Lave and Wenger's (1991) original framework regarding CoPs, but describe both shared and contrasting characteristics as they would apply in a distributed environment. Key features of DCoPs include shared interests, common identity, shared information and knowledge, voluntary participation, autonomy in setting goals, awareness of social protocols and goals, awareness in membership, and effective means of communication (Daniel et al., 2003). The important activity that supports the entire distributed community is collaboration. Collaboration allows for the active exchange of ideas, and helps to promote interest in being a part of the community.

Amy Jo Kim (2000) is the founder of Naima, a leading developer of social architecture/online environments. she has worked with various large media companies (e.g., Sony, AOL, Yahoo) to design online community interfaces. *Community Building on the Web* (2000) provides a simple, yet comprehensive guide to constructing online communities. Many of the principles included in this literature review, especially those related to the characteristics of CoPs, are reflected here. Kim has adapted these principles to show how they relate to her own practice and experience.

Kim (2000) organizes her thoughts around nine basic design principles that characterize successful, sustainable online communities. Together, these principles are developed as *social scaffolding* and are meant to support and empower members. The principles are summarized as follows.

1. **Define and articulate your PURPOSE.** It's important for members and prospective members to understand why the community is being built and who it's being built for. Be explicit through the design.

2. **Build flexible, extensible gather PLACES.** You should develop a small-scale infrastructure of familiar gathering places. These will coevolve through active membership.
3. **Creating meaningful and evolving member PROFILES.** Profiles are important as they help to invoke communication between members and give the community a sense of history and context.
4. **Design for a range of ROLES.** New members will have different needs than senior members. Strategies around welcoming and empowering new members are important for those in leadership roles.
5. **Develop a strong LEADERSHIP program.** Community leaders are integral to the process as they greet and orient members to the community. It's important that leaders are supported in these vital activities.
6. **Encourage appropriate ETIQUETTE.** While conflict can be invigorating, it can also tear communities apart. Communities need to establish ground rules and conduct for communication processes.
7. **Promote cyclic EVENTS.** Events are important for instilling rhythm to communities, as well as providing venues for socialization. Community leaders can establish events or encourage members to set their own.
8. **Integrate the RITUALS of community life.** Rituals are important in temporal communities and may be as important in online communities. Rituals should be established around important occurrences (new members, exiting members, etc.)

9. **Facilitate member-run SUBGROUPS.** In large-scale communities, subgroups are very important because smaller groups can help to establish member loyalty and distinguish your community from others.

These guidelines complement the previous literature in understanding the distinguishing characteristics of communities of practice and virtual learning communities. Central to these ideas is the premise that participation in online communities can be encouraged, promoted and supported. This central idea is important when contemplating, as I do in this study, how to encourage participation in open source communities.

2.4 SOCIAL CAPITAL THEORY

'It's not *what* you know, it's *who* you know.' While simplistic, this aphorism captures much of the essence of what theorists call social capital theory (SCT). *Social capital* (SC), in the loosest sense, is a term used to describe the social networks that exist between individuals and groups and is often used to measure the character and relative strengths of the ties that exist. While the concept of social capital has existed since the early 1900s (attributed to L. J. Hannifin, 1916), it seems to have gained greater relevance to theorists in the last several decades (Sander & Lowney, 2003; Woolcock & Narayan, 2000). In this study, social capital theory is relevant as it helps to conceptualize the role and importance of social relationships in complex communities.

There are various descriptions of social capital used throughout the literature. Here are a few definitions of SC to consider.

> Those tangible substances [that] count for most in the daily lives of people.[49] (Hannifin, 1916)

[49] At the time, Hannifin was particularly focused upon good will, fellowship, sympathy and social intercourse among those that make up a 'social unit.' (http://www.infed.org/biblio/social_capital.htm).

> The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition. (Bourdieu, 1986)
>
> The sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. (Nahapiet & Ghoshal, 1998)
>
> Refers to the institutions, relationships, and norms that shape the quality and quantity of society's social interactions…. Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together. (The World Bank, 1999)
>
> Whereas physical capital refers to physical objects and human capital refers to the properties of individuals, social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. (Putnam, 2000)
>
> Refers to the norms and networks that enable people to act collectively. (Woolcock & Narayan, 2000)
>
> Consists of the stock of active connections among people: the trust, mutual understanding, and shared values and behaviors that bind the members of human networks and communities and make cooperative action possible. (Cohen & Prusak, 2001)

Nahapiet and Ghaoshal (1998) provide a useful framework for describing social capital. The authors express SC in terms of three primary dimensions. First, they propose that social capital describes the intricate connections between individuals and social groups. Individuals may perceive themselves as part of a network or social structure in which they live, work and learn. In order to perform daily functions, advantages are often gained through the understanding and leveraging of relationships. This is what is known as the *structural dimension*. Second, trust and reciprocity are important binding ties and may allow individuals to work more openly with each other. Thus, the corollary, individuals who work in trusting relationships are likely to work more effectively. Nahapiet and Ghaoshal identify this as the *relational dimension*. Third, members of the

network may have common interests or shared understandings related to their organizational structure (formal or informal). And central to this *cognitive dimension*, members of the community partake in knowledge building and sharing. With this framework, each dimension is interdependent on the others, and the strength of one dimension may positively affect another.

Social capital has been studied from many perspectives and disciplines. Social capital research has been particularly intense in the areas of management and organizational behaviour, economic development, and in the study of civic engagement. Studies from these areas provide an excellent basis for social capital theory, but I am particularly interested in social capital as it exists in distributed communities of practice, such as an open source community. For this, a definition of social capital as it relates to virtual learning communities is helpful. *Social capital* in VLCs is defined "as a common social resource that facilitates information exchange, knowledge sharing, and knowledge construction through continuous interaction, built on trust and maintained through shared understanding" (Daniel et al., 2003). This definition conveys the three relational dimensions outlined by Nahapiet and Ghaoshal (1998) and focuses on individual/organizational learning through knowledge activities. Although offered as a description of social capital in VLCs, in my opinion, this definition works well to describe social capital as it exists in open source communities. Open source communities are only as strong as the social ties within them. Studying these social ties may help in better understanding and describing these communities.

2.4.1 Types of Social Capital

As with physical capital, social capital is not a monolithic entity, and it encompasses a broad range of items that may be described as types of SC. Sander and Lowney (2003) developed four categories in which social capital can be divided, including:

1. **Public-regarding versus private regarding.** Community members may form around various issues – some public (e.g., Parent Teacher Association) and some quite personal (e.g., postnatal support groups). Sander and Lowney hypothesize that the latter may attract more community members (but smaller groups), yet the former may be more action-oriented toward solving particular community issues.
2. **Formal versus informal.** Communities are formed for various reasons, by various forces. However, some of the most intricate communities may be those that began as formal communities and slowly evolved into an informal entity. While formal ties may better ensure longevity of a community, informal ties may help to deepen relational bonds.
3. **Bridging versus bonding.** Bridging types of social capital may focus on tying individuals across barriers of race, class, or ethnicity. Bonding types may focus on strengthening existing social relationships. While these acts may occur simultaneously, Sander and Lowney believe that bonding communities *may* be easier to build, but bridging communities are important in building a sense of unity across diversity.
4. **Strong ties versus weak ties.** Strong ties enable the discussion and production of different types of knowledge than those developed by weaker ties. For instance,

> Sander and Lowney hypothesize that members of a community may be enabled to discuss serious, and sometimes personal, issues (e.g., serious health problems, marital problems) with those whom they have strong ties, while the discussion of less serious topics (e.g., a 1-day park cleanup) are a limitation of weaker ties. The strength of community ties will have an effect on what a community can do collectively (Wuthnow, 1998).

While it is not made explicit how each type of social capital will affect a community in every case, it is important to note the types of capital to which attention is paid. This is especially important if one is using the idea of social capital to measure community ties or if one is attempting to build communities. In the study, social capital theory helps to examine the shared values, beliefs and behaviours that bind members of open source communities.

2.5 VISUALIZING MY FRAMEWORK

Before presenting a theoretical framework informed by the previous literature review, I would like to first re-present some of the key ideas from this chapter. Key words have been bolded to assist in the development of my visual model.

> **Communities of Practice**
> A group of professionals **informally bound** to one another through exposure to a common class of **problems**, common pursuits of **solutions**, and thereby themselves embodying store of **knowledge**. (Hildreth & Kimble, 2000, p. 3)

> **Groups of people** who share a concern, set of problems, or a **passion** about a topic, and who deepen their knowledge and expertise in the area by **interacting** on an ongoing basis. (McDermott & Snyder, 2002, p. 7)

Social Capital
A common social resource that facilitates **information exchange**, **knowledge sharing**, and knowledge construction through continuous interaction, built on trust and maintained through shared **understanding** (Daniel et al., 2003, online)

Consists of the stock of active **connections** among people: the trust, mutual understanding, and shared **values** and **behaviours** that bind the members of **human** networks and communities and make **cooperative action** possible. (Cohen & Prusak, 2001, p. 4)

To understand the adoption of technological innovation in open source communities, planned or institutional adoption techniques are only one of many forces influencing potential adopters. From my current knowledge, educators who are pioneers in the open source movement have not been solely inspired by institutional initiatives. Rather, their involvement in overlapping open source communities have inspired such activities and have given them opportunities to learn difficult technical skills, as well as to forge strong beliefs regarding the meaning of open source in the educational context.

Figure 4 represents a rudimentary illustration of the initial theoretical framework for this study. Communities of practice and attributes of social capital are closely related. In fact, the following attributes of social capital can be seen as characteristics of effective communities of practice. Additionally, I conclude that some elements of rich, active communities (which I have labelled *nebulous*) cannot be easily described through change related theories such as diffusion of innovation theory. However, such theories do serve a purpose and are beneficial in partially understanding particular aspects of open source communities.

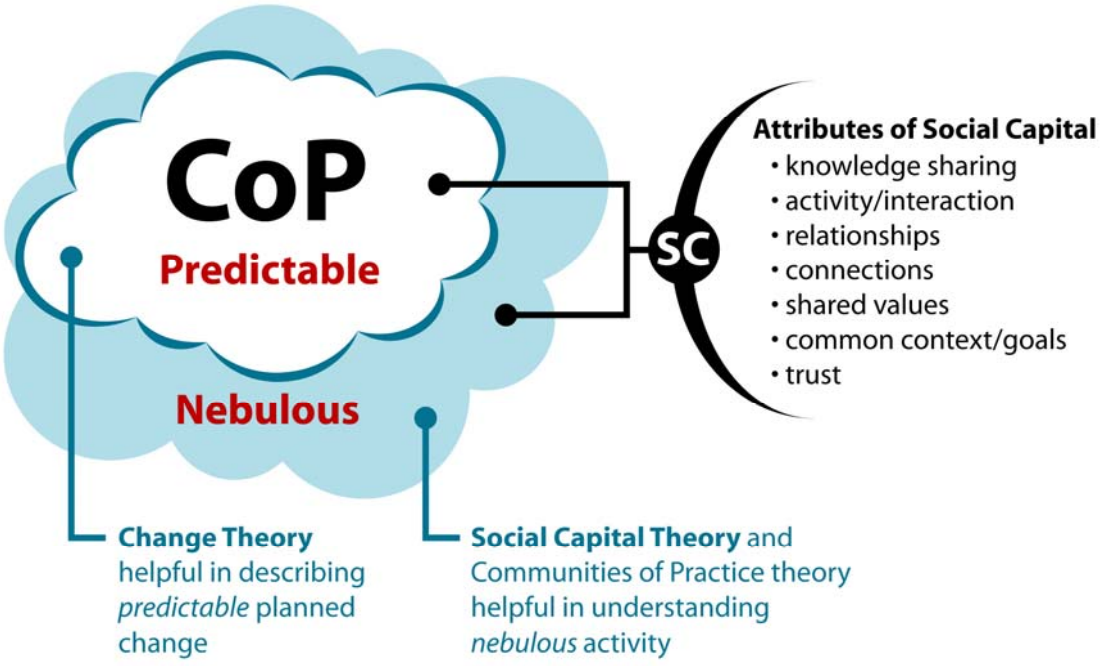

Figure 4. Communities of practice in relation to social capital.

Open source communities represent a culmination of social interactions, human relationships, knowledge-building activities, shared values and beliefs. Such online communities are as complex, if not more, as any temporal community of study. Such communities are not usually a result of geographic proximity or simple, shared economies. What we can observe and study of temporal communities (e.g., buildings, parks, schools, community centres) is not immediately apparent in complex, online communities. It may not be as easy "to see" online communities as they exist without better understanding the literature described in this chapter; that which gives insight into change, complex social relationships, communities of practice and social capital.

As previously mentioned, the above thoughts are meant only as a guiding framework for the study. In keeping with the spirit of grounded theory, emerging theories

continually support the research. The literature reviewed and the understandings developed from this chapter have informed the research process and provided a basis for data analysis. However, throughout the ongoing analysis, other literature and relevant theories were brought into the text; theories which could not have been anticipated through an initial literature review.

CHAPTER 3: THE RESEARCH PROCESS

3.0 INTRODUCTION

This chapter outlines the research methods and underlying methodological orientation (i.e., grounded theory) used for this study. Within the outline is a description of the various communication and research tools that I have used throughout the data collection and analysis.

3.1 METHODOLOGY

Grounded (GT) theory was the primary methodology used in this study. The basic tenet of this approach is that theory will emerge from the data or, as the name applies, theory is grounded in the data (Glaser & Strauss, 1967). Thus, GT is an inductive rather than a deductive approach. Due to the inductive nature of this research, emphasis is placed on reducing the effect and influence of preconceived hypotheses or notions in the context of the research. The following sections outline my use of grounded theory.

There are several important methodological rules and assumptions of the grounded theory approach. These include the following, as adapted from Glaser and Strass (1967) and Charmaz (1990):

- An exhaustive literature review is not done to reduce researcher bias and to allow theory to emerge from the data.
- Literature is reviewed continuously throughout data collection and analysis.
- Participants include those who are experiencing the social process being investigated.
- When describing the findings, descriptive language must be used to provide the reader with the steps of the process and the logic of the method.

- Data are compared continuously with other data (constant comparison method) to detect emerging categories and themes to direct the data-collection process.

In assuming these guidelines, I have broken down the process of 'doing' grounded theory research into three analytic phases[50]. These phases include (a) research design, (b) data collection and analysis, and (c) literature comparison. Within each phase, a series of plausible steps are included. To better understand the applicability of grounded theory to this study, I have constructed the following outline regarding research into aspects of the open movement.

As GT is both systematic *and* emergent, these steps are not to be interpreted as strictly sequential. The linear focus, however, does help to build a framework for my understanding of GT in practice and to frame how GT is used *practically* in this study. Additionally, what is not made explicit within these steps is the actual writing process. As GT uses a constant comparison process (emerging data and literature), writing is an important process throughout data collection and analysis. The writing process allows the researcher to create, compare, synthesize and recreate theories relevant to the emerging data.

3.1.1 Phase 1: Research Design

The research design phase consists of three distinct steps: review of the technical literature, definition of the research questions, and sampling. Each of these three steps is outlined as follows.

[50] These analytic phases are derived from the works of Glaser and Strauss (1967) and Strauss and Corbin (1997).

Review of technical literature

The open source movement is complex and bridges several disciplines (e.g., philosophy, economics, sociology, social computing, network theories). While GT literature advises against an exhaustive approach to literature review (Glaser, 1992; Glaser & Strauss, 1967; Strauss & Corbin, 1997), in researching a complex area of educational computing (and certainly in the case of other complex multidisciplinary topics), a strong understanding of the basic *technical* literature is important, especially in the discovery of relevant categories[51], relationships between categories, and the formulation of research questions. More specifically, Dey (1999) advises that reviewing technical literature (within the grounded theory process) can be helpful in several ways:

- for the development of knowledge of philosophical writings and existing theories
- as a useful bridge to secondary sources of data
- to stimulate research questions
- to foster the direction of theoretical sampling
- as a supplementary validation (an activity to occur after theory has been generated from GT analysis). (pp. 51-52)

In response to this perceived need for a technical literature review, Chapter 2 features seminal information regarding the principles of open source and various theories (e.g., change theory, communities of practice literature, emergence theory) that help to inform the research. Additionally, other technical literature is entwined throughout later chapters, especially in Chapters 4 through 6 that focus on data analysis.

Definition of research questions

As it is important in GT for theory to emerge from the data, the design of the research questions is an important consideration. Generally, research questions must be open and nonspecific rather than formed by a specific hypothesis. GT is not based on

[51] A category is considered to stand by itself as a "conceptual element of a theory" (Glaser & Strauss, 1967).

hypothesis testing. Questions formulated through GT methods must enable theory generation and not be restricted by assumptions within the questions themselves. For instance, one particular question for this study reads, "Are there common values and beliefs held by members of open source communities, and if so, what are they?" rather than, "What common values and beliefs do members of open source communities share?" The second question assumes that *there are,* in fact, shared beliefs to be found. While this is a simplistic example, it was important to develop questions that reflected a basic understanding of the context of study, but would not make assumptions that could hinder the emergence of theory from that data due to possible preconceived beliefs of the researcher. It is also important to note that new questions can arise through the process of grounded theory. As theories emerge from the data analysis, initial questions may no longer be appropriate or relevant in the direction of the study. Therefore, it is common for initial questions to be replaced by questions more relevant to the context.

Sampling

Sampling is described as the process of selecting a number of informants/participants from a defined study population. The most common types of sampling in GT are *purposeful* (purposive, selective) *sampling* and *theoretical sampling*. While in the literature, these terms are often used interchangeably (i.e., selective sampling is the same as purposeful sampling), some theorists make an important distinction. "Selective sampling may be seen to mean purposeful sampling …. Theoretical sampling may be seen as a variation of purposeful sampling, but purposeful sampling is not all necessarily theoretical sampling" (Coyne, 1997).

Sampling, as I use it in this study, has two distinct phases. I have used purposeful sampling to initially target specific members of the open source community. In understanding the goal of selective or purposeful sampling, I looked to Patton (1990, 2002).

> The logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research. (online)

As the sample began to inform the development of propositions and theory, further sampling became responsive. Theoretical sampling became important as new insights and questions arose from the data analysis.

> Theoretical sampling involves purposeful selection of samples to inform the emerging theory in the study. (Coyne, 1997)

> Conceptual elaborations . . . become the hypotheses which guide the researcher back to locations and comparative groups in the field to discover more ideas and connections from the data. (Glaser, 1978)

Theoretical sampling helped to better focus the efforts of the data collection on theoretically useful cases where the researcher could test and/or extend theory.

As a result, participant selection (sampling) was done in the following manner. As sampling and data collection were done concurrently, you will notice that data-collection procedures (discussed in the next section) overlap in the description that follows.

Stage 1 – Reconnaissance

Initial participants selected were those perceived to be involved in various activities related to the open movement in my province of residence (Saskatchewan). In the early stages of the research, these participants were able to inform the direction of the study through informal discussions (e.g., telephone, email, chat). In simple terms, ideas

were 'put out there' as to what the study might look like, what the orientation and focus might be, what questions could be asked, and, finally, to identify key participants for the research.

Stage 2 – Initial survey

From the informal data collected through Stage 1, several exploratory questions were developed and an online survey tool was developed.[52] The survey was announced via word-of-mouth with my initial core group of informants. Additionally, the study and web survey were advertised on several important open source listservs, including schoolforge and schooldiscuss.

Stage 3 – Interviews

Participants from all over the world expressed their views through the online web survey. Once the data from this diverse group of individuals were read and analyzed, additional computer-mediated interviews (via Skype[53]) were conducted with 14 of these participants. Interview participants were chosen in regards to their knowledge and activities related to the open movement and their (perceived) potential for informing the research.

Stage 4 – Informal feedback

As data were collected and analyzed, informal conversations took place between me and the participants to better clarify and further analyze the research findings. These conversations were mediated through email, chat clients or audio-conferencing (e.g., Skype).

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[52] http://cat.uregina.ca/opensource

[53] Skype (www.skype.net) is a service which supports audio conferencing or VOIP telephony.

3.1.2 Phase 2: Data Collection and Analysis

Develop varied data-collection sources

In regards to data collection, grounded theory studies share some characteristics with other qualitative approaches to research. In general, sources of data are typically the same and can include interviews, field observations and documents of all kinds (diaries, letters, autobiographies, biographies, historical accounts, newspapers, and other media materials) (Denzin & Lincoln, 1998). In the case of a study related to the open source movement, data sources include mostly electronic media.

While single sources of data are possibly appropriate with some methodologies, the GT approach advocates the use of multiple data sources that converge on the same phenomenon. Glaser and Strauss (1967) define these as "slices of data" and write,

> No one kind of data on a category, nor technique for data collection is necessarily appropriate. Different kinds of data give the analyst different views or vantage points from which to understand a category and to develop its properties; these different views we have called *slices of data*. While the [researcher] may use one technique of data collection primarily, theoretical sampling for saturation[54] of a category allows a multifaceted investigation, in which there are no limits to the techniques of data collection, the way they are used, or the types of data acquired. (p. 65)

Glaser and Strauss are referring to the concept of data triangulation. While there are various types of triangulation[55], *data triangulation* means that the data are collected at multiple times and/or from multiple sources to overcome problems of construct validity[56] and bias.

Data collection

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[54] *Saturation*, also known as theoretical saturation, is the point where existing and new data no longer bring about new theory or speculation, but continue to confirm theories already derived from data.
[55] Some other common types of triangulation include *investigator triangulation*, *methodological triangulation* and *interdisciplinary triangulation*.
[56] *Construct validity* refers the degree to which the testing/measurement tool used in a study accurately reflects the conceptual question of interest.

Constant comparison is central to the GT process. Therefore the process of data collection involves constant analysis of data as it is collected. In a grounded theory study, data collection and analysis work through the following, usually overlapping, phases.

Data collection. As stated earlier, data-collection sources vary. However, as the participants in this study were exceptionally adept with electronic media, four particular data sources were prominently used for this study. These include:

1. Data publicly available through listservs/majordomos, discussion forums, participant weblogs and wikis;
2. Data collected from a specialized online survey available at http://cat.uregina.ca/opensource;
3. Recorded audio interviews facilitated over Skype (VoIP);
4. Email transcripts collected between the researcher and the participants over the duration of the study.

Note-taking. In GT, note taking is an important consideration in data collection. In qualitative research, there are various approaches to the process of note-taking (Dick, 2002; Glaser & Strauss, 1967). In the case of this study, note-taking was most important during the audiotaped Skype interviews. As each interview took place, notes were taken to capture key themes and ideas from each participant. In addition to these notes, full transcripts were derived from each interview recording. Through a combination of the note-taking and the transcriptions, preliminary themes began to emerge from the data. These themes were assigned codes for further analysis.

Coding. There are three specific types of coding methods described in typical ground theory literature. These distinct but similar methods of coding include open coding, axial coding, and selective coding. *Open coding* involves the process of developing categories, concepts, or themes that emerge from the data. It is 'open' in the sense that the researcher engages in exploration of the data without consciously making prior assumptions about what might be discovered.[57] *Axial coding* is a coding method that serves to facilitate the building of connections within categories and subcategories. Thus, this coding technique "serves to deepen the theoretical framework underpinning your analysis" (Kerlin, 2002). In *selective coding*, the researcher uses the categories identified through axial coding to develop a story line. In this phase, conditional propositions (or hypotheses) are typically presented (Creswell, 1998). All three types of codes were derived and used for this study. More information on the actual process of coding can be found in the discussion regarding the use of Atlas.ti.

Memoing. An important activity in GT methodology is the writing of memos (memoing). Memos occur as a parallel process to data collection, note-taking, and coding. In effect, a memo is a note to oneself related to a possible hypothesis or relationship between derived categories. Glaser (1978) developed a set of "theoretical memoing rules" (pp. 89-91) that are useful in understanding the practical definition and boundaries of a memo. Additionally, Corbin and Strauss (1990) emphasize the importance and place of memoing, as stated in the following passage.

> Writing theoretical memos is an integral part of doing grounded theory. Since the analyst cannot readily keep track of all the categories, properties, hypotheses, and generative questions that evolve from the analytical process, there must be a system for doing so. The use of memos constitutes such a system. Memos are not

[57] Although the tabula rasa approach is an important principle of GT, it is one met with critique.

> simply “ideas”. They are involved in the formulation and revision of theory during the research process. (p. 10)

The data-analysis process, especially coding and memoing, was assisted through the use of specialized computing software known as Atlas.ti.

Using qualitative data-analysis software

There are several qualitative data analysis software packages available today (e.g., Atlas.ti, Nud*ist, Nvivo, etc). For this study, I have used Atlas.ti for three very practical reasons. First, the design of Atlas.ti is based on grounded theory. The software is specifically helpful in the coding and memoing process and, ultimately, in helping to draw relationships between categories and the developing theory. Second, Atlas.ti has a strong user community.[58] The community has helped to shape the functionality of Atlas.ti over several versions and is supportive of users of the software. And third, and perhaps most important, I have had access to local users of Atlas.ti who were willing to help me through the process of data analysis. It is important to note that Atlas.ti is not free or open source. While I attempted to use as many FLOSS tools as possible within the research, I was unable to find a free alternative that would assist in the data-analysis process.

In the past, the most common tools used in the analysis of grounded theory data included piles of divided blank paper, 5” x 7” memo cards, scissors, and possibly a photocopier. Qualitative analysis software programs have emerged to simplify and quicken the mechanical aspects of data analysis. For some researchers, the greatest advantage of these programs is time - more time to concentrate on the more creative aspects of theory building. Tesch (1991) writes,

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[58] You can enter and join the Atlas.ti user community here - http://www.atlasti.com/maillist.shtml

> The thinking, judging, deciding, interpreting, etc., are still done by the researcher. The computer does not make conceptual decisions, such as which words or themes are important to focus on, or which analytical step to take next. These analytical tasks are still left entirely to the researcher. (pp. 25-26)

There are two principal levels (modes) available when working through Atlas.ti - the textual level and the conceptual level. On the textual level, the researcher focuses on breaking down or segmenting the primary documents (i.e., data files) and as well, on the writing of memos. In essence, the different types of GT coding (i.e., open, axial, selective) are directed by the types of memoing that are done in Atlas.ti. For instance, *code memos* relate to open coding and focus on conceptual labelling. Additionally, *theoretical memos* in Atlas.ti relate to axial and selective coding. Then, in Atlas.ti's conceptual level, the researcher is able to visually connect selected portions of the "data, memos and codes into diagrams which graphically outline complex relations" (Atlas.ti, 1997). The conceptual level allows the researcher to examine and explore relationships among the data that may not have been as obvious as in the textual view.

I could go on with a description of the step-by-step process of using Atlas.ti., however, that information is likely more appropriate in a technical manual. My purpose in this short explanation is to show how qualitative analysis software packages are appropriate in grounded theory and valuable to the researcher and the research. Further information regarding Atlas.ti can be found at (http://www.atlasti.com).

3.1.3 Phase 3: Literature Comparison

Comparison with extant and emerging[59] literature

In using a software package such as Atlas.ti, the goal of the data analysis (in a grounded theory study) is to reach a point of "theoretical saturation." Theoretical saturation "refers to the (non)emergence of new properties, categories, or relationships. Once the data no longer offer any new distinctions of conceptual import, categories can be described as 'saturated' and no further evidence need to be collected" (Dey, 1999, p. 8). In GT, at this point, the results of the emerging theory are often presented in the form of a narrative (Glaser & Strauss, 1967). To strengthen both the level of analysis and the theoretical findings, it is wise to continue the constant comparative process and, once again, explore and examine the derived theories with relevant literature. Eisenhardt (1989) writes, "Overall, tying the emergent theory to existing literature enhances the internal validity, generalisability, and theoretical level of the theory building from case study research … because the findings often rest on a very limited number of cases" (p. 545).

When I first started contemplating this research into the open source movement, the literature of the movement was very much in its beginning stages. While much was written about the open source movement as a general philosophy (Raymond, 1997; Stallman, 2000), little was written on how we could learn about the open source movement as a framework for collaborative practice in fields outside of computing science (e.g., programming). Throughout the processes of data collection and analysis, I continued to read and was advised by emergent literature as it related to the findings of

[59] I use the term *emerging* in a fairly specific sense. Much of the literature found regarding open source is either unpublished (in the traditional sense), or is constantly being modified (through collaborative licenses such as found through the Creative Commons).

the study. This became a critical element as I compared research data with current thoughts in the field.

Producing a final[60] narrative

The concluding phase of a grounded theory study may not look significantly different from the final chapter of a study done using ethnography, action research, or other qualitative methodologies. What may be distinct is that the researcher remains focused on the development of theory throughout all phases of the study. While theory can be expressed in various ways (e.g., organizational charts, conceptual diagrams, flow charts, etc.), many GT researchers find the use of a narrative helpful in summarizing and describing theoretical propositions.

Grounded theory has been described as a 'mixed marriage' and a reconciliation of naturalistic inquiry with "the rigorous canons of variable analysis" (Dey, 1999, p. 45). Glaser and Strauss (1967) envisioned GT in this way to provide a "confidence in the data" (p. 68) on which to base theory. While much of the described processes in the previous section (note-taking, coding, memoing, etc.) seem quite prescriptive, there is little in the originating literature to describe the specific actualization of processes (e.g., memoing) and, therefore, the method remains open to sufficient interpretation.

A straight-forward, prescriptive outline for the findings section of a GT study is described by Creswell (1998):

> The findings section presents the theoretical scheme. The writer includes references from the literature to show outside support for the theoretical models. Also, segments of actual data in the form of vignettes and quotes

[60] *Finality* is a concept that can suggest a rigid epistemological approach to a narrative being 'the truth' or 'the final word'. From my stance, I refer to the term *final* to suggest that this work, as in the case of academic 'for-credit' work, must face the reality of having a final condition in to which it is assessed.

> provide useful explanatory material. This material helps the reader form a judgement about how well the theory is grounded in the data. (p. 179)

This format is common and, for most readers, what Creswell describes is not specific to grounded theory studies only. However, although generic, this format does suit grounded theory research well, especially in its positioning of the data and literature (as data) throughout the body of the narrative.

3.2 SO WHAT DID I REALLY DO?

This chapter has outlined the grounded theory methodology, and I have followed this theoretical presentation quite carefully in this study. However, I feel it is important to describe simply how I used this methodology so that researchers can get a practical sense of how research the research was conducted. The following steps present a simplified description of the research methodology used throughout this chapter.

1. **Reviewed the technical literature.** Although I was a participant in open source activities, I didn't know much about its history. I read widely. The literature review, unfortunately, does not begin to express the wealth of computing, change, knowledge management, education and philosophical literature I surveyed. I realized very early in the study that the open source movement is not merely a technical phenomenon but, in fact, has affected many other areas of study, in particular, change/management theory, social network theory and philosophy (Barbabasi, 2003; Sunstein 2003; Surowiecki, 2004). I brought in what I believed was most relevant to the study, filled in the gaps of the literature and used the subsequent chapters to build a new theoretical framework around the open source movement.

2. **Defined guiding research questions.** I formed research questions as I learned from the literature reviewed, from the educational context, and from my own participation in open communities. These initial questions were meant to guide the research and were not outcomes in themselves. I worked to word such questions to be free of bias, assumption or value. I became aware that this intended objectivity was difficult, if not impossible.
3. **Sampling/Participant selection.** As mentioned earlier, I had originally intended to bring together a small group of local (Saskatchewan) participants. I contacted a few that I knew had been active in open communities and I was referred to others of whom they knew. However, most of these potential participants did not reside in Saskatchewan. My sampling method, therefore, best resembles snowball sampling, where "researchers identify a small number of individuals who have the characteristics in which they are interested. These people are then used as informants to identify, or put the researchers in touch with, others who qualify for inclusion" (Cohen, Manion, & Morrison, 2000, p. 104). As I built my participant pool, I soon realized that my arbitrary geographic restriction was irrelevant when conducting a research study on such distributed communities.
4. **Reconnaissance.** In the early stages, before 'real' data collection, I spoke informally to many of the potential participants regarding their activities, thoughts about open (source) software/content/publishing, and about what they were doing in their classrooms and schools. These conversations took place over the phone, via email, blog entries, and listservs. These conversations continued to inform my

research questions and research strategies and helped to acquaint me with the larger open community and its members.

5. **Initial survey.** An online survey was developed and distributed to potential participants via direct email, telephone calls, or through placing information about the study on publicly accessible listservs. The survey is available at this web address: http://prometheus.cc.uregina.ca:7090/opensource/. There were 44 responses to the survey, but because some responses were repetitive or poorly written, a few were excluded from the data collection and analysis. The survey questions are also provided in Appendix A.
6. **Initial data analysis.** All survey data were entered into Atlas.ti, a qualitative data-analysis program, and the responses were scanned and categorized into emerging themes. From this initial data analysis, I was able to discover (a) participants who were interested in being interviewed and (b) target questions for the interviews.
7. **Interviews.** Over the course of several months, I contacted interested participants for Skype (VoIP) mediated interviews. All interviews were conducted via Skype except the final interview with Peter Rock-Lacroix, which was conducted in a face-to-face meeting.
8. **Continued data analysis.** Data were immediately transcribed and entered into Atlas.ti. As I analyzed the data, I began to categorize and build connections between the survey data, the interview data, and the emergent literature. The themes that emerged helped to inform the structure of Chapters 4 through 6. Chapter 7 is built upon these emerging themes.

9. **Participant clarification.** As I analyzed the data and formed theory, it was necessary to periodically gain clarification on points from the participants. I contacted participants regarding any such ambiguities or clarifications via email, and these email responses also became part of the data collected.
10. **Committee/Advisor feedback.** Dr. Cyril Kesten, my Ph.D. supervisor, proofed and reviewed early revisions of this dissertation. As the development of this dissertation progressed, my advisory committee offered feedback, suggested revisions and supported the research process.

3.3 CONCLUSION

The importance of a sound methodological framework should not be undervalued in any research study, especially one of this complexity. A solid understanding of grounded theory and a plan for its implementation proved important in developing the theories highlighted in Chapter 7. In light of this understanding, I see the benefits of careful planning as the perceptions of the participants resonate clearly in the following three chapters. This careful, guided and analytical approach allowed me to describe the rich experiences and beliefs of this unique group of participants and theorize the significance of the open source movement in education.

CHAPTER 4: CONTEXT AND ACTIVITIES

4.0 THE PARTICIPANTS

While I had originally prepared to conduct this study with a group of Saskatchewan educators, I had some difficulty in finding a significant number of in-province educators who could inform the study. I began with the local educators I knew who were early adopters of FLOSS, and I followed their recommendations and found other participants, often in more distant locations. This process of discovering interested informants was similar to what Cohen et al. (2000) describe as *snowball sampling*.[61] Not surprisingly, the participants who emerged were perceivably like-minded, engaged in similar practice, and tended to share similar values toward open technologies and open forms of communication. What I gained from this apparent detour was an informed, diverse, distributed, yet connected group that represented varied forms of practice but similar sets of values. This group of participants will be referred to as 'the core participants' throughout the remainder of this dissertation.

What follows are brief descriptions of some of the core participants, as written by the participants themselves. The list includes participants who were involved in interviews and who waived their right to anonymity. Anonymity did not seem a concern for several of these participants as many are already strong and visible advocates for open source software and open practice in their local contexts. Greater visibility of their practice, beliefs and ideas is perceived to be advantageous to the greater educational community. The list does not include study participants who chose to remain anonymous, or the survey participants.

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[61] "In snowball sampling, researchers identify a small number of individuals who have the characteristics in which they are interested. These people are then used as informants to identify, or put the researchers in touch with, others who qualify for inclusion." (Cohen et al., 2000, p. 104).

Jean-Claude Bradley is the E-Learning Coordinator for the College of Arts and Sciences at Drexel University (Philadelphia, Pennsylvania). His interests lie in the adoption of high-leverage technological tools to augment the educational experience for both faculty and students. Since 2003, Jean-Claude has been screencasting his organic chemistry lectures. In February 2005 he piloted a podcasting program that was adopted in the 2005 spring term for four classes at Drexel. With the conviction that open source content in education is here to stay, all of his course materials are made available on blogs, with links to archived recordings. In June 2005, he initiated the open source EduFrag project to incorporate classroom content into First Person Shooter games such as Unreal Tournament. Jean-Claude joined the faculty in the chemistry department at Drexel in 1996 and teaches organic chemistry, currently with a fully online option.

Miguel Corsi is currently a teacher at CEM 70 (Centro de Educación Media) in Villa Regina, Provincia de RíoNegro, Argentina. Miguel has been teaching English as a Second Language for 11 years and then, after finishing his formal studies in computers, has taught in that area for the past 8 years. He participated in a pioneer experience in Rio Negro, actually the first of its type in public schools in Argentina: the so called *Aulas remotas* (remote classroom) implemented by the provincial government (2000-2002) to capacitate and train staff in several areas (education, law, health, and marketing). The project used a mixture of a closed system of Satellite TV and an Intranet. That was judged to be the best solution to convey knowledge and get feedback in real time in such huge area (less than one inhabitant/square kilometer) - a 203.013 square kilometer region. Nowadays, Miguel is working in schools but, having capitalized his previous years as an English teacher and blending the best of both worlds (ESL & computers), he is translating, on a regular basis, a well-known blog on new technologies: (http://www.masternewmedia.org/es).

Born in Montreal, Quebec, **Stephen Downes** lived and worked across Canada before joining the National Research Council as a senior researcher in November 2001. Currently based in Moncton, New Brunswick, at the Institute for Information Technology's e-Learning Research Group, Stephen has become a leading voice in the areas of learning objects and metadata, as well as in the emerging fields of weblogs in education and content syndication. Stephen is perhaps best known for his daily research newsletter, *OLDaily* (short for *Online Learning Daily*), which reaches thousands of readers across Canada and around the world. His work also includes the development of educational content syndication systems such as Edu_RSS and DLORN, along the design of a digital-rights management system for learning resources.

Currently, **Marilyn Hagle** is teaching music at Joe Wilson Intermediate School in Cedar Hill, Texas, after spending a year at home with small children. She started using computer technology in the classroom in 1982. Coming up through the ranks of Apple IIs, Windows 3.1, Macs, and iMacs, Marilyn finally discovered

Linux in 1998. First, she installed RedHat 5 on two old computers to provide web, email, and file servers for her Mac lab. Several years later, she was teaching music again and used thin-client technology to convert discarded computers into working systems. When the opportunity came to teach high school computer animation, Marilyn chose the Gimp and Blender 3D on a Mandrake desktop for student stations. Students excelled, especially since they could download these Open Source Software packages onto their home computers. Ms. Hagle has a BA in music, a MA in Media Communications, and Texas certifications in all-level music and technology.

Alan Levine is the Director of Member & Technology Resources for the New Media Consortium. Before this, he spent 14 years evangelizing technology for the Maricopa Community Colleges, where he hosted a web server back in 1993. Alan was a key contributor to significant efforts such as Ocotillo, a faculty-led initiative that promotes innovation and drives change, created the Maricopa Learning eXchange (MLX), a virtual warehouse of innovation that pioneered the use of RSS in syndicating learning object content, and developed Feed2JS, and open source software shared for allowing people to easily incorporate RSS content into web pages. Alan works from home in Phoenix Arizona, and continues to publish his work on CogDogBlog.

Tom Radcliff teaches high school physical sciences at Logansport High School in Logansport, Louisiana, U.S. He is a graduate student in educational technology at Northwestern State University in Natchitoches, Louisiana, participating in their online master's program. Tom has been teaching for 10 years and has been involved directly with technology in the classroom for 6 years. He is a strong advocate of Linux and the Open Source movement and is currently building a classroom computer lab using old recycled computers, Red Hat 7.2, and Puppy Linux.

Les Richardson is a high school science and computer teacher who has been writing school administration software as a vehicle for experimentation in computer science. His areas of interest include computer languages, databases and markup languages such as TeX, LaTeX, and XML, as well as CSS. He has been writing an open source school administration program called Open Administration for Schools since 2001. It was initially for school divisions in Saskatchewan, but is now used in many other locations.

Peter Rock-Lacroix is currently a teacher at the American School of Yaounde in Yaounde, Cameroon. Peter has been involved with technology in classrooms since he was in Grade 5 – when he brought his soldered, assembled, and fully functioning (admittedly with help from his father) Apple II computer to school for show-and-tell, over 20 years ago. As a teacher, Peter has taught technology to elementary students and adults for the past 8 years in Egypt, Canada, Lebanon, and Cameroon. Peter has been active with advocation of FLOSS technologies in

education for the past 3 years, offering lectures and organizing discussions with fellow colleagues.

Rob Wall is currently a teacher at North Battleford Comprehensive High School in North Battleford, Saskatchewan, as well as a student in the masters program in Educational Communication and Technology at the University of Saskatchewan. He has also worked for the Battlefords School Division No. 118 as Computer Coordinator. Rob has been involved with technology in classrooms for approximately 14 years, and he is an active blogger, podcaster, and advocate of open source software and open content.

In the reporting of data, core participants who waived their right to anonymity will be cited by name. Core participants who chose anonymity will be identified by number (i.e., core participant #1, core participant #2). Survey participants will also be identified by number (i.e., survey participant #1, survey participant #2). Numbers used as identifiers will be consistently to identify that individual. In other words, "core participant #1" is the same individual identified throughout the study.

4.1 OPEN ACTIVITIES OR "WHAT'S GOING ON"?

The following section describes many of the relevant activities undertaken by the core participants of this study as projected through the interviews and the survey data. To give greater detail and breadth to the various activities occurring in education related to the open movement, I have supplemented these descriptions with data from other data sources (e.g., educator weblogs, listservs, majordomos) and open source case-study reports. The purpose of this section is to project the variety of activities occurring and to give the reader a better understanding of both their complexity and educational relevance. To clarify, this section is used to provide context. The activities are relevant to the research questions, but slightly peripheral to the main thrusts of this study as stated

through the research questions in Chapter 1. Thus, the activities described here were given minimal analysis.

For the purpose of organization, the following section has been divided into four discrete units, with each unit forming an inventory of one particular type of activity. These units include (a) Free/Libre Open Source Software (FLOSS), (b) open content, (c) open publishing, and (d) advocacy. In practice, these activities were not nearly so separate. For instance, one may use open source software for the purpose of facilitating open content or open publishing activities. While this overlap may become a limitation, the simplicity this separation brings to the discussion outweighs any alternate reorganization I could surmise.

4.1.1 Free/Libre Open Source Software

The incredible variety and choice of Free/Libre Open Source Software (FLOSS) were apparent very early in the data-collection process. A simple search of SourceForge[62], a website specializing in facilitating open source code development, lists over 104,000 current software projects. Additionally, Stallman's Free Software Foundation's Software Directory[63] listed over 4200 free software packages. While greater choice can be perceived as a positive attribute, at least one critic believes that the amount of choice is a detriment to the adoption of FLOSS. Andreiana (2003) writes, "The plethora of Free Software applications available today, none working perfectly, is a problem which stands in the way of major adoption of Linux on the desktop. In order to conquer the desktop, we have to stand united." (Online)

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[62] http://www.sourceforge.net
[63] http://directory.fsf.org

While the abundance of FLOSS cannot be denied, all study participants have either tested or adopted software that has brought perceived benefit to their teaching or publication activities. To make the choices around FLOSS adoption easier for analysis, I have divided educational FLOSS into the following categories: desktop operating systems, productivity tools, and managed learning environments. In constructing these categories, I have purposefully ignored publication/communication tools because the discussion of such tools fits more appropriately in the section regarding open publishing found later in this chapter. This section includes discussion of the use of software in each of these three categories.

Desktop operating systems

To a technical purist, the term *Linux* does not describe a popular open source operating system. *Linux* describes only the kernel. The more accurate term for this complete operating system is *GNU/Linux* as this term describes the kernel and its corresponding components. In this study, I recognize the difference, but will use the term Linux to describe the GNU/Linux operating system.

There are many Linux distributions, less formally known as Linux *distros*. Some popular distributions of Linux include RedHat, SUSE, Mandrake, Debian, and Gentoo. As of April 2005, there were currently thought to be "over three hundred Linux distributions in active development".[64] The variety of distributions is well represented in the activities of the study participants[65].

> *I started with Mandrake, but with this particular chassis, Pentium II's, for some reason they came up with a black screen after installing. So I had to go into*

[64] Wikipedia – http://en.wikipedia.org/wiki/Linux_distribution

[65] Participant quotes are presented in italicized text.

> *'drake config and manually set the resolution and the default screen, which I found a bit tedious*. (Core Participant #1, Interview, June 22, 2005)
>
> *I tried Mandrake for a while, but I really didn't like it. I went back to Fedora, and I've tried the various Knoppix distros*. (Radcliff, Interview, May 31, 2005)
>
> *I've been using LTSP (Linux Terminal Server Project) with Gentoo. It took a while to get everything configured, but I was lucky enough to get support from our city's LUG (Linux User Group). Now it's all we run, it's not great with big media or bandwidth, but the kid's really enjoy the change, and it's been no problem for them to adjust*. (Survey Participant #1, April 12, 2005)

Noticeable through these passages is a certain degree of experimentation that seems to be common. Participants describe tweaking each distribution of Linux to overcome minor hardware or client-preference barriers. This extra effort needed to install and configure an operating system, or to experiment with various distributions, would not be as common to those using a preinstalled proprietary operating system (e.g., Windows, OS X). Additionally, the latter passages in this section begin to demonstrate a recurring theme. Participants often rely on the help of outside advocacy groups and/or individual expertise. Informal networks of communication and support are an attribute of the open movement mentioned by all study participants.

In some reported cases, the installation of Linux on school operating systems is still in the experimental stage. Linux is being used as an alternative operating system that coexists along with Windows and OS X-based machines.

> *In our school division we are experimenting with Linux as an operating system in some locations as an alternative to the more usual OS's found in schools, which have been primarily Mac and PC, although we also have a couple of Solaris thin client installations as well.* (Core Participant #3, Interview, June 2, 2005)

Alternately, there are cases where participants are using Live Linux CDs, such as Knoppix or Puppy Linux, that allow Linux to be run from a CD or DVD without having to install an existing operating system on the system.

> *I don't have the time, and the technicians don't have the time or every time a computer goes down to do a new installation. So this is why I am considering using distributions like Knoppix.* (Rock Le Croix, Interview, June 30, 2005)

> *If you haven't looked at the Puppy-Mozilla distribution Live CD as a possibility for education, it is truly great. I am running it on the old machines we were talking about and it runs like lightning. It is easy to set up and work with, auto-DHCP for networks and all.* (Radcliff, Email, August 24, 2005)

In these last two passages, Live CDs[66] were used to solve problems in the users' computing environments; the lack of time and support available for system upgrades, and the poor performance of older PC's with existing operating systems. Through the examples above, it is clear that Linux as a desktop variant is becoming a feasible alternative to Windows or Mac OS for the participants of the study.

The following passage clearly demonstrates how important Linux installations in schools are perceived to be and, additionally, how a volunteering Linux community can provide great benefit to a wide-scale implementation of FLOSS in a school environment. The following is an open letter to the K12LTSP[67] community from a parent who assisted in setting up K12LTSP systems in his daughter's elementary school.

> Dear K12LTSP enthusiasts,
>
> After much consternation, including demands early on to remove Linux from our elementary school, I'm happy to report that our school district technology leadership has not only approved our efforts of deploying K12LTSP in our

[66] Operating systems that run from a CD or DVD, rather than having to be installed on a computer hard drive. Such CDs often make it easier for individuals to trial software rather than attempting a typical hard drive install.
[67] The Linux Terminal Server Project focused on K to 12 schools.

> elementary school, but actually said they'd like to do a formal evaluation of the technology and it's implications for the broader system. This is nothing short of a seachange in their attitude towards Linux.
>
> My thanks, on behalf of my daughter's elementary school, go out to the K12LTSP community, without whose resources we could never have made such a monumental change in the computers at our school. For those who have volunteered their time and effort in making K12LTSP successful, I can think of no greater reward than what has happened at our school: the computers all work now; teachers that didn't want any new computers are now asking for one for every student; teachers are finally using computers to enhance the curriculum; and so on. Bravo K12LTSP community!
>
> Best regards,
> Daniel (School-Discuss Listserv, January 19, 2006)

It is important to note in this letter that at least two traditional power relationships are being challenged. The more obvious challenge is demonstrated in the replacement of proprietary systems by open source alternatives. Secondly, decisions around technology implementation into a school culture are clearly upset. In this case, parents and members of the Linux community have not only implemented computer systems in a school, but also have provoked school officials to reassess broad computing policies.

Productivity tools

One of the more popular FLOSS tools available worldwide, and one known to all the study participants, is OpenOffice.org (formerly known as Open Office). OpenOffice.org is a full-featured, open and free alternative to the proprietary Microsoft Office suite. Participants use OpenOffice.org to create documents in several formats that can also be read in Microsoft Office, and vice versa. As OpenOffice.org is available for Windows, participants reflected on its use in the classroom and as a mainstream, open source application.

> *So we used Open Office, especially Presenter (a component of the OpenOffice.org suite), and made slide shows, and then we exported to HTML and the students*

> *instantly had pretty cool web pages. And then we would post them to our classroom web server so that they could see each other's work.* (Hagle, Interview, June 13, 2005)

> *The future, when I am thinking about the next two or three years of open source in education, it could be a partial victory in the sense that that most of the computers will running some open source, something like Open Office would likely be dominant.* (Corsi, Interview, June 1, 2005)

While OpenOffice.org is very similar in functionality to Microsoft Office, some participants described experiences where users expressed frustration with unfamiliar tools. In this case, one participant recalls working with a classroom teacher who had recently begun using OpenOffice.org Presenter.

> *She said she was having a lot of trouble using Open Office, and that "PowerPoint" was really different on it, and she went on and on about how much difficulty she had. So I thought this was interesting because she was only about 25. And I thought, "What about transferable skills?". I know the buttons are in a slightly different place, but even elementary students don't have any problem switching from OpenOffice to PowerPoint.* (Core Participant #1, Interview, April 12, 2005)

Participants described several experiences similar to this where teachers who had used specific tools over a number of years expressed difficulty in switching to a different application. This phenomenon is not specific to incidents where users switch from proprietary tools to open sources tools, but is common in situations where users move from a familiar application to one that is unfamiliar. Tapscott (1998) and Prensky (2001) provide research to support this perception that younger users are more likely to adapt to and learn newer technologies than adults.

A tool that far exceeds the popularity of OpenOffice.org, or likely any other open source desktop tool, is the web browser, Firefox. By August 2005, SpreadFireFox.com (Firefox advocate organization) proclaimed that Firefox had been downloaded over 80 million times and had reached a significant market share (almost 12% in North

American, over 14% in Europe) competing with major rival, Microsoft Internet Explorer, and other lesser known browsers (e.g., Opera, Camino). Several participants view the increasing popularity of Firefox as a positive event that has helped to increase the awareness of open source tools, combat the perceived dominance of proprietary vendors, and increase the quality and flexibility of the web browser.

> *I think for the first time in a long time, there's a sense that the dominance can be shaken up a little bit, the Firefox inroad to Explorer, for instance. I think Belgium and Brazil are going open source as public policy, and Microsoft being forced to sell software to Vietnam or Thailand for a dollar to keep their market share*. (Core Participant #1, Interview, June 22, 2005)

> *The Firefox advertisement in the NY Times was a great help to let people know about Firefox and the donations from users helped get the ad there. This is just more evidence of how the community effort is both unveiling and tearing down proprietary dominance*. (Survey Participant #2, January 12, 2005)

> *Well the best example of that (the network effect) is Firefox – I mean, you remember the early days of the browser wars and the Internet (Netscape vs. Microsoft). Then Microsoft basically froze the browser. It stayed that way undeveloped for five years or so…. Then along comes Firefox. We have the extensions, we have the developer plugins, we've got the extension that allows you to redraw the webpage that you're using, Greasemonkey. I could go on, right?* (Downes, Interview, April 27, 2005)

The previously mentioned productivity tools, OpenOffice.org and Firefox, are just two of the many FLOSS packages used by participants. Three other notable productivity type software packages that have been adopted to varying degrees by the study participants are:

- **Kword.** KWord is a word-processing and desktop publishing application. As the application is frame-based, it is especially suited for placing text or imagery in precise locations.
- **LaTeX.** LaTeX is a high-quality typesetting system that was designed for the production of technical and scientific documentation. The use of LaTeX is

common in academia, especially by those involved in the natural sciences and mathematics.

- **Cmap Tools.** Cmap Tools is an open source knowledge modeling kit most commonly used to support concept maps and knowledge webs. The tool can be used by individual users or driven by its server version to facilitate the building of complex group maps via web collaboration.

Managed learning environments

The term *Managed Learning Environment* (MLE) describes software that has been designed to assist instructors in managing and developing course content and in supporting learner interaction in educational environments. *MLE* is an umbrella term which, for the purpose of this study, replaces similar terms such as *Course Management Systems* (CMS), *Virtual Learning Environments* (VLE), *Learning Management Systems* (LMS) or *Learning/Learner Support Systems* (LSS). In practice, the most common MLE software used by educational institutions include WebCT and Blackboard, both of which are proprietary packages. However, as evident in this study, open source MLEs are beginning to gain acceptance in practice and are being adopted by many educators and institutions.

Moodle (Modular Object-Oriented Dynamic Learning Environment) is likely the most popular MLE currently available. Several participants in the study have begun to use Moodle for assistance in developing learning environments.

> *I rely on Moodle to host the classes that I teach. I also rely on many server based open source programs like MySQL, PhP, Drupal, and others at my school. Doing all I do with these programs alone would cost thousands if I went with a traditional software avenue, let alone not be as flexible.* (Survey Participant #3, February 21, 2005)

As Moodle is server-based software, those who implement this MLE may have to acquire skills with other server-based software such as MySQL and PhP. Drupal, to be discussed later, is a content management system (CMS) that is used to support various types of communities, including those based in education.

> *I am beginning to use Moodle for putting up some of my course content online. I've found with Computer Science and Computer Networking classes, especially for the Grade 12s, they work at radically difference paces, and instead of doing a lock-step whole classroom instructional model, I put the course outline … they go and they do it, and I am there to work with them when they need my time*. (Wall, Interview, February 23, 2005)

It is evident in the second case, that the participant views his use of Moodle as a mechanism for altering pedagogy (in this instance), in moving from a teacher-centred model toward practice that is much more student directed and independent.

Drupal, considered more a content management system (CMS) than an MLE, was also used in courses by several respondents. *Drupal* is described as a content management/discussion engine, but has also developed features that allow for individual and group blogging. Advantages cited for Drupal adoption include ease of use, a supportive developer community, and technical suitability.

> *I've been using Drupal in all of my senior science courses. It was pretty easy to pick up, even for a newbie (new user), and if I ever had a problem, I just hit the Drupal forums, and help was nearly instantaneous*. (Survey Participant #4, April 7, 2005)

> *We looked around at various solutions but were drawn to Drupal because it was able to do everything we wanted it to do for our classes, was robust, flexible and really expandable. Plus, the students picked it up in a jiffy. It's great for the end user*. (Survey Participant #5, February 14, 2005)

It also becomes clear, through such statements, that many participants involved in open activities spend considerable time researching possible technical possibilities and troubleshooting chosen tools.

In some cases, open source, content-management tools are being used to augment and support communication by individuals throughout school environments. Participant Rob Wall has written several detailed blog posts describing how the school where he works, North Battleford Comprehensive High School, is using Wordpress (an open source CMS) to streamline the school announcements system. In the following passage, Wall describes the initial dilemma.

> *Every teacher in every classroom of our school has a computer terminal on his or her desk. It is entirely possible, from a technical standpoint, for each staff member to enter their own events/announcements onto some sort of content management system …. It is also possible, right now, for every staff member to go online to read the announcements to their class. Instead, however, we waste vast quantities of paper for ROTA (read-once-throw-away) announcements*. (Wall, Blogpost, online)

In considering the advantages of electronic communication in schools and in understanding the potential functionality of specific open source software, Wall was able to develop an efficient electronic publishing system for the school using Wordpress and other complementary open source software.

4.1.2 Open Content

Open content is a term coined analogously to open source. In practice, open content suggests creative work offered in various digital formats (e.g., text, imagery, audio, video, etc.) that is made available in a manner that explicitly allows copying and reuse. Likely the two most popular examples of formalized open content practice include MIT's OpenCourseWare initiative and the Creative Commons. The OpenCourseWare initiative is a concentrated effort by the Massachusetts Institute of Technology to offer the content of all MIT courses to the public for viewing or adaptation. The Creative

Commons is a nonprofit organization that was founded under the assumption that authors of content may not want to exercise all of the rights that copyright law affords them. In other words, rather than adhering strictly to the "all rights reserved" default, the Creative Commons enables authors to choose a more community-oriented licensing structure.

There are also dozens of institutional learning object repositories that share open content. *Learning objects* can be defined as reusable units of instruction (e.g., lessons, units, multimedia objects) that are used in various modes of instruction. Learning object repositories are online, searchable databases that assist in the collection, preservation, and distribution of learning objects. Such repositories are implemented with varying degrees of access to content including open, limited, and closed.

Throughout the data-collection processes of this study, several institutional learning object repositories were mentioned as being important for accessing and sharing open resources. These repositories are listed and briefly described as follows.

1. **CAREO (Campus of Alberta Repository of Educational Objects):** CAREO[68] is a project supported by Alberta Learning and CANARIE (Canada's advanced Internet development organization) that aims to develop a searchable, web-based collection of multidisciplinary teaching resources for educators. CAREO most closely serves the University of Calgary, the University of Alberta, and Athabasca University and, thus, is more specific to postsecondary materials.
2. **LearnAlberta.ca.** LearnAlberta.ca[69] is an institutional learning object repository designed more specifically for K-12 institutions and, therefore, is unique in this list. This site provides resources listed by grade, subject area, or through keyword

[68] http://www.careo.org/
[69] http://www.learnalberta.ca/

search. Additionally, some resources are provided to the public for free, while others are available through paid subscription only.

3. **MERLOT (Multimedia Educational Resource for Learning and Online Teaching).** MERLOT[70] is an open resource designed for both faculty and students of higher education institutions. MERLOT was first developed by the California State University system, but has grown into an international referatory.[71] Access to and membership with MERLOT is free. Materials span many subject areas and include lessons, units, digital collections, simulations, tutorials, case studies, and animations. The MERLOT site includes a peer-review mechanism to help maintain the quality of submitted resources.

4. **Maricopa Learning Exchange (MLX).** The Maricopa Learning Exchange[72] is an institutional repository supported by the Maricopa Community College system of Arizona, one of the largest higher education systems in the world. MLX enables the exchange of learning materials amongst Maricopa employees and adjunct faculty. MLX has also integrated Creative Commons licensing to help protect the rights of original authors while promoting community collaboration of materials.

The description of these institutional repositories helps to portray an educational environment that tends toward formalized approaches to sharing content amongst institutions, teaching staff, and students. All the interviewed participants of this study

[70] http://www.merlot.org/

[71] A referatory is similar to a Learning Object Repository or Institutional Repository in that links are provided to learning objects. However, in the referatory model, the learning objects are stored in sites external to the referatory. Consequently, the referatory acts as a search rather than storage mechanism.

[72] http://www.mcli.dist.maricopa.edu/mlx/

were aware of these large institutional initiatives toward content sharing. However, actual use of and familiarity with formalized repositories greatly varied.

Participant Alan Levine was the key developer for the Maricopa Learning Exchange. It can be argued that the development and implementation of MLX is spawned from an open philosophy toward sharing of educational content. Here, Levine describes this philosophy in practice.

> *I both deploy and create open source software. My philosophy since being on the web since 1993 has been to publicly share everything we have created in my office, freely, and without strings attached, including online resources, tutorials and bits of multimedia code. To be a player in the game, I feel an obligation and desire to both get and give back.* (Levine, Interview, April 3, 2005)

Other participants demonstrated early aspirations and practice regarding the use of institutional repositories and their underlying premise of using a web-based mechanism to share open content. Core Participant #3 remarks:

> *At our last department meeting, I suggested that we develop our own learning object repository using P2P file-sharing, likely something like BitTorrent. This was well received and I will go ahead and begin to plan for it. I believe that certain types of grassroots movements, such as peer-to-peer sharing, have great potential in the educational field, and this is a value that is largely unrecognized.* (Core Participant #3, Interview, June 2, 2005)

While Core Participant #3's initiative was to be based around the sharing of open content by teachers, Rob Wall alludes to the importance that K-12 students also understand the concept of ownership and intellectual property in relation to their own creative works. Speaking of using the Creative Commons for the sharing of content, Wall states:

> *I also show students the process as well. For instance, informing students in a music class who have written their own music … I think that they should know that there are a range of options other than full commercial copyright kind of licenses. We have students who create a lot of intellectual property in our schools, and how should they deal with that after they leave high school? And how do they control its use after they leave high school? These are all important issues. And in regards to computer science, I have begun to talk to them about "who owns the code they*

> *have written?," and how they can put their "stamp" on it if they want credit for it, if that's all they want, if they want to put a stricter license on it, if users should pay them to use it, etc. That's their choice as the creator of that property*. (Wall, Interview, Feb 23, 2005)

A theme that begins to emerge here is that open content, in itself, is not the only benefit to open publishing. The idea of choice, a clearer comprehension of intellectual property law and alternatives to the "all rights reserved" dogma must be better understood by creators, whether teachers or students. Institutional repositories do not demand content; rather, they provide an opportunity for content collaboration and dissemination under less stringent conditions than exist under existing copyright law.

4.1.3 Open Publishing

Merriam-Webster, an American publishing company, chose *blog* as the word of the year in 2004. The term was the most referenced item on the *Merriam-Webster Online Dictionary* for this period (*BBC News*, online). A year later, the *New Oxford American Dictionary* proclaimed *podcast* to be the word of the year for 2005 (*Yahoo! News*, online). Together, and with the addition of *wiki*, these terms represent an increasing social trend toward open, personalized, and collaboratively developed digital publication.

Before blogging entered the mainstream, many educators became active bloggers. An *edublogger* is the loose term for an author who blogs most specifically about educational issues and actively engages in digital conversations with other edubloggers through social software tools. Participant Stephen Downes, likely one of the first edubloggers, has maintained a web presence since 1995 and authors *OLDaily* (*Online Learning Daily*), a popular electronic newsletter initiated in 2001. *OLDaily* provides

> Daily news related to online learning. Covers new tech such as wireless access and tablet computers, e-learning standards such as SCORM or IMS, learning

> management systems, instructional design, assessment and evaluation, and issues such as copyright and open access. (online)

A key feature of the *OLDaily* website is the inclusion of EduRSS, a service developed by Downes that aggregates several hundred educational blogs (edublogs) into one source feed. Therefore, if a reader is interested in subscribing to all of these edublogs, the service allows for easy access to this open wealth of materials. Then, when any of the authors write to one of the included blogs, readers are notified of a new post as they are notified when a new electronic mail message is received via email client software.

While Downes is an early champion of the edublog, the writing and reading of blogs, as well as commenting to others' blog posts, are activities familiar to all the study participants. Several participants are early adopters of blogging and convey the importance of blogging as an open publishing activity, as a source of knowledge, and as a way of establishing and maintaining personal and professional connections.

> *I have been blogging for about 2 $^{1/2}$ years. I think blogging is an important part of the open exchange of ideas and open content. I keep up with about 20 different blogs on a daily basis, and write about once every 2 weeks (I would be writing more if I had more time). I will continue to blog and probably* increase my blog output next year when I resume work on my masters degree. (Wall, Survey, November 17, 2004)

> *I know what I know via weblogs and open source related websites. I monitor via RSS feeds. I often see what other colleagues in my field have to say about new projects, etc., so I depend a lot on a network of trust-ed (sic) peers*. (Levine, Survey, April 3, 2005)

> *I have my own blog in which I explore personal and professional concepts and interact with the blogging community by commenting on other people's postings and musings. I have an RSS feed for sharing my bookmarks in Furl and del.icio.us as well as my Flickr photos. As I mentioned earlier, I am looking into publishing my work under a Creative Commons license. I belong to some virtual communities of practice and of course, I belong to the greater Internet community*. (Core Participant #3, Survey, November 11, 2004)

> *I use my blog to begin flushing out ideas about what I would like to write about and how I would like it to look, and get some feedback from people who are reading it to say, "This is really a good idea," or "This is really stupid." I'm using this not so much as a draft, but for idea development.* (Core Participant #2, Interview, April 27, 2005)

In addition to blogs being used for personal and professional use, several participants have begun to experiment with blogs through their teaching activities. In some cases, participants have used related open publishing activities (e.g., wikis, podcasts) in conjunction with blogging.

> *I currently screencast and podcast my chemistry lectures and assist faculty in our college to do the same. Much of the class content is made open in blog format under a Creative Commons license. We have been doing this for about 6 months and plan on continuing*. (Bradley, Survey, April 3, 2005)

> *I was involved with a grassroots project last year and, there were a few different classes involved. So one of the things we were looking for was the perspective of a farmer in terms of what agriculture was all about, and we couldn't find anything online like that. So I had my students go out and I had them interview a farmer to find out about farming and get their view on what was happening to farming and agriculture. And then I had them log into Moveable Type (a blogging tool), and have them share their content that way.* (Wall, Interview, February 23, 2005)

In the latter example, it is relevant to note that Wall's teaching practice as described here shifts from a consumption model to a production model, depending on the scarcity or abundance of information resources. In both cases, student content was made available freely to a wider Internet audience.

As is evident in the quotations above, participants are able to publish much more than simply their personal thoughts. They are also able to publish important aspects of their own research and interests in indirect ways. For instance, the del.icio.us[73] service mentioned above is a popular social bookmarking service that allows users to publish their personal web bookmarks and to view what websites are being bookmarked by

[73] http://del.icio.us

others. Then, if a del.icio.us user finds that another del.icio.us user has similar interests and tends to bookmarks similar websites, one can subscribe (via RSS) to another's del.icio.us feed. This, then, alerts the subscribed user to any subsequent bookmarking.

This social sharing feature is an important and enabling characteristic in many new social software services. Other popular services, described by the study participants, include the following.

Flickr. Flickr[74] is photo-sharing software that allows the organization and sharing of photo objects. Flickr users can share their digital photographs and, as well, subscribe to and comment on others. Flickr also allows for easy blog integration and therefore works well with other digital publication methods.

LibraryThing. LibraryThing[75] is similar to del.icio.us, but rather than sharing web bookmark lists, LibraryThing allows for the sharing of personal book collections. The service allows for the sharing of book catalogues and encourages the sharing of books. More importantly, the software connects people with similar literary interests.

Writely. Writely[76] is similar to a wiki, but is much more user-friendly. Writely, known as "the web word processor," allows users to collaborate easily on shared, written documents. Additionally, Writely allows users to easily place permissions and restrictions on who has access to certain documents, and who does not.

While increasing in popularity, many of these services remain relatively obscure. However, it is interesting to note that large corporations have recently purchased several of these services. Both del.icio.us and Flickr have been acquired by Yahoo! and Writely has been purchased by Google. LibraryThing, for the time being, remains independent.

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[74] http://www.flickr.com
[75] http://www.librarything.com/
[76] http://www.writely.com/

As I alluded to in the beginning of this section, open publishing technologies, such as blogging, are beginning to reach a critical mass. While Gutenberg's printing press sparked the first information revolution and helped make information available to people across class systems (Drucker, 1995), these same liberating technologies were also subject to increasing commercialization, ownership, and commodification (Noble, 1998). As blogging and other democratizing publishing technologies advance into the mainstream, they will be subject to similar commercial forces.

4.1.4 Advocacy

One of the most interesting developments of this study was observing the tremendous amount of advocacy demonstrated by participants pertaining to aspects of the open movement. All study participants who used open source tools, developed open content, and/or practiced open publishing described their beliefs regarding active promotion of these open tools. Several representative descriptions follow.

> *One of the technologies I am cultivating and encouraging in our schools is the use of weblogs. This has a huge potential in education for both teaching and learning as do other related technologies such as RSS, podcasting, Flickr (photo-sharing application), wikis, social bookmarking, instant messaging, and of course, video-conferencing. I feel these and many other digital technologies have such great potential for enhancing critical thinking and knowledge building.* (Core Participant #3, Survey, November 11, 2004)

> *I have advocated for and supported the use of open operating systems (specifically Linux) for most uses with a school context. I have this for about 6 years. As long as I am involved with computer use in schools, I will continue to take this stand.* (Wall, Survey, November 17, 2004)

> *I am working with a teacher consultant in a building Linux terminal servers, advocating the use of open source in the classroom to save money and to show that OSS at times is more stable and runs better. I will continue to use Linux as long as I can and hope to show that there is another choice than Microsoft*. (Survey Participant #2, January 12, 2005)

> *My participation in the OS movement has been more toward advocacy and use rather than development. I have been using it for about 5 years. I will always use open source software. I will also continue to advocate its use. I wrote a short primer on its use in education and plan on keeping that up and spreading the word*. (Survey Participant #13, February 23, 2005)
> *I have declared myself a missionary for open source in my modest Christian private school*. (Core Participant #1, Survey, March 28, 2005)

> *My major activity in the field is advocacy, especially in regarding open content in learning. Additionally, all work that I produce – articles, essays, photos, software – is released under an open source license. Additionally, I contribute to large community-based open source projects, such as the recently launched OurMedia*. (Downes, Survey, March 29, 2005)

> *My key activities at this point, are primarily of advocate. I have distributed many OpenOffice discs, as well as various distros for the students, and started a small LUG (Linux User Group) at our school. I began this about 6 months ago and will likely continue indefinitely*. (Survey Participant #1, April 12, 2005)

As is evident in the previous descriptions, open movement activism occurs through various contexts including administrative staff meetings, professional development sessions, classrooms, and in public fora. Some participants said that where their skills and knowledge lacked in the area, they compensated through social activism in their local contexts.

It is also interesting to note that many of the participants self-identify themselves through the advocacy role, one going so far as to claim to be "a missionary for open source." Reasons for activism among participants vary, and some participant perceptions include perceived cost-savings, better software, flexibility and adaptability of open tools, the enhancement of pedagogy, and the development of a better, more knowledgeable society. One participant goes so far as to write:

> *This may sound cheesy, but I want to make the world a better place. I recognize/believe that the Free/Open movement is an intelligent and progressive way of dealing with information in a digital world. Basically, I continue to learn because as a teacher, it is partly my duty to make sure I engage students in an approach that challenges the status quo through*

> *values that I believe are in line with holistic education. I think that I would mentally burn-out if all I did was teach students how to use MS Windows and MS Office in order to prepare them for the "real world."* (Rock Le Croix, Interview, June 30, 2005)

In this case, and as is apparent in previous quotes from the section, perceptions of the open movement are often tied closely to the personal value and belief systems of the participants. It also seems that several participants take the role of activist where the promotion of open tools and content is a mechanism to forward social or political change.

The term *advocacy* is often used synonymously with activism or dissent, although it can assume a number of political and social orientations. As advocacy often assumes a position that rejects the status quo, literature discussing the nature of dissent may help to inform points in this study, more specifically in describing reasons as to why participants tend to reject the current proprietary position of software and content and bid for a more social, open and free educational context. In *Why Societies Need Dissent*, Sunstein (2003) argues that "widespread conformity deprives the public of information that it needs to have. Conformists follow others and silence themselves, without disclosing knowledge from which others would benefit" (p. 6). From this point of view, advocacy and dissent have vital roles in providing alternatives to the current state of education.

4.2 SUMMARY

In this chapter, I have attempted to provide a context for the study. I have introduced the participants and have listed and described many of their activities related to Free/Libre Open Source Software, open content, open publishing, and advocacy. These descriptions are very limited compared to the entirety of what I refer to as *the open movement*. The scale of the study limited the number of participants involved in the

research. Participant activities were represented through a scattering of events, none meant to represent comprehensively the breadth of individual participation. Rather, what I sketch here are the ambiguous boundaries of the open movement as drawn by the participants themselves. This chapter was also meant to introduce the reader to technical language, to help describe the complexity of collaboration in such communities, and to give insight as to how participation in the open movement can provoke emotional and impassioned responses.

CHAPTER 5: BENEFITS OF AND BARRIERS TO OPENNESS

5.0 INTRODUCTION

In Section 1.2, I set forth the guiding questions for this study. Observing these key questions throughout the data-collection process, I was able to discover perceptions and beliefs shared by participants related to the benefits of the open movement, and barriers to open practice that seem to be becoming more widespread in educational environments. This chapter describes these benefits and barriers as perceived by the study participants and as organized through my analytical lens. These findings reflect aspects of the open movement including open source software, open content, and open publishing.

5.1 BENEFITS

In this study, several benefits of the open movement were identified through data collection and reinforced through the literature. The main categories in this section include access, adaptability/transparency, economics, institutional change, pedagogy/critical pedagogy, power of networks, and values/free culture. Each of these categories is perceived either to be a benefit of or to be benefited by the open movement.

5.1.1 Access

Many of the study participants expressed the belief that participating in open practice and adopting open principles could provide greater access to software, content, and other digital resources. In some cases, the current inability to access educational materials as needed is due to the expense of such content.

> *People around the world are denied the possibility of an education due to the high cost of materials. Open content addresses this directly.* (Survey Participant #6, March 29, 2005)

As mentioned earlier in this dissertation, several open content projects are currently offering once inaccessible materials to a wide audience. Notable projects include MIT's OpenCourseWare project, Wikipedia, and the many learning object repositories mentioned in Section 4.1.2. Also of importance is the eGranary Digital Library[77] project which provides educational teaching materials to African scholars through the provision and installation of data-rich servers in localized contexts. This project may prove to be beneficial in instances where there is little or poor Internet access and a lack of print materials.

Open access to educational materials in some contexts may also be improving due to the declining price of hardware. MIT has spawned the nonprofit organization, One Laptop per Child (OLPC)[78]. OLPC has been researching and developing a sub-$100 (USD) laptop computer which may be ideal for educational organizations in developing nations. The laptop is projected to feature an open source operating system (Redhat Linux), various open source applications, and open content. Additionally, the unit's power source will be recharged via a built-in, hand-crank generator (online, http://laptop.org). While the laptop is not yet in production, the idea foreshadows the type of access that may be generated through the hypothetical convergence of open software, open content, and low-cost, portable hardware.

Several participants also viewed the concept of open access as removed from the consumption paradigm. Open publishing, through blogging, wikis, and other media, may also give individuals access to, and the ability to participate in, the act of publication and dissemination of materials, views and ideas. These enablers may help to lessen the

[77] http://www.widernet.org/digitallibrary/
[78] http://laptop.org/

monopoly of current, formalized publishing approaches and potentially reshape the forms of content produced. As one participant, remarks, "The concentration of publishing in the hands of a small number of corporations has tended to result in a biased and prejudiced information environment, open source and open content promote a democracy of views and opinions (Survey Participant #6, March 29, 2005).

The power of open publishing (i.e., blogging) as a viable balance to mass media was revealed to some extent through a series of popular media occurrences, now widely referred to as *RatherGate*. On September 8, 2004, CBS's documentary series, *60 Minutes*, revealed documents which cited criticisms of George W. Bush's service in the U.S. National Guard during the Vietnam War. Within hours of airing, internet forums and blogs voiced criticisms and questioned the authenticity of these documents. Due to the timing of this airing (previous to U.S. election) and to the high-profile individual that the episode targeted, there was much public pressure on CBS to authenticate the source of the documents. CBS was unable to provide authentication and offered a public apology shortly after the incident (CBS, online[79]). While there certainly could be criticism that the previous event was oversensationalized due to partisan attempts to either defend or cloak any significant issues during George W. Bush's military service, these incidents stand out as a vivid example of how open publishing has begun to counterbalance formal media protocols.

The combination of open publishing and access is not only perceived to be beneficial in the wider media arena, but may also have advantages in localized educational environments. While this point will be further discussed in the 5.1.8 (Pedagogy/Problem-Solving), several participants argued that traditional content

[79] Available at: http://www.cbsnews.com/stories/2004/09/06/politics/main641481.shtml

providers (e.g., book publishers) follow an outdated mode of production and that open practice in classrooms may help to inspire new methods of alternative publication.

> Textbook publishers are following the dinosaur's path, and as there become more viable alternatives for collaborative sources of content, rather than continuing in the piecemeal way it is now, things could change in terms of what we provide and how we access content for students. And this is especially true in the ability to change content as needed rather than to wait nine months for books to come out. (Levine, Interview, April 3, 2005)

In keeping with this idea, an anonymous participant cites Lawrence Lessig's book, *Code v. 2*, suggesting that this book-production process is a strong example of how book publication may evolve via open philosophies. Here is a brief explanation of how *Code v. 2* is being developed.

> Lawrence Lessig first published *Code and Other Laws of Cyberspace* in 1999. After five years in print and five years of changes in law, technology, and the context in which they reside, Code needs an update. But rather than do this alone, Professor Lessig is using this wiki to open the editing process to all, to draw upon the creativity and knowledge of the community. This is an online, collaborative book update; a first of its kind. (Codebook, http://codebook.jot.com/WikiHome)

Code v. 2 was then made available for free on the Code wiki and was also sold as hardcopy through various publishers. The free version of *Code*, however, became the most dynamic as it spawned many freely available translations, audio narrations of various chapters, and allowed for commentary at various points throughout the book. While *Code v.2* in paperback was a static publication, *Code v.2* on the web became 'alive' and continues to be transformed.

To summarize, the participants in this study identified two specific areas where the concept of open access is important in the educational context. They are (a) access to resources, including both software resources and educational content and (b) access to digital publication processes and tools. Open source software,

open content, and open publication are characterized as inherently supporting access, whereas closed or proprietary systems/content are perceived to restrict or suppress user access.

5.1.2 Adaptability/Transparency

Several participants emphasized the concepts of adaptability and transparency as key characteristics of the open movement. *Adaptability* is perceived as the ability to take software or content and modify or tailor it to the specific needs of an individual or group. For instance, a teacher may download a presentation from a learning object repository and modify it to make it suitable for a Grade 6 classroom. *Transparency* reflects the ability of others to view any changes, modifications, and decision-making processes. This same teacher may decide to upload her modified presentation to the same learning object repository with documentation describing changes made and other pedagogical notes. While adaptability and transparency are distinctly different concepts, they are closely related, and thus I have chosen to group them in this section.

One participant uses an automobile metaphor to describe his perception of proprietary software as it relates to openness, transparency and adaptability.

> *Buying proprietary software is like buying a car, and when you drive it off the lot, the dealer locks the hood and keeps the keys. And when you want to do something with your car, you have to drive it back to the dealership, and they unlock the hood, and take it into the garage and do their thing, and then they lock it back up and give it back to you.* (Core Participant #4, Interview, June 3, 2005)

The metaphor compares the restrictive, yet likely misunderstood, practice of the software industry against a concept much more familiar to the masses - automobiles. While not every automobile owner may actively work or even wish to work ‘under the hood,’ the

possibility to do so exists. And this is strongly represented by study participants as a relevant freedom available to computers users.

> *I have the right to examine the source code for any executable program which is running on my computer. This allows me (or anyone else) to inspect for flaws, conflicts or malicious code*. (Wall, Survey, November 17, 2004)

> *Open = Free: code is open for review, supported and vetted by a strong community of users.* (Survey Participant #7, November 18, 2004)

> *It's unreasonable to purchase something and it being a big black box on your desk. Many software packages store vital human data, your human data. It must be a right to be able to take apart these same programs that are storing this vital information. The process simply must be transparent, not only on a philosophical level, but on an every day practical level as well*. (Survey Participant #9, July 30, 2005)

In addition to the value-laden idea of software/content adaptability as a right and freedom, participants expressed the idea that the adaptability principle, open, can assist in the creation of products and processes that are of greater quality and more responsive to the needs of individuals and institutions.

> *Vendor driven products have a difficult time keeping up with rapid change in both scope and needs. Open source products are more responsive to change. Their distributed development model is better suited to shift directions more rapidly. Look at the Linux kernel, the growth of the Apache products or the growth and development of support environments like Sourceforge*. (Survey Participant #7, November 18, 2004)

> *The answer is not to buy a static piece of software anymore, and then to consider your organizations needs are met. Today, you have to become a part of a continually adapting community that hopefully produces a stable release every 6 months or so. Revisions that happen every couple of years simply don't cut it anymore*. (Survey Participant #10, January 17, 2005)

> *As for content, no books that you can use right now are going to have a full-fledged treatment of the situation in Iraq, for instance, and these are issues in people's minds. World maps are getting rewritten every year, history is being made constantly, and we need technologies and protocols that enable us to keep up*. (Levine, Interview, May 31, 2005)

As a final point in this section, several participants expressed the idea that open source processes are very similar to the processes that exist in many contemporary classrooms. While asking teachers to work on software code is not likely to occur, many teachers already retrieve digital resources and adapt these for use in classrooms.

> *Teachers for years have always had these little things they pull out and run 25 copies for their class, their little worksheets that they got from this, that, or another place. Nine times out of ten, they're using them illegally. But they have this idea and teachers know they can't reinvent the wheel every time, and so they're used to building their toolboxes of toys and tools and applications. So the more we can relate what we would call open content to what teachers would call their toolboxes, the better and the more rapidly we're going to see acceptance of open content*. (Core Participant #2, Interview, April 27, 2005)

> *I really wouldn't expect everybody to be developers. But I guess, perhaps the communities need to be a bit more open and have things built in for more laypeople to do things, like testing and giving feedback. I think as a developer, you just get too close to the code to really be able to understand what it's like for people who don't have the knowledge to use it. I think when you get more into the open–content area, there is a lot more room for people to be players and contributors. Not that everybody needs to be building tools, but I think a lot more people can help build shared content. Wikipedia alone makes this case*. (Levine, Interview, May 31, 2005)

It is important to note that the open movement, as perceived by the participants of this study, does not demand all collaborators to be developers, coders, or content creators. Participation comes in many forms and opportunities as varied as the projects themselves.

5.1.3 Economics

There is a strong, shared perception among the study participants that free and open source software, open content, and open publishing may provide an economic and financial advantage to adopters, especially for those in the educational context.

> *In the context of education, I think that open software such as the Linux OS is the only economical feasible way that computer technology can be present in schools in sufficient numbers to provoke a substantial change (hopefully an improvement) in the context for learning in public schools.* (Wall, Survey, November 17, 2004)

> *Open technologies are important because they offer a choice that costs much less than other options but still provides educators with powerful working tools*. (Survey Participant #2, January 12, 2005)

> *The majority impact of open technologies would be a substantial reduction in the cost of providing learning to students, all the more when the programs extend from the use of open source software to the use of open content. It (open adoption) also allows for more flexibility, learner centred environments, and personalization*. (Downes, Survey, March 29, 2005)

> *Every dollar I don't spend on infrastructure is a dollar we can spend supporting children who are blind, deaf, or have significant disabilities. This is why we continue to adopt open technologies in our system. It simply frees up so many financial resources. (*Survey Participant #8, April 5, 2005)

> *From my point of view, the Open Movement facilitates the access to software for people with budget limitations, the majority of cases at schools and universities in the so called 'third-world.'* (Corsi, Survey, December 2, 2004)

Participants in this study have varying expertise with the finances of technology in schools. A few administer the technological and financial resources to school districts, while others are teachers looking to increase the educational resources in their classrooms. As supported by these statements, the overwhelming perception is that the adoption of open technologies may help to free resources in educational settings (Lerner & Tirole, 2002).

There have been various studies that support the claim that the adoption of open technologies, particularly free and open source software, can result in cost-savings for institutions (Fink, 2002; Lerner & Tirole, 2002; Perens, 2005; Wheeler, 2005). There has been little to support an alternate view on the economics of open technologies, other than the widely disputed "Get The Facts"[80] campaign from Microsoft. Get The Facts is a website that offers Microsoft's view on the economics of open source and contests the notion that adopting free and open source software is less expensive than Microsoft/proprietary solutions once other costs are factored in (e.g., service, support). In this dissertation, I purposely avoid the open-source-is-better-because-it-costs-less analysis because I feel that it belittles the other important reasons for the adoption of open technologies. Economic reasons often overshadow socioeconomic, environmental or ethical reasons for supporting particular views (e.g., supporting sustainable energy alternatives, shopping at locally owned businesses). Therefore, I will conclude this section by saying that it is widely perceived - in both the literature and by the participants of this study - that the adoption of open technologies is beneficial from an economic standpoint. However, as should be clear by the long list of benefits presented in this chapter, better economics is only a single factor of many.

5.1.4 Institutional Change

Possibilities for institutional change, as perceived by the participants of this study, are both potential benefits of open source adoption/practice and barriers to its adoption. In a sense, we reach a 'chicken-and-egg' dilemma as the benefits for open practice in schools may never be achieved without the prior institutional change that will allow its

[80] http://www.getthefacts.com

adoption. In this section I report the perceptions of the study participants in regards to the potential effects of open source adoption and practice in an educational environment.

In the recent *New York Times'* article, 'Here's An Idea: Let Everyone Have Ideas,' Taylor (2006) argues that institutions typically get their key ideas from only a few sources within the organization and that the open movement is challenging the notion that successful institutions must have greater, whole-scale participation by its members.

> Creativity is no longer about which companies have the most visionary executives, but who has the most compelling "architecture of participation." That is, which companies make it easy, interesting and rewarding for a wide range of contributors to offer ideas, solve problems and improve products? (Taylor, March 26, 2006, online)

The 'architecture of participation' is a concept described by Wenger et al. (2002) in *Cultivating Communities of Practice.* It is related to the notion of social affordance[81], that is, the ways in which a social environment is designed to promote or encourage social collaboration and participation. Open source environments are inherently collaborative, and, as described by Taylor (2006), could change the way in which institutions innovate.

Several participants spoke to the perception that open communities have the potential to change power structures in formalized educational organizations. While in some cases this may encourage more active participation for institutional change, it also has implications for the role of school in society and may problematize school reform well beyond a superficial level.

> *A lot has been made of the collaborative decision-making in open source communities, and in my experience, the open source community is no different than the wider community, save that in open source communities autocracy (control by management by fiat) is not sustainable.* (Downes, Survey, March 29, 2005)

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[81] *Social affordance* is an expansion of the term *object affordance,* coined by perceptual psychologists who advance the idea that certain objects provide suggestions as to how individuals act with and onto them (e.g., if one sees a bench, one may feel they should sit or lie down on it).

> *Openness is almost the antithesis of our current model for schools. The schools themselves are literally closed (at least here in the US, don't know about CAN so much) with warning signs and badges everywhere. Then there are the closed classrooms, with shut doors*. (Core Participant #4, Survey, December 1, 2005)

> *A weird thing that has happened with technologies in some schools is that it just represents another place for a person to get power. There are all these nontech people vying for technology power. The school district that I've been in, at one point, the person who was controlling and planning the technology in the school did not even know how to check her email. An open source model would allow for distribution of this power, and allow much more informed decisions around implementation of innovation.* (Hagle, Interview, June 13, 2005)

> *Schools arose in an environment or context where information was a scarce resource. Many of the institutions were there to make sure that everyone had access to such information … and in the early part of the 20th century, schools were basically the only places where there were books available. And this great institution arose as the institution that controlled the flow of information to people in a way that it was distributed equally and fairly amongst people. With the revolution of information, with the advent of the world wide web, and the pervasiveness of media in our lives, I don't think that we are in that same situation anymore. We are no longer in a position where we are short of information. People now have access to all kinds of information everywhere they go. Yet, schools seem to be acting as if they are the gatekeeper of information, and that they should dole out information a little bit at a time, instead of acting in the realization that information is so freely available. The comparison that sits in my mind is that public schools are a lot like the Catholic Church after the arrival of the printing press, but prior to the Reformation. They don't realize that their monopoly on information has been completely subverted by a change in technology*. (Wall, Interview, February 23, 2005)

While participants see the potential benefits of open technologies and practice in educational institutions, they are also attuned to many of the existing power structures in schools. These power structures are present throughout the context of education, from the relationship of teacher and student in classrooms, to teacher relationships with other teachers and administrators, to the very role that schools take in general society. While open technologies and practice may be perceived as potentially beneficial, changes cannot be made easily to existing power structures. Study participants argue that an open

source model could transform school culture in respect to the distribution, access and creation of educational materials and tools.

5.1.5 Pedagogy/Critical Pedagogy

While participants of this study commented on the many ways in which open source software, open content, and open publishing could be integrated into the classroom, their commentary also supported the perception that open practice and adoption have the potential to transform current pedagogical practice and, more particularly, to support critical pedagogy in the classroom. Pedagogy, the art or science of teaching, relates to instructional strategies and theories put into practice. Critical pedagogy is a teaching philosophy intended to help students question and challenge domination, power, and those beliefs and practices which are dominant in their social context. In other words, critical pedagogy is designed to help students develop a 'critical consciousness' (Freire, 1970, 1973; Freire, Freire, & Freire, 1994) as they become increasingly aware of social, political and economic oppression in their world. This section describes how participants believe the open movement may support the transformation of pedagogy and critical pedagogy as perceived by the participants of this study.

Open source software culture is based on the sharing of knowledge or, more specifically, code as bits of knowledge. Open content and open publishing are somewhat different in the sense that this knowledge is typically multimodal and is expressed through media such as learning objects, multimedia content, blog posts and wikis. Through this lens, participants stress pedagogy as shaped by explicitly collaborative

knowledge building, multiple channels of information and critical synthesis, and feedback structures.

> *I'm interested in empowering students for deeper learning. And I think that the open-source movement is all about that. Collaborative knowledge building is of most importance to me. That is the primary skill they are going to need to be successful. They have to be knowledge builders, and they have to do this in participation with others.* (Survey Participant #11, April 3, 2005)

> *There is a world of experience that the open movement can contribute to education, particularly in changing school culture. Students tell us that in order to engage them in learning, the tasks they are asked to do must be authentic, relevant, academically challenging, and have merit beyond the walls of the school … they have to have relevance in the real world. The challenge, then, is to make current school culture reflect the real world, rather than being so far removed from it. Digital technologies, and in particular, open ones that allow for great collaboration and social construction of knowledge, can change the isolationist mentality and culture that exists in so many schools and classrooms. We know that knowledge is best constructed in a collaborative social setting. Living in a knowledge society, we have so much technology that could be used to support this kind of socially constructed knowledge, but due to the schism between those who are growing up immersed in the technology of today and those who grew up with so much less, the reform of educational practice continues at a glacial pace.* (Core Participant #3, Interview, June 2, 2005)

> *What we're observing now is really nothing new in the sense that open-source education has been available forever. There was never anything stopping anybody from opening a book and learning on their own. But what's happening now is that you have additional channels that are available. So all of a sudden, you have recorded lectures that you can listen to, or online testing, or open content … there are many, many channels. And because it's becoming easier to create a new channel, and for these channels to actually offer critical feedback of one's work, we're seeing something we could never have been supported by formalized educational structures. We're finally locking into a very natural mode of socialized learn*ing. (Bradley, Interview, June 1, 2005)

Open source pedagogy, in this view, depends not only on what happens within the formalized structure of the classroom, but also on an informal reliance of distributed information sources and individuals found outside this localized context.

There are a couple of emerging scholarly views of pedagogy and learning that also argue in this way, that knowledge building is becoming more dependent on

distributed networks and, in some ways, knowledge exists in the networks themselves. David Weinberger (2005, online) theorizes that traditional theories of knowledge conclude that knowledge exists within the knower; that knowledge and being are fused. Weinberger argues that the advent of the Internet has taken us beyond the content-as-a-container outlook and that links to knowledge are more important than the knowledge itself. Weinberger writes, "Links, not containers. A page is what it points to." (online) George Siemen's (2004, online) connectivist theory takes a parallel view and "presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity." Siemen argues that knowledge building in the digital age is dependent on connecting of nodes of information (whether these be human or nonhuman sources), that knowledge exists in a diversity of opinions, and that these often informal connections are the most effective mechanisms for creating knowledge networks.

Arguing the related position that learning may best occur outside normalized school structures, participants of this study also questioned credentialism as a power structure incompatible with open source pedagogy.

> *When students teach each other, when people teach each other, and when credentials are not required – or even desired – what role will the Academy or schools serve? Education cannot continue in the top-down, credential rich/knowledge poor manner that it exists today*. (Core Participant #2, Interview, April 27, 2005)

> *The Academy has protected itself through barriers to entry for at least 200 years. You need a particular approval to participate as a student. You need more credentials to be a teacher. You need different credentials to teach different subjects and different levels in the same subject. Students are made to follow traditions and adopt practices that are codified in history rather than supported by research and informed practice. However, the open movement – open source software, the blogosphere, peer-to-peer, RSS, all of that, rips the lid off.*

> *Cluetrain*[82] *shifted the world. Education needs to catch up or it will be left behind. We'll know better in the next 5 years.* (Survey Participant, May 8, 2005)

The Wikipedia project is a foil for credentialist views. The central premise of the project is that expertise is distributed throughout a general population; it is not exclusive to academic institutions. Wikipedia allows netizens, anyone with access to the Internet, to contribute to knowledge-building through wiki technology. Anyone who feels they can contribute to a subject, can easily voice their ideas and beliefs.

A related example of how the open movement is challenging traditional power structures in credential-rich institutions can be seen in the development of open source religions. Open source religions "are created through a continuous process of refinement and extension by the believers themselves. In comparison to traditional religions - which are considered authoritarian, hierarchical, and change resistant - they emphasize participation, self-determination, decentralization, and evolution" (Wikipedia, 2006a, online). Open source religion, much like open source software, is characterized by rapid development, community development, and collaborative decision-making.

The open movement can be perceived as challenging traditional power structures whether they be the dominance of Microsoft, formalized religion, or educational institutions. Critical pedagogy may be a tool to strengthen these challenges to dominance through a wider understanding of societal power structures and, ironically, could assist students in understanding the power structures within their own educational environments.

> *Students now have a plethora of a choice when it comes to their schooling. They can choose to take online courses from a number of institutions, and they can customize their educational experience based on interests and passion. The days of one-size-fits-all education is over in many jurisdictions. However, the more*

[82] http://en.wikipedia.org/wiki/Cluetrain_Manifesto

> *difficult challenge will be to move beyond the idea of credit-transfer, and "what makes up a degree?". You will see an increasing number of students soon reject the notion of formalized schooling altogether when they realize that they can learn much more, more relevant information, and more efficiently, through connecting with each other, and other freely available resources. That may just be the shape of our future education*. (Survey Participant #12, October 27, 2005)

> *I teach my students to challenge everything, absolutely everything, including anything they hear from me. This is the open source way, that their voices can be heard, and be taken seriously before a wider audience, and that their views count as much as any others'. The open movement has taught me a lot about power and dominance, and education can learn from this because we, as teachers, can traditionally be compared to the software peddlers of Microsoft. We know there's better out there, we know there are better ways of learning and better ways of making learning happening, but we continue to sell the old ways because this is what we have always known. It's time to realize the power influences that oppress us and to no longer socially reproduce our students in the old way*. (Core Participant #5, September 17, 2005)

It seems that several of the participants who have been exposed to the open movement have begun to reshape their own pedagogy. Not only is this evident in the tools and the content they use, but it is also evident in the attitudes they take in respect to dominance and power in educational institutions.

5.1.6 Power of Networks

The power of networks is an idea central to the open movement, and there are various network theories relevant to this section. Stanley Milgram was one of the first of many theorists who researched the power structures of networks and hypothesized their effects on individuals and communities. In his "small world experiment", Milgram (1967) hypothesized that a relative short chain of social acquaintances connects everyone in the world. From research conducted in two U.S cities, he found that most participants were connected by an average of six acquaintances. More recently, other theorists (Barabasi, 2003; Surowiecki, 2004; Watts, 2004) have extended Milgram's work, have

studied network theory in relation to historical events, and have emphasized the importance of network theory in understanding complex trends and everyday events.

At the most basic level of these theories, there is a simple hope that collaborative work may spawn a better product than that developed through individual effort. The quote, “Given enough eyeballs, all bugs are shallow” (Raymond, 1997) is representative of this philosophy. The phrase arose from the success of Linux as a rapidly developed, robust operating system. At a more complex level, there is the perception that characteristics of the network itself may encourage collaboration and that networks should not be viewed in a reductionist sense as merely the sum of individual connections. The latter may be expressed through the theory of social affordance previously highlighted in Section 5.1.4. These views are compatible with each other. It was clear through the data collected for this study that participants had a positive perception of the potential of networks as a key attribute of the open movement - one that could potentially transform teaching communities. This is an important characteristic of the open movement and will be central to the summation of this dissertation and this topic will be discussed in Chapter 6.

5.1.7 Values/Free Culture

The analysis of the study data revealed common values shared by participants related to involvement in the open source movement. These values are seen to be a driving force for participation in and advocacy of open communities. The quotations that follow may help to expose these values.

> *I am very philosophical about “openness” and view the entire (open) movement as a symbol of our human right to be creative and to share.* (Core Participant #4, Survey, December 1, 2004)

> *I think of my inspiration as value driven. I don't think belief is necessary. Once one sees the facts and is open to understanding what the open movement is about, I don't see how any intelligent individual could reject it. That may sound harsh, but I see articles and paper after paper out there that clearly describe the advantages that the freedom of the Free/Open movement brings. Yet, I continually see nothing but babbling propaganda from those that wish to fight it. I value cooperation. I value sharing. These values are inherently opposed to the proprietary approach to information. I don't view the world from a nationalistic or religious or stockholder's perspective. To me, cooperation and sharing is only true if it is occurring at a level that includes every single human being. Holding information hostage (the proprietary approach) is not in line with my values.* (Rock Le Croix, Survey, June 30, 2005)

> *The very idea of an open-source community is a different mindset than a commercial one. That open community mindset really suits the way our school operates and its general outlook as a nonprofit organization with values-based education.* (Core Participant #1, Interview, June 22, 2005)

> *Today, we are continually moving away from the Enlightenment. Take for instance, if we could take a list of the top 10 things vital about the concept of science. Somewhere in that list, within the top 10, is going to be the idea that you openly publish your results. OK, hold on, think about the top 3 things important about science. That you openly publish your results will be still be in the top three. Now if you were given just one choice? It's gotta be openly publish your results, propagate your discoveries. And this is what is so important openness and the open movement. This is a value that has both meaning and great benefit across society*. (Core Participant #6, June 30, 2005)

The thoughts expressed here relate to the participants' beliefs regarding creativity and sharing and collaboration as a preferred mode of cultural engagement. While participants value openness and sharing and collaboration, they believe that corporate-driven culture and the proprietary nature of popular media and software create resistance and barriers to openness.

Lessig's (2004) *Free Culture* documents the history of what he terms *free culture*, a culture or society in which creativity is shared and built upon freely. Lessig argues that free culture has always existed in balance with commercial culture, also known as *permission culture*. Free culture exists in all aspects of life, for instance, "when old men

sat around parks or on street corners telling stories that kids and others consumed" (pp. 7-8). Commercial culture, while not nearly as prevalent, has been incredibly influential because it bombards us through popular media (e.g., television, radio, newspapers). As the Internet emerged, the delicate balance between these two modes was affected because mechanisms for mass publication were now available to anyone with a computer and controlling the flow of information became much more difficult, if not impossible. While this may have been an opportunity for free culture, large media corporations began to leverage intellectual property law to protect their interests.

> The rough divide between the free and controlled has now been erased. The Internet has set the stage for this erasure and, pushed by big media, the law has now affected it. For the first time in our tradition, the ordinary ways in which individuals create and share culture fall within the reach of regulation and law, which has expanded to draw within its control a vast amount of culture and creativity that it never reached before. The technology that preserved the balance of our history – between uses of our culture that were free and uses of our culture that were only upon permission – has been undone. The consequence is that we are less and less a free culture, more and more a permission culture. (Lessig, 2004, p. 8)

The participants of this study share the critical values of Lessig's free culture. Most notably they value and see benefit in the free sharing of knowledge and information across a wider society.

5.2 BARRIERS

While the potential benefits of open adoption were clearly stated in the previous section, there are also several barriers identified by participants of this study regarding the adoption of open technologies and practice in the educational context. The barriers discussed in this section include lack of awareness (very few people have been exposed to open tools and methods), technology decision-making (those making technology

related decisions are not likely to promote open technologies), FUD (fear, uncertainty and doubt), technology skills/understanding of teachers (teacher abilities/understanding levels regarding technology are lacking) perceptions of technology in the real world (proprietary technologies are seen to be more credible than open source alternatives), interoperability (technical barriers to adoptions) and power (control and domination of proprietary vendors over the education market).

5.2.1 Lack of Awareness

On March 21st, 2006, Microsoft announced they would be delaying the release of their next generation operating system, Windows Vista, until January 2007. Windows Vista had originally been slated for release in 2005 but Microsoft has since made several announcements regarding a delay in the project. In a *Wired News* report, one interviewee expressed the idea that this latest delay could adversely affect holiday sales of personal computers (consumers are likely to wait for a new release than purchase a soon-to-be discontinued operating system) and, at the same time, expressed the reliance of PC manufacturers on Windows software.

> *Certainly PC makers aren't going to be happy about it, but I don't know exactly what they're going to do. They'll wait, there's not a whole lot of choice at this point.* (Rosoff, 2005, online)

PC Makers are not alone in this view of technology. It is clear from this research that open technology users believe there is very little public awareness of open source alternatives to proprietary software. Microsoft Windows and other proprietary forms of software are perceived as the only viable choice for many vendors, purchasers, and users of computing technology.

Several participants in this study identified free and open source software as an important alternative, but one that is not yet well known to the public. Even individuals with greater experience with technology may lack exposure to free and open source technologies. This may be partly due to the saturation of the market with Microsoft and other big-name technologies.

> *One perceived barrier is that people think if it's not Microsoft, it won't work. And people in training, or who have to set up training, are afraid of it. And, some technicians have the idea that MS products are much easier to use when in fact it may be more complicated and require more funds to make it work properly.* (Survey Participant #2, January 12, 2005)

> *I was of the opinion that Linux was too complex and command script driven. This was corrected by a willing and helpful parent who introduced me to Knoppix and Mandrake. The installations have for the most part been user-friendly, and the GUI (graphical user interface) provides a familiar environment. So, the biggest barrier is the perception of availability. Students, teachers and administrators tend to think that Microsoft is the answer to everything simply because they haven't been exposed to any other viable options.* (Core Participant #1, Survey, March 28, 2005)

Related to the previous point, several participants expressed the idea that free and open source software is not well known to the majority of computer users due to the lack of marketing capabilities and the minimal funding of open source projects versus the large advertising budgets of big companies.

> *Microsoft has a lot of money to spend on marketing and so, people are going to know about Microsoft and they'll know about Macintosh, but Linux doesn't have that marketing department or the money that big corporations do.* (Wall, Interview, February 23, 2005)

> *There's a lack of awareness in the educational community about open source software, and part of this is due to the choices that are made at the administrative levels. Superintendents, directors, administrators, etc., don't have the technical expertise or know-how to make technical decisions and they are often blinded by the marketing tactics of the first salesman they meet. And if they've heard even the name of the product before from other directors, or superintendents, or whatever, they are even more likely to buy it. That's why I think that important technical*

> *decisions should never be made with salespeople in the room.* (Anonymous, Interview, October 25, 2006)

In the second quote, it is suggested that the concept of brand recognition may also be a factor for technological decision making, especially for those decision makers who are not experts in the field.

5.2.2 Technology Decision Making

As presented in the previous section, there is a strong perception among those participating in this study that those making the technology adoption decisions in some educational institutions are not well acquainted with free and open source technologies, or perhaps with technology in general, to make informed choices regarding technology implementation.

> *Unfortunately, the people making decisions aren't always the most knowledgeable about open source or even technology in general. Often these people fall into the trap of thinking that you have to pay to get something worthwhile. To these people, open source and free doesn't make sense. "How could anything free be worth it?" This is a reason for my advocacy of open source in education. Knowledge is power in this situation.* (Survey Participant #13, February 23, 2005)

> *The primary barriers are that the people making the decisions are totally clueless. They come from education – not technology. They spend too much time listening to salesmen and too little time researching technology. Calling a salesman for a quote is NOT technology research*. (Survey Participant #8, April 5, 2005)

> *Schools are run by administrators who are caught between budget and accountability. They lack the requisite skills to move into open source, the requisite knowledge to adopt CC (Creative Commons) over Copyright, and requisite wisdom to get out of their boxes to find out how to do things differe*ntly. *The old bromide in information systems was that "nobody was ever fired for buying IBM." The corollary, of course, is that their companies often failed from paying too much for yesterday's technology today. Schools in all areas are facing the same dilemma. They cannot afford to a take a chance on – what for them – is unknown technologies because if they do and they are wrong, then students suffer. School boards, trustees and parents get upset when that happens.* (Core Participant #2, Interview, April 27, 2005)

As the last paragraph suggests, poor decision making regarding technology may not always be due to the lack of knowledge on behalf of the decision maker. Instead, there is a great deal of responsibility equated with technology implementation and, at the present time, adopting free or open source technologies would be perceived to be a risk, even assuming there could there be considerable fiscal benefit.

5.2.3 Fear, Uncertainty and Doubt

Much of the perceived risk represented in the previous section can be attributed to the phenomenon of *FUD* or, as several participants elaborate, "fear, uncertainty and doubt." FUD is defined as "a sales or marketing strategy of disseminating negative and vague or inaccurate information on a competitor's product" (Wikipedia, 2006a, online). Open source software is a direct threat to proprietary, for-sale software, and several participants in this study stated that administrators, teachers, and students are often exposed to such tactics of disinformation.

> *Most users and decision makers have been indoctrinated into the 'my operating system is better than your operating system' dogma, and they remain suspicious of any alternatives that are presented to them. There is also the consistent message by vendors that if you do it yourself, if you choose free and open source, 'who will take care of things when it all goes sideways?'* (Survey Participant #7, November 18, 2004)

> *Microsoft has already distributed a lot of false information about open source. Even Bill Gates labels these programmers as communists*. (Core Participant #1, Interview, June 22, 2005)

> *There is a fear around using open source that is unwarranted in my opinion. Many people are not confident or comfortable with technology to begin with, and feel that using a "brand name" gives them some sort of guarantee. This is a message they consistently get from others, it's a comfort factor*. (Core Participant #3, Survey, November 18, 2004)

> *There's quite a bit of it (FUD) out there largely – I put it down to that. And sometimes it's unintentional. I call it ignorant knowledge, people who think they*

> *know something but they don't. I do understand that it's out there, either deliberately or in a shadowy sort of way, being put out by people from Microsoft and so on.* (Core Participant #4, June 3, 2005)

While the Wikipedia definition constrains the concept of FUD to being deliberate and usually delivered by salespeople or marketing agents, the previous quote helps to reconceptualize the term. While FUD may originate from these sources, FUD becomes viral in the sense that it can be passed from person-to-person in organizations, even through those not directly involved in sales.

> *The single biggest obstacle to the adoption of open source has been the tech support staff in our local school districts. They are almost uniformly "frozen in time" with their skill sets from the 1990s, in their training from Microsoft, and are unwilling to consider even the smallest deployments of "funny new stuff". For instance, one district's technology coordinator refused a request to install the Firefox web browser because I could not prove to his satisfaction that it would work with his district's web-content filtering software (two totally unrelated technologies).* (Core Participant #4, Survey, December 1, 2004)

> *We have pro-Microsoft teachers in our school, and I just don't know where they get these beliefs from. If it's not Microsoft, it's just plain crap in their eyes. They won't give anything a chance if it's not branded by a well known name. And what's worse is they just try to force their views on everyone they see. Sometimes, it's kind of a comical Mac vs. Windows vs. Open source thing, but you know they're darn-well serious.* (Survey Participant #8, April 5, 2005)

Another important barrier related to FUD may be in the strategy's tendency to polarize opinions related to technology. Those who call to question the validity of arguments made from proprietary software advocates may, themselves, be accused of disseminating FUD. Fear, uncertainty and doubt is not exclusive to either camp and can emanate from or be used by either. In some respects, such polarities may make it less likely for legitimate debate on the merits of either technology. Consequently, arbitrary usage of FUD may lead to the logical fallacy, *ad hominem circumstantial*, arguing against an individual for one's bias, rather than focusing on the matter itself.

> *Some people use the term 'open source' like it's a brand itself, because it's trendy like driving a Prius or being a vegan. When you get into that condition, when you become religious about it, you lose sight of what we're talking about and you become irrational in your arguments. This is all about choice, and forcing one to use open source, or making someone see the world in the open source way, ironically destroys the whole concept of open source itself.* (Survey Participant, July 17, 2005)

5.2.4 Technology Skills/Understanding of Teachers

Participants in this study stated that the technological skill levels and the understanding of teachers is a relevant barrier to open technology adoption in schools. This section relates mostly to the use of open source software, but they relate more generally to issues of open publishing and the adoption of open content. In some cases, participants viewed technological skills in general as being a barrier to using any technology in the classroom.

> *The biggest barrier to using open technologies, or really any technologies, is the fact that teachers are not comfortable or even cognizant about them. You have the case of digital immigrants teaching digital natives. It's been an incredibly hard sell to get teachers excited about using any of these technologies, although the students are totally on board as they are using them in their daily lives. Teachers, for the most part, will not venture to try something unless it is guaranteed to work. What other profession requires that guarantee?* (Core Participant #3, Survey, November 18, 2004)

> *The 'unknown' factor is a real problem. People are afraid of learning new things, an ironic attitude in schools. The steep learning curve is also a problem, although that is a perception problem more than anything else*. (Radcliff, Survey, December 15, 2004)

> *Maybe it's just the old dog, new tricks metaphor? I find that teachers are very gung ho about it, in the sense of "Oh yeah". And, they'll listen to what I have to say about it, and they'll say "yeah, yeah. That's great! That's great!" But when it comes down to it, when it means that they have to click in a slightly different place, or navigate a screen a little differently, then there's a problem. A lot of the current free software is now very intuitive. It doesn't take a lot of energy to switch over. But boy, if they switch over and one thing goes wrong, It's like all of a sudden it's my fault or something. It takes a lot of energy to be an advocate.* (Rock Le Croix, Interview, June 30, 2005)

Open source software is not perceived to be much more difficult to learn than proprietary software; however, due to copyright restrictions, patents, and developer preference, open source software will look and feel different than proprietary equivalents. In many cases, these differences are subtle, but even these slight variations can cause confusion and discomfort for users.

The discomfort was viewed to be partly due to a systematic, ordered approach to using software. Whereas digital natives (typically younger users) are comfortable with software in a more holistic sense, digital immigrants may view the use of software as a sequence of ordered steps (Prensky, 2001; Tapscott, 1998).

> *Skills are overrated in technology. To me, it's a matter of really being comfortable with the technology that you're using. I have a two-and-a-half year old son who – all on his own – can go and click on the red hat, or whatever it might be, and go up to the games menu, and then select a game of Mah-Jong style, and start clicking on tiles that match. I mean, he's two-and-a-half years old. I don't see myself teaching him skills. I feel like skills are something you try to teach people who have already missed the boat. People are trying to play catch-up. The emphasis should probably be just a more conceptual understanding of what's going on, because if you understand how a machine works, you're going to be a lot more comfortable with that machine, rather than memorizing a few steps.* (Rock Le Croix, Interview, June 30, 2005)

> *If their (teacher's) opinion is that in order to know how to interact with this computer, they need to figure out what sequence of buttons to push, they'll always have a hard time using computers. And they will need specific training in order to use computers. And the idea that other people will be able to use computers better before because they don't approach trying to figure out a computer that way will always remain outside of their sphere of understanding.* (Survey Participant, June 14, 2005)

The participants seem to believe that computing must be learned holistically. While the participants describe this problem, they provide little information as to how this deficiency may be addressed. A similar barrier was also expressed as a problem of fluency.

> *Your primary language, you learn when you're a kid, and then maybe you pick up a second language, and the third one is still a struggle, but by the time you have learned four or five languages, picking up a sixth language is nothing. So part of it is a fluency factor. If you only know one way, learning a second way is a pain.* (Core Participant #2, Interview, April 27, 2005)

The lack of technological competency of the teaching staff is also blamed at two levels of training. First, it is expressed by participants that teachers are not prepared well enough in teacher education programs previous to their professional service.

> *The outlook for teacher training in universities in respect to technology, for the most part, remains bleak. They may take one technology course, but most of them do not see technology integrated into their remaining course work, nor is it expected in their practicum work. I don't believe the open movement is discussed at all, and any knowledge they may have of it would be personal knowledge.* (Core Participant #3, Survey, November 18, 2004)

Second, professional development programs by school districts are viewed as deficient in their approach to technology training.

> *Teacher training and professional development has to change. When training teachers that have been teaching for 30 years we can't say 'What you're doing is wrong,' but rather say 'Times have changed. Your students are different. The technologies are different.' Believe me, these kids are coming in with different ways of understanding and constructing meaning, different ways of interacting* with media in general, and our teaching has to adapt to that. But first, teachers have to understand it. (Core Participant #4, Interview, June 3, 2005)

Rather than teaching sequenced software events, technology training for teachers should address how educational technology and media are changing and how these changes affect the environment for learning, both at school and at home.

The arguments made thus far in this section may seem to drift away from open adoption and into the realm of pedagogy. This is intentional, as it is important to emphasize that open adoption, especially its participatory nature, may play as important a role in infrastructure and training as it does in empowering learning through media. In describing the former state of media and culture, Lessig (2004) writes, "Read only.

Passive recipients of culture produced elsewhere. Couch potatoes. Consumers. This is the world of media from the twentieth century" (p. 21). Open source software, open content, and open publishing are each inherently participatory technologies. Participants in this study urge us to move beyond the step-by-step, ordered, systematic pedagogy embedded in our notion of technology training and move toward the view of technology as social participation. Certainly, skills will always play an important role in using technology. However, as software becomes more intuitive, user-friendly, social, and universal, the focus on skill building will likely become less of a barrier to multimedia/modal literacy.

5.2.5 Perceptions of Technology in 'The Real World'

Another significant barrier identified in the study is the perception by some administrators, teachers, parents and students that using free and open source software and tools at school will not adequately prepare students for a proprietary, Windows-dominated workplace.

> *The major barrier, of course, is the perception that students must use proprietary technology because this is what they will be expected to understand in the workplace*. (Downes, Survey, March 29, 2005)

> *Some administrators and parents just don't understand what we are doing with this, especially those parents with a foot in the corporate world who have been indoctrinated into the MS world. There's the notion that our world will be the same as the world of our children and students. It's not going to be. Technology will change, and adapt. What we teach here and now in school may not look anything like it does now. We have to get out, and get people out of that headspace.* (Survey Participant #14, April 22, 2005)

This particular barrier closely relates with the previous barrier (in Section 5.2.5); regarding an approach to technology as systematic and ordered. Many teachers, and curricula, approach technology as a set of ordered tools and instruction that may not be easily transferable when changes are made to software, or in the case of nonproprietary

software being used beyond the classroom. Participants expressed the importance of nondirect transferability of skills and knowledge.

> *I have to continually explain to people that I don't teach kids IT by having them memorize a certain sequence of steps on a certain platform using a certain software package to complete a certain task. I teach them concepts. I am not an MCSE (Microsoft Certified Systems Engineer) trainer, nor to I work for the LPI (Linux Professional Institute). As long as I teach constructively, there is no reason why a student learning to use GIMP will not easily adapt if confronted with using Photoshop in the future*. (Rock Le Croix, Survey, June 30, 2005)

As with previous barriers in this chapter, participants express the importance of a departure from the systematized, ordered training of technological skills typically found in classrooms and express the need for a supportive pedagogical approach to support nondirect transferability of concepts rather than skills.

Related to this point, participants also argued that the common technology curricula found in many school districts are loaded with many proprietary-based skills and generally lacks generic, cross-platform content. Additionally, curriculum resources to support nonproprietary technologies in the classroom are often scarce.

> *I think that we're not really addressing the knowledge issues that kids need. Yea, we're teaching them how to highlight and cut-and-paste text, but what's a font? What's FTP? What's HTTP? What's TCP/IP? A port, a packet? These are all things essential to our Internet use, and no one is teaching it, and no one is learning it. These are much bigger concepts for teaching, and that's what I'd like to see addressed*. (Richardson, Interview, May 17, 2005)

> *You can easily go and pick up manuals on MS Word, or MS Powerpoint and say, here, we are going to cover these 25 pages. But it's much more difficult to find resources like this with the same kind of quality for say, Open Office or The Gimp.* (Survey, July 21, 2005)

To support this point, *THE* journal released an article titled "Twenty Skills Every Educator Should Have" (Turner, 2006). While the list does feature several generic technological skills (e.g., word processing skills, spreadsheet skills), there is also strong

mention of skills tied into particular proprietary technologies (i.e., WebCT or BlackBoard teaching skills). Additionally, even as generic skills were highlighted in the article, the provided resources supported only proprietary tools (e.g., Microsoft Office). While there are many open source manuals available, there was no mention of this in the article. While Turner's (2005) list, of course, is only one article and is certainly limited to the knowledge and biases of the author, it is typical of the resources available regarding technology training in schools.

5.2.6 Interoperability

Participants said that there are perceived technical issues regarding free and open source software working within existing proprietary software environments.

> *There are proprietary issues that prevent using open source for the administrative office programs in schools*. (Core Participant #1, Survey, March 23, 2005)

> *And I think one of keys to getting people to consider a Linux-type system is presenting them with a working system and working software that is compatible with their environments, because that's a major concern. Compatibility is a definite concern and it is still a real problem as well*. (Radcliff, Interview, May 31, 2005)

> *Interoperatibility is one key question administration/board members had when I planned to implement FOSS. Microsoft's proprietary formatting for their Office documents (as they obviously intend) is a royal pain. Any complex Word document, for example, often loses a lot of its formatting when opened in a FOSS package such as OpenOffice. Using two operating systems on a school network to access files is possible, but requires a lot of thought and energy to implement*. (Rock Le Croix, Survey, June 30, 2005)

However, even with the perceived technical difficulties, participants report initiatives to have free and open source software work within existing systems.

> *Well, in our school division we are experimenting with Linux as an operating system in some locations as an alternative to the more usual OS's found in schools, which have been primarily Mac and Windows. We use OpenOffice in*

> *several locations as well as CMap as a concept mapping tool, and Mozilla's Firefox and Thunderbird clients for browsing and handling mail. This is not a standard across the school division, in fact there really is no standard at this point. The idea is to remain open and flexible, to meet the needs of the students and teachers in each school*. (Core Participant #3, Survey, November 18, 2004)

Technology/computer standardization within schools and across school districts is often seen as a cost-savings measure because it is perceived to be more expensive to support various technologies versus a standard set. Standardization of technology across schools as a concept has met with resistance from adopters as the values of a school system (e.g., cost-effectiveness, control) clash with the flexibility and the unpredictable needs of teaching staff (Hodas, 1993)

As a final thought for this section, a comment from a participant struck me as an excellent argument for the adoption of Linux and FOSS into existing systems, with the understanding that such systems should not necessarily be implemented in isolation from other technologies, even proprietary technologies.

> *If you use the biological example, I mean, we're seeing a lack of biodiversity here folks. Bio-diversity is a good thing. I mean, we're seeing a lack of bio-diversity here folks. Biodiversity is a good thing, but compudiversity is a bad thing? We want them all the same, we want everything standardized?, Let's make a monoculture here folks. I just think that's bad, any kind of monoculture is bad. And Linux monoculture is not necessarily a good thing either 'cause we want kids to be able to do things with computers, and not just Linux boxes and not just Windows boxes.*. (Richardson, Interview, May 17, 2005)

Technology and the choices that are made in its implementation are value-laden. Decisions regarding the implementation of proprietary technology, open technology, or a combination is not simply a question of economics. However, such decisions, supported by both institutional values and economics, must also be informed by the practical requirements of teachers.

5.2.7 Power (Control and Domination)

Participants in this study viewed the conflict between FLOSS and proprietary software as one that is partially based on principles of power, control and domination. In earlier sections of this chapter, it can be seen that free and open source software is beginning to challenge the status quo regarding the use of proprietary software in school districts. Additionally, open content and open publishing tools are becoming viable alternatives to textbook/content publishers and major media corporations. In these ways, the open movement is beginning to both expose and challenge power structures in the technology and media sectors, and could potentially lessen the control and domination of commercial companies in regards to educational technology and media.

Richard Stallman (2000) has written much regarding perceived power structures, especially those regarding free software. With Kuhn (2001), he writes,

> Proprietary software is an exercise of power. Copyright law today grants software developers that power, so they and only they choose the rules to impose on everyone else--a relatively few people make the basic software decisions for everyone, typically by denying their freedom. When users lack the freedoms that define Free Software, they can't tell what the software is doing, can't check for back doors, can't monitor possible viruses and worms, can't find out what personal information is being reported (or stop the reports, even if they do find out). If it breaks, they can't fix it; they have to wait for the developer to exercise its power to do so. If it simply isn't quite what they need, they are stuck with it. They can't help each other improve it. (online)

While software coding and revision is not typically the role of educators, a similar power structure extends into the realm of publishing and is relevant to academic and scholarly work. Copyright control and intellectual property can be seen as an extension of this power in that users/readers become limited in their abilities to use, reuse, edit, extend, and redevelop proprietary content. In justifying reasons to publish through informal, noncontrolled mechanisms (i.e., blogging), Downes writes:

> *Probably the major reason for my participation in these (open) activities is an unwillingness to submit to the conditions required by commercial publishers, for example, surrender of copyright, creative control, limits on 'acceptable discourse,' etc. Moreover, I find that open publishing in particular allows my voice to be heard immediately and to wide effect, much more so than via traditional venues*. (Survey Participant #6, March 29, 2005)

It is perceived by participants of this study that blogging and other forms of open publishing can help writers circumvent traditional publishing power structures thus allowing for more personal and flexible choices regarding creative control, sharing and potential collaboration.

Throughout the data-collection processes, participants shared their perceptions of power relationships regarding proprietary software and the merits of the open movement. Participants developed the idea that both proprietary software and mainstream media companies are seen widely influential concerning school technology implementation decisions and in controlling the flow of published content.

> *Education is pushed. Education depends on a lot of funding from companies like IBM and Sun, and they push commercial products and services. In this same way, education tends to be a top-down enterprise, and so they are compatible with such top-down, enterprise, centralized sorts of software.* (Downes, April 27, 2005)

> *We have a problem in the States with getting a very narrow view of important things like news, but even things like media and culture. If all the record companies are owned by essentially the same four or five wealthy people, you're only gonna hear certain kinds of music. We have one newspaper in our town, and it happens to be a Gannett News newspaper, which is one of the big monster newspaper companies in the States. And so even though it's got a local editor, it's still part of the monster conglomerate*. (Core Participant #4, Interview, June 3, 2005)

While first identifying the imbalance of power, other participants suggested that adopting open technologies could help bring elements of control to technology users over choices and freedoms regarding adopted technologies and media. In some ways, these choices

may effect corporate/institutional power relationships, and thus give greater freedom and power to teachers.

> *I am drawn to OS because of the community that surrounds it. I have problems with abdicating responsibility to an outside vendor. I do not need to be 'taken care of' with some turn key solution that a vendor sells me and then charges me forever for having made that decision. I prefer to be in control of what direction the software goes and how it meets my needs*. (Survey Participant #7, November 18, 2004)

> *The value of the open movement is not just for teens or kids, but for teachers to take control of their tools, in order to build up and share specific teaching material without the constraints of money, legal issues or the power of corporations.* (Corsi, Interview)

These power relationship can also be seen at individual levels where controlling technologies, such as digital rights management (DRM), can restrict an individual's freedom to use and view digital media.

> *I can plug in a DVD on my Linux laptop and play it. I can plug that same DVD in a modern Windows machine, and it tells me "no". I have every legitimate right to watch this thing, damn it. I rented it for my own personal use; I'm using it for my own personal use. And the fact that DRM says "you can't do it on this kind of machine" is unacceptable*. (Core Participant #2, Interview, April 27, 2005)

While the dominance of proprietary software companies and major media conglomerates is clearly identified above, participants also expressed hope that the open movement is beginning to positively rebalance such power relationships. In some cases, this rebalance is happening at government levels where legislation and policy support a national open agenda.

> *I think for the first time in a long time, there's a sense that dominance can be shaken up a little bit - the Firefox inroad into Explorer, for instance. I think*
>
> *Belgium and Brazil are going open source as public policy, and Microsoft being forced to sell software to Vietnam or Thailand for a dollar, just to keep the market share.* (Core Participant #1, Interview, June 22, 2005)

Yet in many ways, the open movement is most prevalent at grassroots levels where individuals are perceived to have choices about the technology they adopt, and these personal choices are seen as credible and empowering alternatives to others.

> *Sometimes I have a question in my mind, why should we keep sticking with Microsoft, and why not change? But it is a much bigger frame than this, because there is so much power and a monopoly from Microsoft that we cannot change. However, there are people realizing this and we see the common people, they do not have to be genius or have to be geeks. They are just trying to think different and make this change and remove themselves from this overwhelming power*. (Corsi, Interview)

> *The thing that interests me about the open source content thing is the ability for small individuals to have effects. I think more should be shared, and I think corporations are fighting a losing battle by trying to lock things down*. (Levine, Interview, May 31, 2005)

> *Actually Canadian libraries are doing it (opening content). I was at the Internet Archive, and I spent a lot of time there looking at materials and saw that they're scanning huge amounts of original documents and sharing them with the world. That to me is so exciting, and that other people don't get that - I worry that I'm too much of a zealot and can't calm down and explain it rationally to people, because for me it's such an emotional argument. Don't you want to take part in this? Don't you have something you want to give back to the world too? And then when teachers say, "I would never put my lesson plans online because someone might steal them." And I said, "That's why you put them online. And it's not stealing, it's sharing*." (Core Participant #4, Interview, June 3, 2005)

While it is perceived by the study participants that progress is being made in promoting and nurturing open activities, and thus combating corporate dominance, one participant cautions:

> *We're at a really dangerous spot here, I think, where a lot of the old powers are finally just at the point where they're realizing 'Holy crap. We could actually be usurped.'* (Core Participant #6, Interview, June 30, 2005)

Power and control are not easily lost or gained, and the antagonism between corporate/proprietary dominance and open advocates will likely continue for many years to come.

CHAPTER 6: SHARED PROJECTIONS

6.0 INTRODUCTION

Participants in this study have been affected and influenced by many facets of the open movement. For some, the use and implementation of free and open source software are common activities. For others, open and collaborative publishing methods through technologies such as wikis and blogs have proven transformative, both philosophically and pedagogically. Others embrace the increasing wealth of open content available and, in many instances, participants are publishers, editors, and redistributors of such content. In all cases, participants are advocates for open practice and technologies as they perceive the potentially transformative nature of their adoption.

In this chapter, I attempt to pull together several of the shared perceptions of participants regarding the open movement and combine these with the work of experts in the field. In doing so, I suggest to the reader possible areas for transformation in an educational system that readily adopts open practice, open technologies and what I will define in this chapter as *open thinking*. In this chapter, I discuss (a) the definition of open thinking, (b) free and open source software and infrastructure, (c) the open movement and pedagogy, and (d) the open movement and school culture. In discussing these key areas, my hope is to capture the many ideas, thoughts and perceptions of the study participants and begin to envision an educational context where openness is common.

6.1 DEFINING *OPEN THINKING*

It would be both difficult and futile to widely generalize about the beliefs, perceptions and experiences of the participants in this study. The data collected for this study came from individuals involved in all aspects of education - from administrators,

teachers and technical personnel. The institutions where these individuals work include elementary, secondary and postsecondary organizations. Through the process of this research, I have discovered predispositions and tendencies many of the participants share as they view the world, use technology, partake in knowledge construction and dissemination, and advocate for openness and collaboration. Combined, these characteristics generate what I define as *open thinking*.

I have defined open thinking as the tendency of an individual, group or institution to give preference to the adoption of open technologies or formats in regards to software, publishing, content and practice. Open thinkers critique, question and seek to reject technologies or formats that compromise the power of adopters, especially in the freedom to use, reuse, edit and share creative works and tools. Open thinkers value group-based problem solving and give preference to tools that enable social collaboration and sharing. Open thinkers actively strive to replace adopted technologies and formats with open alternatives. Open thinkers advocate for the adoption of open technologies and practice.

In the remainder of this chapter, I will describe how open thinking can be ascribed to particular contexts, specifically those related to school culture. This will include a discussion of open thinking in regards to school technology infrastructure, teacher pedagogy, and teacher collaborative culture.

6.2 FREE / OPEN SOURCE SOFTWARE AND INFRASTRUCTURE

Proprietary software are ubiquitous in the modern classroom. The vast majority of schools I have encountered in my career have been dominated by Microsoft Windows or Macintosh-based operating systems. The educational software packages running on these

operating systems have been predominately proprietary. Software like “All the Right Type,” “Inspiration,” “HyperStudio,” “PowerPoint,” “Photoshop,” “WebCT,” and “Blackboard” are commonly implemented in educational institutions around the world, at a cost and with significant restrictions on use and with the assumption of vendor dependency. These costs, both monetary and of freedom, are no longer necessary.

The Simple End User Linux (SEUL) organization supports a database of Linux implementations in schools around the world[83]. While the database is far from comprehensive, it is interesting to browse through the list and read about relatively small implementations (e.g., six computers in an elementary school in Pribeta, Slovak Republic) and major institutional implementations (e.g., 40,000 computers at Nanjing Normal University). Collectively, these cases begin to reveal changes in the long-standing dominance of proprietary software in educational institutions. In this database, the success of these liberations, and the knowledge gained, is celebrated and shared with others who may be inspired to do the same.

The one limitation of the SEUL database is that it represents only implementations of Linux in schools and does not share other types of hybrid free and open source implementation. Full-scale Linux implementation may be difficult to achieve considering the many barriers to open source adoption listed in Chapter 5. Therefore, it is important to understand that there are various levels of free and open source software penetration into the infrastructure of school institutions. My description of these adoption levels are informed by the SEUL database, my own experience, and by the data collected from participants in this study, especially as they talk about computing in their own educational environments.

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[83] http://casestudy.seul.org/

1. **Full-scale free and open source adoption.** This type of implementation occurs when the GNU/Linux operating system is installed onto all of the institution's machines. All software that is compatible with GNU/Linux is free and open source and, therefore, no proprietary software can be installed directly[84]. While any Linux distribution could be used, there are certain distributions made specifically for educational institutions[85], including Edubuntu, Freeduc, College Linux and EduLinux.

Advantages. This type of adoption is likely the most cost-efficient and compatible with the open thinking concept. This type of implementation is the most abrupt, direct way of exposing users to the free and open software, although such drastic change can be problematic. Users of the software may find it difficult to adapt to a new computing environment, and technicians need to be trained how to implement and support the software. Additionally, thin-client implementation types (e.g., K12LTSP), compatible with this level of adoption, can revive older computers for use in the classroom, potentially increasing the computer to student ratio with little additional cost.

Disadvantages. Full-scale adoption can be seen as problematic for adopters because the entire computing environment replaces a Windows or Mac OS environment with an environment that is likely less familiar. Not only would individuals have to learn new software applications, but they would also have to

[84] Some legacy Windows applications can be run on Linux indirectly (ported) through a Windows emulator known as Wine. Details on Wine can be found here: http://www.ota.be/linux/workshops/19981017/wine.html

[85] Education-specific Linux distributions can be found at: http://lwn.net/Distributions/#edu

launch these applications from an unfamiliar operating system and learn to manage files and file types in slightly different ways.

2. **Free and open source applications on a proprietary OS.** As described in Section 4.1.1, there are a number of free and open source applications that can run on proprietary operating systems such as Microsoft Windows and Mac OS X. Certain free and open source applications, such as the Firefox web browser, have gained popularity among users[86], while others like OpenOffice and The Gimp still have a relatively small user base.

This second, hybrid approach, is what we currently employ at the Faculty of Education, University of Regina, in the computer labs. We use primarily Windows-based machines for our student labs and license several proprietary software packages (e.g., Microsoft Office, Adobe Photoshop Elements). However, the Faculty of Education computer technicians also actively maintain over 120 free and open source software packages on these systems to provide FOSS exposure and software alternatives to the students. As these labs cater to preservice teachers, access to these free and open alternatives plays an important role in teacher professional development.

Advantages. Using open source software on proprietary operating systems may be less stressful for individuals who are already familiar with a proprietary operating system and only have to learn a new application. Using free and open source software on a proprietary system may spur users to adopt these

[86] SpreadFirefox.com reports that there have been over 150 million downloads of Firefox as of March 3rd, 2006. See: http://www.spreadfirefox.com/node/22360

same tools at home because they are most likely using a proprietary system there as well.

Disadvantages. While users are exposed to FOSS, they may not be explicitly aware that these tools are open and freely available or be aware of what these freedoms imply. This approach takes a more utilitarian approach to software adoption, rather than a more critical approach as congruent with the open thinking concept. Most importantly, the use of proprietary systems continues to favour the power and influence of large corporations as users are not made aware of the free and open alternatives.

3. **Multiple-boot operating system adoption.** Multiple operating systems can be installed on a one-computer system, and each of these operating systems can be accessed through a boot manager at computer startup. Therefore, a distribution of GNU/Linux and Microsoft Windows could both be installed on the same computer, giving each user the choice of which to use when booting the computer.

Advantages. Potentially, users have exposure to free and open source software on both platforms, more so on the Linux partition.

Disadvantages. While this implementation is favorable to implementation #2, users have to reboot to move from one operating system to the other, and there is little interoperability between systems. Therefore, users may give preference to one environment or another, and it would be unlikely that they would expose themselves to both environments in common practice.

4. **Mixed computing environments.** Many of the Linux case studies represented in the SEUL database represent Linux installations in mixed environments or, in other words, Linux installations used as a supplement to existing Windows or Mac OS computing systems. Participants of the study reported that these mixed environments were common in their institutions.

Advantages. Such an implementation gives direct exposure to FOSS workstations and the ability for users to experiment with their use. In such cases, users may find that FOSS systems are particularly useful for certain applications (e.g., word processing, educational games), but less useful for activities like digital video editing. With this type of adoption, users would have the ability to easily compare the advantages and disadvantages of systems at a technical level.

Disadvantages. To some extent, any implementation of proprietary software still continues to favour the dominance and power of large, software corporations.

It should be obvious that there are many possible variations of how technology can be implemented in a school setting. Choosing the type of hardware and software is not the only factor which may affect pedagogy. For instance, choices around computer placement and type (labs vs. classroom computers vs. laptops) is debated in the literature (Culbertson, 1999). Also, choices around computer security or "what teachers are 'allowed' to do on school computers" is discussed (Faronics, 2006). Solutions include locking-down all computers (no additional software is allowed), reactive approaches (allowing teachers to install software and fix problems as they arise) and reboot-to-restore approaches (using maintenance software that restores computers to a "clean" state after

each reboot). What is important to note about all of the issues noted in this section is that they all deal with power and that they all affect pedagogy. This important realization relating to choices around technology should be made evident to those who make key implementation decisions in educational environments.

6.3 THE OPEN MOVEMENT AND PEDAGOGY

Several participants in this study reflected on what they believed to be the poor state of pedagogy in current classrooms and theorized about how the open movement and associated technologies could inform pedagogical practice. Core Participant #4 writes:

> *I believe that open technologies are the future. Unfortunately, US schools currently teach students as if it were 1953. Too many of our classes are still teacher-centered, frontal lectures where the only nod to technological advances is the substitution of a PowerPoint slideshow for overhead transparencies. Schools are typically slow to adopt current (or slightly outdated) technology, yet they are even more sluggish in adopting innovative pedagogy. The processes inherent in the development of open source software may just hold the key to a new way of responding to pedagogy*. (Survey, December 1, 2005)

Core Participant #4 reflects a common theme throughout the data analysis. I was not surprised to find some literature on what is described as *open source pedagogy*. Specifically, Taylor and Riley (2005) explore the production model of open source software and apply this to teaching in composition classes. They outline several benefits of open source pedagogy, and these points are compatible with the open thinking definition I have constructed, as well as with the data collected and analyzed in the study. To summarize these points, open source pedagogy offers the following advantages:

1. **True collaborative work.** Taylor and Riley (2005) liken current collaborative practice in classrooms to the assembly-line model. In this frame, tasks are broken down into units, students develop each of these units in isolation, and then the units

are stitched together. The disadvantage of this model is that students only learn portions of the content, and students are silenced. They cannot give feedback or voice to other aspects of the project. Taylor and Riley suggest that open source pedagogy should resemble a "garage band" model, which "allows each member to create an individual part that operates within the overall project, but that may express different ideas and methods" (online).

If they are to understand this notion of collaboration, teachers need to better understand computer related technologies of communication, including the software and hardware that permeate the lives of students. As one participant critiques,

> *Here is a teacher standing up in front of a classroom full of people who are connected in ways that the teacher doesn't even know about, let alone adopt and use. Telling students things that the students know are totally false, and yet the teacher knows perfectly well that what they are saying is perfectly true. But the difference in perspective, because of the technology savvy of the students who are sitting in the classes wired together with their cell phones and instant messengers after hours, able to communicate in ways that the teacher doesn't even know exists, able to express themselves in ways that the teacher doesn't appreciate or even recognize as being communication*. (Core Participant #2, Interview, April 27, 2005)

Some technologies available today are increasingly social, and students are using these tools outside of the classroom (Oblinger, 2005). Teachers who begin to embrace the teaching and learning possibilities that these tools bring may better use innovative collaborative processes, while embracing existing student practical knowledge.

2. **Peer review communities.** Open source pedagogy also implies a change in the nature of classroom writing assignments and how these assignments are reviewed by a wider audience. Open source pedagogy enables both formal and informal

connections to individuals and communities outside the classroom. While ideas regarding online classroom collaboration and telecollaborative projects (Harris, 1995) have been around for many years, open source pedagogy emphasizes human connections as a core function of its design. Classroom learning is based around these wider community ties, and such connections are valued, highly leveraged, and not trivialized or seen as novelty. Teachers who embrace open source pedagogy see the inherent value in human connections and orient student learning in mind of these linkages.

Various forms of social software (introduced in Section 4.1.3), now widely and freely available, can assist in developing the peer-review communities described above. Blog engines, wikis, web-based word processors, object-sharing and aggregation services may assist in connecting individuals and classrooms to more distant communities. A look at *Room 208*, a weblog collaboratively developed by Grade 3s and 4s from a school in Maine, helps demonstrate the connections that are possible through social software. Here, student work is published through connected student blogs, and constructive comments on each piece are offered from students and teachers from all over the world.

This peer-review process may allow students to simply test and retest ideas as they receive often rapid, informal feedback from various voices. Assignments require communication within a community, including both the local classroom and other interested individuals. While some of these connections may be short lived, others may have the potential of being long term. In either case, the connections made may help students value and better understand collaboration in

the global context and foster the notion that the wider community can be as, if not more, beneficial for the process of developing ideas. While it can be argued that the peer-review process is not exclusive to the open source mindframe, open source pedagogy makes this process more explicit.

3. **Understanding attribution.** As in gift cultures, collaboration in open source communities usually occurs without financial reward. What is valued in collaborative cultures is attribution and recognition for effort (Raymond, 1997). In open source pedagogy, there is an emphasis on the value of one's contribution to the wider community. The attribution of ideas becomes an important function and, as Taylor and Riley (2005) argue, open source pedagogy can help to reduce traditional problems in the classroom regarding issues of plagiarism and intellectual property.

> Composition classes need a model that can incorporate ideas of collaboration, the ethics involved in writing, and the need for revision. Open Source provides this model and, with it, provides a way to foreground the nuances between collaboration, plagiarism, and citation—large issues in composition classrooms. (online)

Earlier in this dissertation (Section 4.1.2), participants described their practice regarding student publishing and, more specifically, how the idea of copyleft/Creative Commons publishing was addressed and promoted in the classroom. Open source pedagogy explicitly helps students learn and understand the importance of their contributions to the wider knowledge community, the processes of publishing for collaboration, and the power dynamics implicit in the act of licensing intellectual 'property.' Certainly, open source pedagogy as it applies to licensing carries with it a copyleft, power-to-the-consumer bias. However, greater

emphasis should be given to the idea that individuals have choice in the publishing and licensing of their creative ideas.

4. **Building lasting resources.** Open source pedagogy shares commonality with the underlying notion of learning object repositories discussed in Section 4.1.2. *Learning object repositories* are mechanisms developed for the storage, sharing, and collaboration of learning materials. Such mechanisms are important for sharing cultural and educational artefacts in open communities, and such repositories (although not necessarily as complex as those listed in 4.1.2) are ideal for the archiving and further development of student work. As Taylor and Riley simplify, "work done by students could also provide lasting resources for the larger community; the projects could exist as resources for later classes to work on and improve" (online).

Open source pedagogy, in regards to building lasting resources, differentiates itself from a pedagogy that is traditionally ahistoric in regards to former student work. While it is common, from my experience, to see teachers highlight exemplary work from former students as a mechanism for 'setting the bar,' the majority of student work and ideas are lost on an annual basis. While the emphasis on developing peer review communities can help to connect individuals and communities across geographic regions, learning object repositories can help connect individuals and communities across spans of time. As Faber (2002) writes,

> An open source classroom would extend projects from a single term or semester and would build in tools for handing each project over to a new group. . . . This approach would teach students to see themselves as part of a larger trajectory of work rather than as solitary instantiations of one project. In addition, it would teach them to make temporal connections in their work spaces—connections to both the past and the future. As such, it

> would teach students about the interdependence of project-based work and how their own work fits within larger frameworks and communities. (p. 34)

5. **Deconstructing power and dominance in creativity and publication.** As part of my open-thinking lens, I emphasize the critique of power and dominance inherent within creative and publication processes and in the technologies typically supporting these activities. While Taylor and Riley (1995) do not pursue this particular line of thinking, I believe this to be a vital component of any envisioned open source pedagogy.

In *Technopoly*, Postman (1993) writes, "New technologies alter the structure of our interests: the things we think *about*. They alter the character of our symbols: the things we think with. And they alter the nature of community: the *arena* in which thoughts develop" (p. 20). These alterations can be argued to exist in regards to one's relationship with formalized education. For example, how do class assignments affect what students think about? How are these thoughts represented? What is the manner in which these thoughts are brought into, embraced and formed by the community? How might the provision of open content or open publishing affect the outcomes of these same inquiries? Open source pedagogy could assist students and teachers in asking critical questions such as, why do I create? How should I publish? Whom do I serve through my creative works? And. is my creativity benefited by collaborative processes? The open source movement is inherently a reaction to power and dominance as it reflects methods of democratizing creative processes, publishing and creativity (Jesiek,

2003). Therefore, any envisioned open source pedagogy must reflect these critical and deconstructive approaches.

Open source pedagogy is an implicit critique of educational systems and how learning occurs in these formalized environments as compared to learning as it occurs in non-formalized environments.

> Students now teach themselves on IM, email, and phone messaging as they decipher the silliness that teachers subject them to. Home schooling is on the rise. They know the real point of school is to get an adequate grade on the test so they can move ahead. They know that real learning happens someplace other than school. They know that the Educational Establishment has no more idea than the average lawnchair about the reality of the Cluetrain[87] world. (Anonymous, Survey, Feb 23, 2005)

The Internet, social software, open publishing, and open content challenge the power of schools as the fount of knowledge in society. Institutional credentialism (discussed in Section 5.1.5) is critiqued as individuals discover new ways and environments in which to learn. As students become more connected to sources of knowledge and to informal knowledge creation/dissemination processes, educational institutions may lose credibility.

6.4 THE OPEN MOVEMENT AND SCHOOL CULTURE

School culture is complex. In defining *school culture*, Peterson (1994) writes:

> This unique quality of each school, the *school culture,* affects the way people act, how they dress, what they talk about or never speak of, and whether or not they seek out colleagues for help. The school culture is a complex web of norms, values, beliefs and assumptions, and traditions and rituals that have been built up over time as teachers, students, parents, and administrators work together, deal with crises, and develop unstated expectations for interacting and working together (online)

[87] http://en.wikipedia.org/wiki/Cluetrain_Manifesto

To assume that school culture, as a whole, can be easily and radically changed through the mass adoption of any philosophical lens would be entirely too optimistic and simplistic. In any organization, there are resistors to change who will remain firm in their long-held beliefs (Fullan, 2001). Yet, the results of this study provide optimism in that the open movement, and particularly open thinking, has the potential to transform one particular aspect of school culture - the way in which teachers collaborate, create, and share knowledge.

Several participants reflected that the open source model of collaboration could be an ideal for school culture. But, participants also identify barriers to such change.

> *Teachers are not encouraged to collaborate or share with their colleagues. There is little to no time built in the school day for teachers to spend time together, and when there is (staff meetings, department meetings) the time is usually spent on "school business" such as schedules, discipline, supply purchases, etc., rather than anything regarding innovation. The open movement could be a model for teachers and schools, both as a way to share ideas within a school, but also as a way to bring the rest of the world into the school.* (Core Participant #4, Survey, December 1, 2005)

> *According to Negroponte, bites of digital knowledge could be shared without loss for the person that shares that info. That is the nature of digital information, it's lossless. If our staff of teachers could resign away from their selfish attitudes of "I know something that you don't," the benefits for our young people and for our community would be fantastic*. (Corsi, Interview, June 1, 2005)

> *I'm not sure how you can bring open thinking into schools as it's very difficult to change an existing, entrenched institution. It hardly ever happens. In fact, it almost never happens, and the usual way these things work is that an alternative institution or forum springs up alongside the existing institution and then, there's a generation long change as you migrate. It's pretty much like the transition from trains to airplanes. We didn't try to convert our train system into an airline network. Air sprung up as an alternative form of travel to train, and it was first used by only a few, but the premise was that air travel is completely different. And, gradually as it proved its worth, people moved to it*. (Downes, Interview, April 27, 2005)

> *The more you think about it, the tougher it is to implement an open model of collaboration in schools. People are now working in their basements, independently of each other, and not a lot of people are really working together to solve problems or joining in on the whole community aspect of things. There are currently so many political and bureaucratic things that are separating people*. (Richardson, Interview, May 17, 2005)

It is widely perceived by the participants that an instituted, top-down collaboration model is unlikely to succeed in a school culture. Participants cite barriers that include administrative/bureaucratic factors, the duration of time necessary for long-term change, and current attitudes of teachers regarding sharing and collaboration. If the culture of collaboration in schools is to change in favour of an open thinking model, the catalyst for this change will be indirect and decentralized, assumptions that are characteristic of the open movement itself. Furthermore, as Downes argues above, it may not be schools at all the change. Rather, alternate forms of learning may emerge that slowly become a viable alternative to the traditional, institutional model. Over time, a new model of learning may supercede the old.

Ryder and Wilson (1997) came to similar assumptions regarding a decentralist model for the adoption of innovation in studying the development of the Collaborative Online Support System (COSS), a software-based support infrastructure developed for engineering professionals. Ryder and Wilson, borrowing heavily from complexity theory[88], discovered that the hierarchical control structure initially devised for this knowledge-sharing platform was actually inhibiting the sharing of knowledge by individuals. In other words, the structure that was designed to support innovation and collaboration itself became a barrier. It was not until new assumptions regarding knowledge and control were made that the environment could be redesigned to support

[88] http://en.wikipedia.org/wiki/Complexity_theory

innovation. These new assumptions developed in part by asking some of the following key questions:

- Who owns the information?
- Who maintains the information?
- Who assumes mediating roles, assessing values, and worthiness?
- What central tasks remain?
- What factors promote or inhibit the sharing of knowledge?
- Who is accountable for the veracity of new information?
- What self-organizing patterns emerge as users take control of the environment?

When the responses to these questions shifted from institutional control toward decentralized, community control, the software designers responded and the structure became more conducive to knowledge sharing and collaboration.

Ryder and Wilson (1997) also argue that perceptions of knowledge and the types of knowledge available to a community are also important considerations in supporting innovation. First, the authors give favour to the definition of *knowledge* as "an attribute of an interaction" (Winograd & Flores, 1986), rather than the more traditional view of knowledge as commodity or representation (Haugeland, 1989).

> An objective repository, whether an encyclopedia or a rule-based expert system, is a closed system whose contents are fixed in time and space. Closed systems lend themselves to quantification, stability, and control. In contrast, the human mind is an *open* system which resists quantification and adapts readily to its environment. Information is not stored anywhere in particular. Rather, it is stored everywhere. We subscribe to the idea that *knowledge is not a fixed commodity, but a function of our interactions with external resources, including tools, media, other humans.* (Ryder & Wilson, 1997, p. 3)

Second, the authors identify that knowledge in a distributed, digital environment can be divided into several categories. Three of these defined *knowledge spaces* are important to this section, and include:

1. *Public knowledge*. This is knowledge compromised of information that has been published or made public. Such knowledge is usually seen to have a degree of veracity, to have undergone some degree of vetting and to be more stable or static.

2. *Collaborative knowledge*. This type of knowledge is in an on-going state of development and is, by definition, constructed through group processes.

3. *Shared personal knowledge*. This type of knowledge contains notes, memos, reflections and other types of information that is specific to an individual contributor, but also available to the wider community.

In the above model for knowledge construction and collaboration, two assumptions are made. First, knowledge construction is more important than the knowledge itself. Second, the process of knowledge construction and collaboration should occur in spaces that give variation to the types of knowledge produced, the producers of that knowledge, the protocols for knowledge production, and the emphasis on formal versus informal knowledge.

In contemplating the assumptions above, reading through the data, and reflecting on my own experience in working within educational institutions, I see that knowledge construction and dissemination processes found in modern schools are incompatible with emerging open models of distribution. Modernist notions of knowledge[89] view curriculum as complete and view teachers as those who transfer this knowledge from themselves to their students. The postmodern lens[90], one that demonstrates compatibility with the open thinking model, reflects a need for teachers to redevelop their respective positions. As Usher and Edwards (1994) argue:

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[89] Jardine & Abram (2000) suggest that modernist view of knowledge "separate mind and body, thought and experience, self and other, human and nature…"

[90] The postmodern lens is used by theorists to refer to aspects of contemporary art, culture, economics and social conditions that are the result of the unique features of late 20th century and early 21st century life. Such features include globalization, consumerism, the fragmentation of authority, and the commoditization of knowledge (adapted fromWikipedia - http://en.wikipedia.org/wiki/Postmodern)

> [I]t is impossible to be a teacher without also being a learner, that in order to be a teacher it is first necessary to abandon the position of the "one who knows," recognizing both one's own lack of knowledge and of self-transparency and mastery and that one's own learning is never, and never will be, complete. (p. 80)

And while moving toward this more active view of knowledge is necessary for open thinking, Usher and Edwards (1994) further their argument by emphasizing the deconstruction of power relationships between teachers, students, and learning.

> For this, teachers need to be trained to analyze what is repressed in order to foreground the affects, release the emotions [and imagination], and broaden the sense of fulfillment. The pupils would then be allowed to extend their analysis to their environment. To create the space they live in rather than just fit in with the set rules. Literally. To paint. To build. To co-operate. To participate. The limit then would be the analysis of the transference. (p. 80)

As the analysis in this section suggests, collaborative communities of innovation are not easily formed within current contexts. Participants of this study perceive school culture as centralized, bureaucratic, and, therefore, restrictive to the development of innovation. It is believed that some progress in supporting innovation may be discovered in light of redefining the view of knowledge in school organizations and in developing a decentralized, distributive infrastructure where individuals are encouraged to participate in varied knowledge spaces, through both formal and informal creative activities and communities. Alternately and ideally, major changes to educational processes within society may need to occur. Existing power structures (e.g., schools, boards of education) will need to be revamped, reorganized and reinvented as their relevance as centres for producing a knowledgeable public becomes questionable as informal modes of learning emerge.

6.5 CONCLUSION

In this chapter, I have defined the term *open thinking* and have described how the concept can be ascribed to the educational context through an open source infrastructure and open pedagogy. Additionally, I have described how the open movement and open thinking could potentially shape and transform school culture. In my wide reading of the literature - both refereed publications and web-based articles - I have yet to discover an educational environment that has been (allowed to be) wholly transformed by the open movement, and thus, my conclusions remain mostly theoretical. However, implementation models, with many of the characteristics I have described, are beginning to emerge and, thus, my theories are initially supported outside this research.

An excellent example of open thinking implementation lies in the case of Elgg, technology described as "an open source learning landscape platform." As described on the Elgg project website[91]:

> Elgg is the creation of Ben Werdmuller and David Tosh. The concept behind the system is to develop a fully customizable learning landscape. To achieve this Elgg is a hybrid of weblogging, e-portfolios and social networking. It is hoped this combination of features will provide an engaging environment for learners to create their own learning space and then connect to others, forming online communities of learning.

Elgg development is based on years of accumulated theoretical knowledge related to developing personal digital portfolios, but has been obviously influenced by the advent of social software and the rise of social networks like MySpace and Friendster. Moreover, the premise of Elgg as a "personal learning landscape" rejects the previous course management system notion that students are added *to* courses. Rather, students and their "digital identity" are central to the Elgg platform, and, thus, courses (or any other

[91] http://elgg.org/about.php

learning artefact) are added *to* a student's learning landscape. The learner's digital world always remains central.

Elgg can act as a digital platform applied to serve specific educational needs of an institution. The adoption of Elgg, or of any open source platform, does not represent whole-scale adoption of openness within an institution. Yet, the characteristics of Elgg, from its development to its possible implementation, imply key characteristics from the open thinking model represented earlier in this chapter. These characteristics as described include the following.

1. **Open source licensing.** The Elgg platform/software is licensed and distributed under a GNU General Public License (GPL). As highlighted in Section 2.1.3, this allows interested individuals and groups to freely use and modify software source code under the presumption that the edited code will be made available to the larger community and that the software cannot be sold for profit. Distributions of GNU/Linux are also licensed under a GPL license and are an attributed factor to successful development. Distributing Elgg under the GPL allows other educational institutions to incorporate the software into their local environments and, as well, encourages the growth of a larger development community. As of May 8, 2006, there were over 40 educational institutions and organizations listed as active users of Elgg[92].
2. **Open pedagogy.** The Elgg interface is learner-centric, yet in principle relies on and encourages users to connect to a larger social framework. Learners have access to several social tools (e.g., a blog, file storage, tagging, aggregation) through Elgg that give the ability to develop one's learning space through digital connections

[92] http://elgg.org/feedback.php

with others. This may foster the key points described in Section 6.3 including true collaborative work, the development of peer-review communities, understanding attribution, and the building of lasting resources. Additionally, Elgg allows users to give access rights to all of their digital objects. Thus, users have the option of sharing their digital objects with the larger community or restricting access by others. This act of control may allow users to behave more consciously in decisions related to the sharing and distribution of content.

3. **Knowledge spaces.** Knowledge spaces available to a community were identified in Section 6.4 as public knowledge, collaborative knowledge, and shared personal knowledge. While such knowledge is available to most terrestrial communities, online digital communities can make such spaces more explicit. Elgg, through the access controls and social tools described above, helps to define these important knowledge spaces, yet blurs the boundaries between such areas.
4. **Integration/Interoperability with other tools.** While course management systems such as WebCT or Blackboard have taken mainly monolithic, architectural approaches, Elgg is designed to work well with other existing and emerging tools through its adherence to web standards and protocols (e.g., FOAF, RDF, RSS, IMS). The development of Elgg seems to follow the philosophy described by Weinberger (2002) as "small tools, loosely joined," that the potential of the Internet will come through understanding the need for links between tools, individuals and groups, and in not attempting to create single, massive structures that attempt to do it all. And, in view of this philosophy, Elgg's functionality expands well beyond the capabilities and pursuits of its own developers to bridge the innovations of other

social tools such as del.icio.us, Flickr or LibraryThing (all described earlier in Section 4.1.3).

I have used Elgg here as a microexample of how open thinking principles can lead to success in the development of successful collaborative spaces. Certainly, Elgg is not the end-all in this argument; as in practice, it is usually implemented only as an extension to institutional programming (e.g., an eportfolio program for students or a knowledge management tool for staff). However, I believe this to be a telling example of how an open thinking model can nurture change in a culture of innovation. Weinberger (2002) writes, “the web is enabling us to rediscover what we've always known about being human: we are connected creatures in a connected world about which we care passionately”. In the next chapter, I attempt to bring together how open thinking and our connected world can effect change in the larger educational context.

CHAPTER 7: FINDINGS AND CONCLUSIONS

7.0 INTRODUCTION

I have concluded that four distinct questions have risen from and been addressed by this research. These questions are first presented here, in the final chapter, for two reasons. Grounded theory promotes the process of discovery. As the focus of this research is unique, it was initially difficult to construct questions that could accurately represent the phenomena within this emerging context. However, as the data emerged, the guiding questions themselves appeared and were transformed. To paraphrase, the emerging data analysis informed the emerging guiding questions for this study. The questions provide a framework for the development of this final chapter. The questions and the underlying conclusions presented in this chapter are written simply to allow for greater access to the theories derived from this research. The questions framing this final chapter include:

1) What is the open movement as it applies to education?
2) What effect might the adoption of the open movement and its embedded epistemologies have on education in institutions and societies that adopt it?
3) How can the activities inherent within the open movement be supported and nurtured in educational environments?
4) What are the potential barriers to the growth of the open movement in education?

This chapter will be constructed in the following manner. The next four sections will focus on each of the four questions outlined above. Following this discussion, two

sections will conclude this dissertation. These final sections will address areas for further research and concluding thoughts and theories resulting from this research.

7.1 DEFINING THE OPEN MOVEMENT

In Section 1.3, I defined the open movement as " a tendency by individuals to work, collaborate and publish in ways that reflect ideals of the open source and/or free software movements. Additionally, the movement also reflects a tendency and a preference by individuals to use tools that are available under FLOSS licenses." This definition was useful throughout the research as a basic frame for context. However, my understanding of this movement has been informed through the data analysis, and I have expanded this basic definition.

The open movement is an informal, worldwide phenomenon characterized by the tendency of individuals and groups to work, collaborate and publish in ways that favour accessibility, sharing, transparency and interoperability. Advocates of openness value the democratization of knowledge construction and dissemination, and are critical of knowledge controlling structures. The open movement challenges existing political, societal and corporate structures that hold power, dominance and control over knowledge, and over the tools needed for its creation, distribution and dissemination.

The open movement in practice is characterized by many local and worldwide initiatives. I have listed examples of such initiatives below and have categorized these into various, relevant strands. These examples are included here and not in an appendix to demonstrate the breadth and diversity of the open movement in society. Awareness of these open initiatives, and others, is important for their success.

- **Software:** The Free Software Foundation[93] is an organization dedicated to creating robust, free distributed software.
- **Media/Art:** The Creative Commons[94] is a non-profit organization that offers content creators an alternative to disseminating their creative works with full copyright. Librivox[95] offers audio recordings of books in the public domain. The audio recordings are created by Internet volunteers.
- **Government/Civic Data:** HowTheyVote.ca [96] is a volunteer service that provides information on how individual Canadian Members of Parliament vote on every issue served in the House of Parliament.
- **Infrastructure:** Île Sans Fil[97] is a non-profit community group devoted to providing free public wireless internet access to mobile users in public spaces throughout Montreal, Canada.
- **Hardware:** OLPC[98] (One Laptop Per Child) is a non-profit organization spawned by MIT to research the feasibility and development of low-cost notebook computers for developing nations.
- **Academic Research:** DOAJ[99] (Directory of Open Access Journals) lists many of the new and emerging open access journals now available to support and disseminate academic research.
- **Information:** Wikipedia[100] is a free, multilingual, online encyclopedia written and maintained by authors from across the globe.
- **Biology:** GRAIN[101] is an international non-governmental organization which promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge.
- **Learning Objects/CourseWare:** MIT OpenCourseWare[102] is a free and open educational resource for faculty and students, provided by MIT. UC Berkeley Podcasts[103] is a collection of webcast courses from the University of California Berkeley.

Underlying all of these initiatives is a desire by collaborating individuals to support openness, transparency and access of knowledge. In the next section, I focus on the potential effects of the open movement in the context of educational communities.

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[93] http://www.fsf.org
[94] http://www.creativecommons.org
[95] http://librivox.org
[96] http://www.howtheyvote.ca
[97] http://ilesansfil.org/tiki-index.php
[98] http://laptop.media.mit.edu
[99] http://www.doaj.org
[100] http://www.wikipedia.org
[101] http://www.grain.org
[102] http://ocw.mit.edu
[103] http://webcast.berkeley.edu

7.2 POTENTIAL RESULTS OF THE OPEN MOVEMENT IN EDUCATION

Chapters Five and Six detailed several perceived benefits of the open movement and open thinking in education. In this section, I summarize the key findings from this data analysis and provide a frame for understanding the effect of the open movement and its embedded epistemology on education.

7.2.1 Access

Access is potentially one of the greatest benefits of the open movement in education. However, the term is ambiguous and therefore, is clarified here in respect to the educational context. The open movement may support access in the following ways:

Access to Hardware: Initiatives like the OLPC (described earlier) may soon benefit individuals with no or limited access to computing equipment. While the promise of low-cost hardware has the potential to benefit learners in developing countries, there are also opportunities that can benefit the majority of North American schools. For instance, the K12LTSP[104] project provides software that can bring new use to older, outdated computers. While proprietary operating systems (e.g., Windows, OS X) require greater base hardware specifications, K12LTSP requires only modest hardware requirements and could improve student to computer ratios with little additional cost while making use of computers thought to be obsolete. Dozens of case studies, success stories of broadened access in K-12 schools, are documented at the K12LTSP case study website[105].

[104] http://www.k12ltsp.org
[105] http://www.k12ltsp.org/casestudy.html

Access to Software: Open source and free software programmers have developed hundreds of applications that are relevant for the educational context. Throughout this study, participants spoke to their use of educational applications in practice. These free and open applications provide comparable replacements to almost every proprietary package available. A relatively comprehensive list of some open source and free applications can be found at Wikipedia[106].

Access to Networks: Since the late 1990's, Industry Canada has made digital connectedness a key priority across the nation.[107] This agenda fostered wide-scale broadband connectivity across Canada through schools, and government institutions, while strengthening the capacity of private telecommunication companies to provide subscription access to sparsely populated areas. Before the end of this decade, free, wireless access is likely to become ubiquitous in larger, urban areas. City-wide free wifi projects have already begun in North American cities such as Montreal, Toronto, Seattle, Dayton, Austin and the New York City park system.

Access to Information/Media: Even before Wikipedia and the OpenCourseWare project gained prominence, low-key initiatives such as Project Gutenberg[108] began to leverage the potential of digital distribution by archiving and making available public domain literature in the eBook format. Media for, and produced by the masses, is becoming the new focus for web activity, and this phenomenon can be characterized by the success of services like the Creative Commons and YouTube, services in which individuals can license, share and distribute their own, locally developed media. Blogging, podcasting, vodcasting (video-blogging), moblogging (mobile-blogging) are

[106] http://en.wikipedia.org/wiki/List_of_free_software_packages
[107] http://www.ic.gc.ca
[108] http://www.gutenberg.org

becoming the habits of choice for young netizens, and these activities are reshaping the balance between production and consumption in the digital landscape.

Critique: Collectively, greater access to hardware, software, networks and information/media have the potential to transform educative practice. As a classroom teacher and as a faculty advisor for preservice teachers, I have witnessed the reluctance of teachers to assign certain homework activities or to integrate technology into lesson plans due to the variance in students' access to information and communication technology. Access, in the context of education, will always be problematic for at least three reasons. First, access will likely never be uniform, across all school divisions, towns, cities, provinces/states or nations. I agree with Postman (1998) as he writes, "the advantages and disadvantages of new technologies are never distributed evenly among the population." (online). Governance and administration, at whatever level, shapes the level of access at each individual school, and in each community. Furthermore, political interference often imposes artificial/technical restrictions on access (see numerous reports of the MySpace social networking service being banned from schools). What may be accessible to a teacher or student at home is unlikely to be congruent with what is available in the school environment. Second, teacher/student knowledge *of* access is often incomplete. For instance, while OpenOffice.org is a viable alternative to the proprietary Microsoft Office, very few students or teachers that I speak to know that it exists. Access *to* often does not equate to knowledge of or utilization. Third, teachers and students may not have the knowledge of how it is best to utilize our increased access to information. While broadband and access to materials is increasing, many teachers favour wholesale transfer of information as a teaching method. Rather than seizing the

opportunity to produce, modify and redistribute forms of knowledge (i.e., as found in the Gift Economy or Web 2.0), many teachers continue to work within primarily consumption paradigms.

The open movement is enabling in that it provides alternative sets of tools, knowledge bases and publishing mechanisms. Advocates of openness, as described in this study, strive to make others (e.g., colleagues, family members, students) aware of these alternatives to proprietary sources. Given the marketing power of large corporate entities, it is only through these grassroots efforts that such alternatives can be developed, sustained and made available to the general public. Without open advocacy and continued open development (e.g., open source software, open content, open publishing), access may someday be limited to only proprietary forms.

7.2.2 Adaptability/Transparency

Educator use, reuse and adaptation of online resource materials has been well researched and documented (Littlejohn & Page, 2003). Additionally, the recent popularity of institutional learning object repositories characterizes the desire of educational institutions to formalize the collective sharing and collaboration of teaching and research personnel (Couros & Brogden, 2006). Thus, it is not surprising that the participants of this study emphasize the importance of adaptability and transparency of educational tools and content.

To understand the importance of adaptability and transparency of tools and content in the open context, it is useful to understand the open movement as a gift economy. As highlighted in Section 2.1.6, in gift economies, artefacts or work is

exchanged forming a bond of mutual obligation. Those who partake in gift economies hold realistic expectations that one's individual contribution will be returned with a gift of equal or greater value. Where commodity-exchange economies are faced with the "law of diminishing returns"[109] gift economies are potentially self-sustaining and long-term, depending on the need of their members and the quality of the contributions.

The Moodle community[110], an online community based around the Moodle learning management system, is a prime example of a micro gift-economy formed to support an educational need. With over 100,000 registered users, the community user forums are rich with interactive commentary supporting: the implementation and installation of Moodle, pedagogical principles of the Moodle environment, use of specific tools (e.g., Gradebook, Blogs, Calendar system), teaching strategies, bug lists, ideas for further development and the sharing of code for localized adaptation.

The Maricopa Learning Exchange, an institutional learning object repository highlighted in Section 4.1.2, is a strong example of an institutionalized gift economy formed around content creation, distribution and adaptation. Items in the repository are categorized by key words and easily searchable, and for developers, content packages are easily added or adapted. All items are licensed under Creative Commons licenses and thus, reuse and adaptation is less restrictive than full copyright.

Critique: The Moodle community and the Maricopa Learning Exchange are examples of successful online communities that support educational practice. However, it's important to note that not all open (source) communities or projects are successful. There are hundreds of stalled or dead open source software projects found at

[109] Wikipedia - http://en.wikipedia.org/wiki/Diminishing_returns
[110] http://moodle.org/course/

SourceForge, and the success of many institutional learning object repositories is questionable (Nash, 2005). As the literature emphasized in Chapter Two suggests, viable online communities are difficult to develop and sustain. I have witnessed failure in attempting to develop preservice teacher blogging communities. It quickly became clear to me that online communities are much more complex and difficult to maintain than they may initially appear.

Of the digital era, Weinberger (2005) observes,

> We're linking to one another, disagreeing, amplifying, making fun, extending, sympathizing, laughing. We are talking with one another, thinking out loud across presumptions and continents. If you want to know about an idea, you could go to an encyclopedia and read what an expert says about it. Or you could find a blog that talks about it and start following the web of links. You'll not just see multiple points of view, you'll hear those points of view in conversation. That's new in the world.

While connectedness is an integral component of online networks, it is important to recognize that such systems include its objects (i.e., content and tools) and inherent communicative processes. It is erroneous to think about social networks as consisting simply of people. Social networks consist of people connected by shared objects or interests. Without these connecting commonalities, community members will see little benefit in membership. In a thriving open community, resources must match the needs of its members.

7.2.3 Economics

There is a general consensus by study participants that the adoption of open source software and open content into educational settings potentially results in

significant cost-savings. Dozens of case studies at SEUL[111] also support this finding via detailed descriptions of open source software implementation. However, what may be more difficult to assess economically is the impact that localized development of software/content has on individual school districts and institutions. Rather than schools paying for annual licensing costs of either software or content, this money can be redistributed to support localized development of tools and materials. This form of economic redistribution has been realized by some developing nations in their move to open source software development.

> When a country goes OS, it changes its relationship to the world economy. It is no longer just a market for developed world know-how. It moves to becoming (to the extent that local coders are contributing to OS projects, and thus developing skills) a maker of knowledge…. Developing countries with an open source approach become participants, nationally, in a collaborative culture of problem-solving which has implications far outside the realm of software and which ideally suits countries with lots of smart young people and not much cash. (Oni & Onibudo, 2006, online)

While school media/information resource costs will never totally disappear, there are strong economic as well as pedagogical factors that would warrant localized content and tool development.

When I first began teaching undergraduate courses related to technological integration in 1999, I remember touting a student technology project that began in a school in Apex, North Carolina. The SWAT (Students Working to Advance Technology) Team Project[112] worked to make students responsible for school technology integration activities. In other words, students assisted teachers in setting up computer labs and equipment, making PowerPoint presentations, assisting younger students with web searching, etc. Now, in light of what I have discovered through this project, I see the

[111] http://casestudy.seul.org
[112] http://www.ncsu.edu/meridian/jun98/feat2-5/feat2-5.html

possibilities of developing sustainable technological infrastructures in schools through learning experiences of students. Through open activities (e.g., software/content development, publishing), students can potentially support and co-develop school technologies (e.g., learning course management systems, school webpages) while learning valuable skills related to technology. More importantly, openness in this respect, has the potential to connect students to supportive communities of educational technologists, and others students with similar goals.

Critique/Caution: From my own experience and from the sentiment expressed by participants, it is important not to treat open source cost savings as an economic windfall that can be directly reallocated to other programming areas. Open source software and open content development *do* require significant support and maintenance time, and thus, there are human costs that must be calculated, budgeted and compensated. If one is to involve students or staff in developing a supportive technological infrastructure, it is important to support these activities with appropriate and flexible funding structures, especially throughout initial stages.

7.2.4 Institutional Change/Pedagogy

In Chapter Five, the topics institutional change and pedagogy are addressed as separate items. In practice, the pedagogical principles of an educational institution rarely affect its overall organization or structure. School structures are often more greatly influenced by business practice than by teaching. However, it is my hypothesis in this section that if we begin to embrace principles of openness in education, we can achieve a greater congruity between the institutional structure and the pedagogical practices

prevalent within the institution. In other words, pedagogical practice inspired by openness can inform the architecture of the learning institution.

I begin with the issue of networks, and how the networks used and formed by the study group of participants differ so radically from those typical in the educational context. Regarding social networks, Jarvis (2006) writes:

> Networks are about sharing now; they used to be about control. Networks are two-way; they used to be one-way. Networks are about aggregation more than distribution; they are about finding and being found. Networks are now open while, by their very definition, they used to be closed. You join networks and leave them at will; you can join any number of networks at once and content can be found via any number of networks, there is no practical limit. Networks used to be static. Now networks are fluid. (online)

Networks found in our traditional schools are more closed than open. A teacher may have professional and social contacts that span the globe, but these are likely rare. Teacher practice and content knowledge are more likely shaped by geography than by digital connectedness. In contrast, the practical and content knowledge of the study participants was informed by a much broader frame of reference. Beyond the usual localized relations, participants were connected to a greater social network that informed their practice, and their beliefs and perceptions regarding education. Perhaps more important, participants engaged in both consumption *and* publication. Knowledge was shared and exchanged, not simply taken. The figures below express the contrast between the communicative structures of a typical teacher (simplified) and those of teachers who embrace and participate in an open and distributive culture.

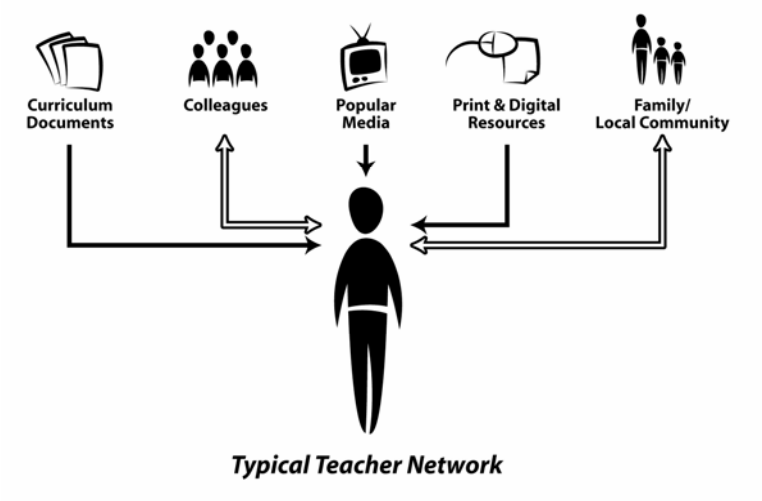

Figure 5. A typical teacher network.

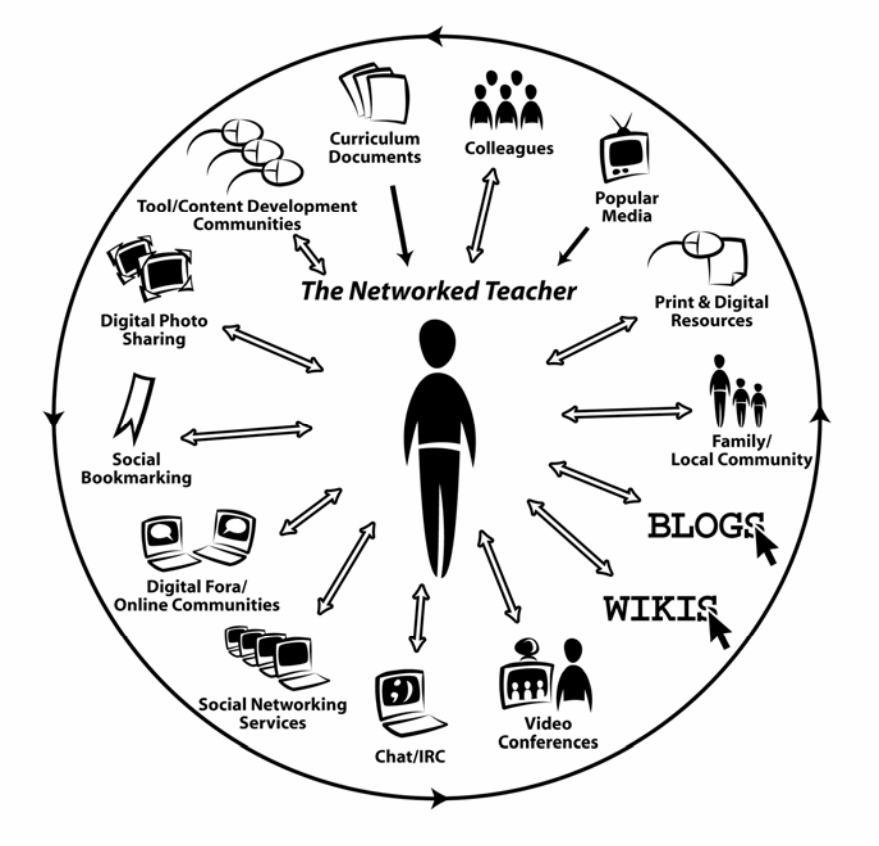

Figure 6. The networked teacher.

These two figures are meant to represent ranges of communicative structures and connectiveness of teacher networks. These illustrations are not meant to be exact snapshots of any particular teacher network. Rather, they are used here to demonstrate the possibilities on either end of the spectrum

If we begin to embrace Jarvis's (2006) idea of the limitless and openness of networks, and combine this with the richness of resources we can establish through these connections, we can begin to see potential changes in pedagogy. It is already beginning. Take, for instance, Bob Sprankle's "Room 208" classroom blogging/podcasting project.[113] This project highlights the publishing activities of a classroom of American Grade Four students who are beginning to use social publishing technologies. Many student publications (e.g., poems, short stories, podcasts) featured on the website are reviewed by individuals from other states and countries. Students are often given immediate feedback on their work, not only from their teacher, but also from a larger, informal web community. Then there is the Open Student Television Network (OSTN), a multicast, 24/7 digital channel delivered over Internet2.[114] The channel features video produced by university and college students from countries around the globe. OSTN is one of many services that have emerged recently (e.g., YouTube, CDigix) offering free distribution mechanisms for digital work. These are examples where institutional boundaries and the tradition of information consumption is transformed through distributed, open publishing and informal feedback mechanisms.

We *could* stop there. Fully incorporating social networks/networking into our school culture could provide many changes both structurally and pedagogically. But if we

[113] http://bobsprankle.com/blog
[114] http://www.internet2.edu/

did stop there, we would miss much of the essence of the ideas discussed in Section 5.1.5. An important characteristic of openness and open thinking is its inherent antagonism toward structure and hierarchy. As knowledge consumption and publication become more greatly distributed, and social networks become a greater part of a learner's experience, what becomes of the institutional role? What happens to the teacher's role? Will educational institutions and teachers continue to simply exist as guardians of an approved curriculum, credentialism and accreditation? In writing about changes in pedagogical practice due to increased connectedness and openness, David Warlick (2006) writes:

> ***Education, defined by it limits***, required a curriculum that was packaged into products that could be easily used in the classroom. We used textbooks with scope and sequence, pacing guides, and a teacher's guide with the answers.
> ***Education, defined by it's lack of limits***, requires no such packaging. It's based on experiences, tied to real-world, real-time information that spans the entire spectrum of media — crafted and facilitated by skilled teachers, who become more like tour guides than assembly-line workers.

When we fully embrace this notion that educational institutions should not be the keepers of knowledge, and that *the role of education is better realized through teaching how to learn rather than teaching what to learn*, we may have revolutionary change in our schools.

Critique: Simply said, educational change is complex. While the previous comments are optimistic, it is understood that openness, distributive social networks or any form of technology should not be seen as a panacea for education. Furthermore, the type of institutional change discussed here, while providing many diverse opportunities in some respects, may still restrict access to learners with limited technological skill or equipment. Access to digital equipment, even though potentially broadened through the open

movement, may still likely never be universal. Additionally, learner styles and characteristics of students must be acknowledged. Learners are not uniformly motivated, focused and independent, and this must be taken into account as pedagogy is transformed.

Perhaps more importantly, participants have expressed that it is difficult to change established institutional power relationships. Opening education to informal educational processes can be met with resistance. This resistance is sometimes demonstrated in the tendency of those in power to increase control of educational processes. In responding to such phenomena, a school administrator (Survey Participant #15, June 5, 2006) writes:

> This ties in with some struggles I've been having with how schools seem increasingly driven to "protect" students from connectivism[115]. I hear other school district technology directors talking about stronger filtering, going to RADIUS authentication[116], locking the networks down tighter, preventing access to virtually every interpersonal communication tool available: chat; blogs; social networking sites; VOIP; and of course all peer-to-peer sharing.

While emerging research in various disciplines (neurology, systems thinking, chaos theory, network theory) characterizes the nature of learning as increasingly social, connected and distributed (Restak, 2006; Senge, 2006; Gleick, 2002; Barabasi, 2003), learning in schools often resembles corporate learning environments in that it is still generally structured and hierarchical. The power relationships inherent in our schools must be recognized and upset before significant changes can be realized through open pedagogy.

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[115] Connectivism is a learning theory related to openness and connectivity developed by George Siemens (2004).

[116] A tight, secure authentication protocol designed to control access to computer networks.

7.3 BARRIERS TO THE OPEN MOVEMENT IN EDUCATION

In Section 1.3, I shared the success story of Peter Rock-Lacroix, the participant who successfully lobbied the board of a West African school to recommend the conversion of their academic computing labs to purely free and open source software. However, only days after this perceived victory, this switch to open source was unexpectedly blocked by the Director of Peter's educational institution. A portion of a letter describing the Director's decision to reject the board's recommendation reads:

> … due to numerous recommendations forthcoming from the US Embassy, the State Department, and technology professionals involved in providing services to international schools worldwide, it has been decided that the switch to open source software on such a large scale is premature, and has therefore been reversed. …We are not interested in being 'cutting edge' in this area, nor will such a change be made as an ideological stance or only to save money. (Peter Rock-Lacroix, Blog Posting, June, 06)

Beyond stating the technical justification for the decision, the letter also went on to partially reprimand and discourage Peter's use and installation of free and open source software within this international school.

> Time spent during the school day installing open source software and the ensuing time and labor required for converting programs, repairing documents, etc. is not part of your duties and has detracted not only from your teaching responsibilities but also from advancing the school technologically. While open source software may of course be used as per individual preference, time during the school day is no longer to be used for any technical tasks having to do with the installation, conversion, etc. of open source software. (Peter Rock-Lacroix, Blog Posting, June, 06)

The stated restrictions did not stop at simply using and installing FOSS. Peter was also asked to refrain from advocating for its use and adoption.

> You have expressed strong opinions against Microsoft, obvious from comments made by teachers and students, statements posted on your classroom door, etc. In accordance with Personnel Section 5.032 e) Code of Professional Ethics, "All staff should refrain from proselytizing for a personal, political, or religious belief." Therefore, you need to refrain from placing undue focus on your personal

> beliefs concerning the philosophy and practice of Microsoft. (Peter Rock-Lacroix, Blog Posting, June, 06)

Peter's work and efforts in respect to FOSS and the open source movement are applaudable. Yet, this incident does well to demonstrate that there are strong power structures in school culture. In this case, authorities block the change from proprietary technologies to open technologies. Additionally, those in power react to and attempt to silence the alternative philosophy and teaching role that Peter exudes. Even with the many advantages of open source adoption expressed through this dissertation (e.g., economics, robustness, interoperability), there will be resistance from those at levels of decision-making, from end-users to administrators. More critically, there can be strong resistance against teachers who demonstrate alternative philosophies in regards to traditional teaching/learning structures and roles. These forms of control prove difficult and problematic for those working to change education.

Resistance to change (by administrators, teachers and students) is common in educational institutions. In the above noted case, resistance arises in opposition to certain technology implementation decisions made by a school board. Yet, openness represents much greater change in schools than switching from Windows to Linux, or from MS Office to OpenOffice.org. Openness and open thinking are characterized by much broader changes in staff collaboration, school resources, pedagogy and technological infrastructure. The following table describes the closed (proprietary) model of schooling versus the open model in respect to these four described issues.

	Closed (Proprietary) Model	Open Model
Staff Collaboration	- linear process, often slow - proprietary knowledge - knowledge as product - school staff insular and informed by limited population	- distributed, rapid exchange - shared/open knowledge - knowledge as process - school staff open to knowledge from other institutions/groups
School Resources	- mostly print form and static - authority paramount/wisdom of experts - truth	- mostly digital and dynamic - authority questioned/wisdom of crowds - perspectives
Pedagogy	- consumption of information - teacher-directed - learner mostly isolated by local learning community - knowledge attained is most important - connecting to information is critical - learning as passive, consumption paradigm	- critique of knowledge - "teacher as tour guide" - learner connected to dynamic communities beyond the local - capacity *to know* is most important - connecting to other knowers (humans) is critical - learning as active, collaboration paradigm
Technological Infrastructure	- proprietary software - monolithic tools/courseware - closed formats/standards - technologies secure/lock away knowledge	- free and open source software - "small tools loosely joined" - open formats/standards - technologies assist to distribute, and modify knowledge

As is evident by the information conveyed in the table, the switch to openness is complex and challenges educational beliefs, values and practice.

Zaltman and Duncan (1977) offer theories which are useful for understanding resistance and barriers to change, even in this emerging context. Their 1977 *Strategies for Planned Change* includes a chapter identifying eighteen resistance factors grouped into cultural, social, organizational and psychological categories. I found that these factors were relevant to what had been discovered in this study. Through this piece, I better understand the various types of resistance to openness found in educational environments and institutions.

Zaltman & Duncan's (1977) framework is adapted here to help explain resistance to openness in education. I have kept their original eighteen categories and have supported each with insights/data discovered in this dissertation.

Cultural	
Values & Beliefs	Openness is as value-laden as a proprietary culture. Those who espouse open beliefs may have contradictory views from the norm regarding collaboration, sharing, ownership of knowledge and copyright. Changing one's beliefs and values regarding these issues may difficult and problematic.
Cultural Ethnocentrism	Both proprietary and open movement proponents may believe that their own culture or "way of doing things" is superior to the other. Such opposing views tend to lead to polarization and conflict and result in a slow change process.
Saving Face	Open movement advocates tend to stigmatize proprietary products or practice. This may put those who have adopted proprietary products and practice in a defensive position, and this may decrease the likeliness to accept change.
Incompatibility of Cultural Traits	Open thinking/practice/products are currently incompatible with the culture of most educational institutions.
Social	
Group Solidarity	Past professional development efforts in educational institutions may have developed groups of educators with particular ways of knowing and with specific forms of practice. This group cohesion/culture itself may carry inhibitors to change, although this may also provide positive opportunities.
Rejection of Outsiders	Once a group culture is formed, there may be an inherent rejection of the views/beliefs of others if such views/beliefs do not match the groups'. This reactive element may cause resistance.
Conformity to Norms	Social systems may be seen as a collection of individuals who accept a set of rules or norms in exchange for the benefit of membership. Thus, penetrating these social norms may be difficult. Open communities, in some respects, bind through the rejection of such norms or through the creation of alternate norms.
Conflict	The rift between proprietary and open source ideas/beliefs may create conflict. Conflict itself, may be a valuable catalyst for change. However, managers/administrators may view conflict as destructive to organizational cohesion, and may vie for an end to conflict through the reinforcement of past social norms.
Group Introspection	Introspection or self-awareness may lead to "the members' imperfect awareness of their own interpersonal processes and their lack of a frame of reference in which to judge their performances and their possibilities for improvement. (1997, p. 75) In other words, educators with a deeply set insider perspective may fail to "see the forest for the trees" and thus, have difficulty being critical of their own practice and beliefs.
Organizational	
Threat To Power & Influence	The open movement inherently critiques power structures and moves toward more democratic, creative processes where power is distributed equally through organizations. Through openness, power is threatened at many levels: corporations, school bureaucracies, teacher-student relationships, information technology consults, technical personnel, etc. This transfer of power will create resistance to change.
Organizational Structure	The typical hierarchical educational organization is a target for open reform. Therefore, the structure itself is an impediment to change as it is in structural opposition to open source values and practice.
Behaviour of Top-Level Administrators	In most cases presented in this study, the open movement is represented through grassroots initiatives, often in opposition to administrative leadership. There are few top-level administrators known to me that have implemented wide-scale open initiatives and implementations in schools. The old adage, "no one gets fired for buying IBM" exemplifies the lack of risk by leadership in many contemporary educational institutions.
Climate for Change	Zaltman & Duncan (1977) emphasize the need for change, openness to change and potential for change. Institutions where none of these three are evident are typically slow to change.

Technological Barriers for Resistance	As perceived by the study participants, open technologies are not often accepted or understood by school technical personnel. Additionally, existing proprietary technologies may not possess the social affordances that contribute to collaborative and participatory processes.
Psychological Barriers	
Perception	As many facets of the open movement are widely misunderstood, individual adopters may possess little knowledge related to open source software, open publishing or open content. A typical teacher's perception on software/practice will likely be influenced more by proprietary beliefs and prior understandings of and experiences with educational technology.
Homeostasis	Change is difficult for individuals, and there is often a natural desire by potential adopters to maintain a comfortable level of stability. A change in values, perceptions and practice as abrupt as openness characterizes may cause sustained, initial levels of discomfort and an increased work load.
Conformity & Commitment	Teachers, through prior professional development experiences and practice, may have likely already conformed to accepted institutional norms. Additionally, teachers have likely invested many hours of work into proprietary formats, lesson planning, etc., that conform to a proprietary paradigm. Commitment to past beliefs and practice is easier than the work required to "shift gears" into something entirely new.
Personality Factors	The participants of this study have shown high degrees of advocacy in their work, and can be seen as oppositionists or change leaders. These personality traits are not typical to the teacher population as there are many educators who would likely resist change entirely, or tend to uphold the status quo.

As I viewed each of the eighteen factors in light of this study, I was able to correlate the results of the data analysis with each barrier. Reading the Zaltman & Duncan (1977) piece helped me to understand that many of the same human and institutional barriers working against change (as revealed in this study) also existed thirty years ago. In other words, many of the same factors that caused resistance to change in the past are similar to factors found in our current educational environments.

A shift toward openness is complex in that it affects well-established cultural, social, organizational and psychological structures. In understanding this complexity, it can be assumed that a shift toward openness will not be easy. Furthermore, such changes may not be welcome or wanted by all participants. Simply put, some individuals may continue to favour independent approaches to problem-solving, or be more comfortable with slower processes of knowledge exchange. I assert that these changes are possible if

efforts are concentrated on supporting educators throughout the change process. However, change will likely not occur if change is not wanted. Nevertheless, the supports necessary for change to occur are highlighted in the next section.

7.4 SUPPORTING OPEN THINKING IN EDUCATION

This section will provide recommendations for the support of open thinking and openness within educational institutions. These recommendations are informed by the data analysis of this research, including the literature review presented earlier in this dissertation. For the sake of simplicity, I have developed the CARES acronym to represent important considerations needed for the support of openness in educational institutions. CARES stands for Community, Acceptance, Recognition, Exposure and Support. Each of these considerations is developed below.

Community: The activities of rich, thriving and collaborative communities are central to understanding the open movement. From data and code sharing in open source software communities, to the active publishing of educators in the blogosphere, it is apparent that informal, collaborative communities produce powerful tools, materials and conversation. Educators and students must view themselves within the global context, as consumers *and* producers of dialogue, and educational activities must reflect this universal connectedness.

Acceptance: The roles of teachers and students continue to evolve. Both teachers and students now have a wealth of networked possibilities. While for several years, teachers

have been able to retrieve and submit educational work (e.g., unit plans, lessons plans, websites) to share with others, conversation and true collaboration has been lacking. Rather than scatter educational artefacts across the Internet, educators can now collaborate with other through wikis, blogs and learning object repositories. They can appear as virtual micro-mentors/guests in classrooms, and can bring the live expertise of others into their own classrooms. Yet, schools are slow to change. Rather than accept the potential of networked technologies (e.g., hardware, cellular phones, social networking sites), such vehicles for collaboration are often banned.

Educators must accept that:

- We are no longer alone. The classroom walls have come down. Blogging, wikis, learning object repositories, and other social technologies have given us the mechanisms to collaborate, consume and contribute.
- Many students are already networked in ways we do not understand. It must be a priority to understand these connections, apply our pedagogical understandings and leverage these relationships.
- There is an on-going struggle between proprietary and open knowledge. Educators must come to understand the implications for education, and what is at stake.
- The roles of educators are changing, and those espousing open values and practice need time to reassess and experiment with learning.
- Time is needed to critique the many new sources of knowledge, and the technologies of connectivity. This is important for any consumers/producers of knowledge, not just teachers and students. Information literacy and management should become a more explicit feature of our curricula.

Recognition: Participants of this study expressed that much of their work toward openness was often invisible to their respective administrations. Whether it was installing or testing software, collaborating with colleagues at different institutions, reflecting or commenting on personal blogs or advocating for openness, the work was time-consuming, yet perceived (by the participants) as productive and worthwhile.

Yet this work is atypical for educators. It is adventurous work that is exploring the boundaries of learning and how knowledge is to be produced and treated in society. Openness combined with distributed technologies has the potential to transform our current views on education as it upends the knowledge processes, counters dominant structures and can bring us closer to a democratized education. However, before this potential is realized, the work of educators in this field must be recognized. This recognition can be incarnated at various levels. From simple recognition by administrators (e.g., the metaphorical “pat on the back”), to more formalized recognition like teaching releases, targeted professional development, open visioning, etc., the agenda of openness should be made more readily accessible to our educational institutions as an alternative to our existing proprietary paradigm.

Exposure: Rogers (1995) uses the term trialability to argue that potential adopters need the ability to experiment with an innovation before they may see its application. I use the term exposure here to extend on trialability, as the open movement implies not just a set of unique tools that can be “test-driven”, but a whole set of values and beliefs around knowledge and collaboration. Teachers should be given exposure to the methodologies and tools that favour/support the exchange of ideas and open collaboration.

As far as free and open source software is concerned, there are many existing distributions and packages that can be easily installed in the labs throughout our institutions. Students can be given free CD’s that will expose them to practical software tools, many which are educational in nature. Such software can be obtained and distributed at no or very little cost to educational institutions. There are also many free

services (e.g., blogging, wikis, course management) that can be of use to teachers. Yet the greatest exposure will come from teacher/student use of these tools. Educational bloggers around the world are sharing their experiences with such implementations, and administrators, teachers or technology coordinators should be highlighting such experiences for others, through both formal and informal approaches. Allowing the spread of the open "aha" moment from teacher to teacher, from learner to learner, will prove to be the most effective mechanism for the continued spread of open thinking in education.

Support: The simple premise, "change requires support" was clear from the perspectives of the study participants and in the literature review. Change in schools typically arises from technical consultants, designated teachers, professional development opportunities or specially-funded projects (e.g., technological mentorship programs). These venues and approaches continue to be important, yet are all faced with limitations of scale and of time. Simply put, institutional support cannot support all of the change required for large-scale processes. Luckily, openness has potentially built-in support structures that can accommodate these needs. Those who participate in open communities learn within these communities as they themselves become support structures for others. Gift economy mechanisms allow such communities to sustain support for their members as long as there are members to support.

CARES does not represent a prescriptive approach to the adoption of openness in educational institutions. Rather, it is a set of considerations that highlight some of the perceived insufficiencies in current institutional structures that have, in the perceptions of

the study participants, hindered the growth of openness and the understanding of its benefits. Furthermore, CARES is incomplete as a set of considerations. The question marks on the figure below represent other unknown considerations that are yet to be discovered. Those who begin to first understand and partake in open communities will be able to utilize the CARES model as a guiding framework, and perhaps, may be able to further develop the insufficiencies of the framework itself.

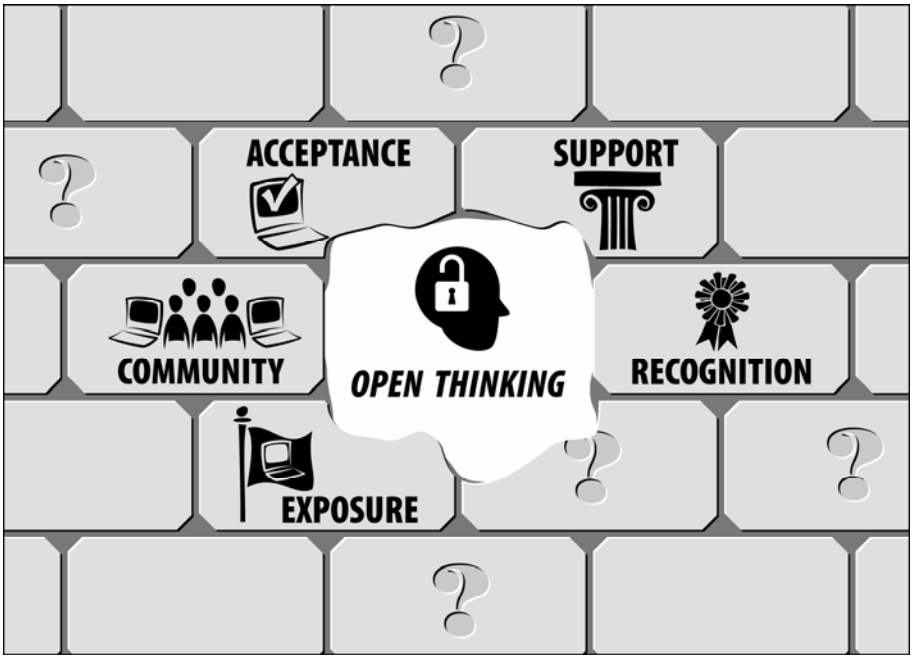

Figure 7. Visualization of the CARES considerations.

It is important to reemphasize that the CARES considerations apply most appropriately to supporting change in educational institutions as they exist. Participants of the study, as seen through data analysis, believe strongly that significant changes are possible in our schools, especially those related to collaborative processes, open technologies, open publishing and open content. The data also suggests that revolutionary change may be necessary to fully realize open thinking in education. The open

movement, through its inherently critical processes, has the potential to reinvent views of formal education. It is my intent that this study be only the beginning of my continued research concerning the open movement in education. This work has reinforced and extended my knowledge in this emerging field, and has alerted me of present and future possibilities. Some of the possibilities are outlined in the next section.

7.5 AREAS FOR FURTHER RESEARCH

The spread of open thinking and openness in education is already underway. Through the participant voices, I have been able to share with you many examples of how open source software, open publishing and open content are beginning to infiltrate educational practice. As this phenomenon emerges, the following questions may be worth exploring.

1) What are the characteristics of open educational environments, or what will open forms of education look like? What can be done to help nurture the growth of these alternative educational environments?
2) How can openness and open thinking (for the time being) improve our contemporary educational environments? For instance, how can open thinking inform current educational practices? Or, how can open thinking help individuals and groups critique and change power structures as they exist in schools/school districts?
3) What are current degrees of implementation of open thinking ideals in various educational institutions (e.g., open source software, open

publishing, open content, critical pedagogy)? What are the perceived benefits of this integration?

4) Are there methods or strategies in which educational administrators can support openness and open thinking in academic environments? How can educational administrators be encouraged to distribute power more democratically in school environments?

5) What is the relationship of openness, open thinking and power to "the larger community" (e.g., educational, civic), and can this relationship be of an advantage to knowledge sharing throughout wider societies?

6) What is the nature of power in open source communities? Is power and decision-making distributed as much as expected, or do power structures simply become less explicit?

7) In open educational environments, how is knowledge created, shared and negotiated? What does participation in these communities imply or require from its members? Are these types of knowledge-creation and sharing activities sustainable? Are open educational communities sustainable?

7.6 **CONCLUSION**

As I began to write the final words for this Chapter, I received an email from an old friend, my former Grade 8 teacher who had taught me over two decades ago. I always loved Mr. Hill's classes as he was young and new to teaching, and always seemed to be on the cutting edge of his practice. He attempted things in his teaching that few other

teachers would try, and whether they succeeded or not, our class always seemed to gain something from his efforts. In retrospect, I realize that Mr. Hill taught me the importance of change and innovation in educational practice. The email message reads:

> A while back you asked how are class blogs were going. I just wanted to share that they have been a big hit with my grade 8 class. The students have been journaling their thoughts and work for our ELA unit -The 5M's of Fantasy. The results have been tremendous; the kids enjoy writing and sharing their blogs, I am interested in what they are saying and some have even shared their blogs with their parents!
>
> Please check out the post Reflections on Myths at (address withheld) by a student who is in our SEEDS class (Structured Success). He just started joining our ELA class in February and has done well academically and emotionally. Previous to this he created all kinds of problems for his classroom teachers. I love the way he incorporates the language of his SEEDS class into his writing (perseverance, making amends). I really don't think I could have got such a meaningful response from pen or paper or even verbally.
>
> Thanks for getting me started on blogs... there are so many possibilities... I can hardly wait until next year. (Hill, email, June 13, 2006)

Mr. Hill's comments and his outlined activities represent an important central thesis of this dissertation. Innovation, inspired by openness, can be achieved as simply as utilizing non-traditional paths of communication and feedback (in this case through blogs) for student work. Openness does not require overcoming huge technical obstacles, but rather, requires a change in mindset and a differing view of practice, and of how learning can be achieved. To me, Mr. Hill's practice always represented innovation, risk-taking and the open mindset, yet up until recently, the tools and communication channels that may best leverage these attributes and beliefs did not exist.

Through better understanding openness, open thinking and the CARES considerations, educators and educational administrators may potentially advance what is now only a fringe movement in education. The open movement in education has the

potential to improve access to educational media, networks and equipment, can provide better legal and technical channels for the adaptability of existing and yet-to-be-created education materials, can improve the economics of providing rich digital tools and information and perhaps most importantly, can help to reshape and transform pedagogy and educational institutions themselves.

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APPENDIX A: ONLINE SURVEY QUESTIONS

Open Source Study: Online Survey Questions

1. Express some of your key understandings of the 'open' movement as it applies to your particular orientation (i.e., software, content, publishing, etc.). How did you learn what you know? What drives you to continue to learn more about this area? How do you continue to learn in this area?

2. Describe your key activities as they relate to the open movement (e.g., use or development of open source software, advocacy). How long have you been involved in these activities? Do you plan to continue for an indefinite period?

3. Are these activities (as described in question #2) inspired or driven by a specific set of beliefs or values? Or, do you feel that your activities are likely more due to your technical background, or other factors?

4. What are your thoughts on the importance or value of 'open' technologies in the K-12 classroom or schools, or in higher education institutions? Are schools, colleges or universities beginning to adopt these technologies? What are the perceived barriers to the use of 'open' technologies in educational institutions?

5. Describe your collaboration or activities (if any) with other members of 'open' communities (e.g., Schoolforge, Freshmeat, Slashdot, blogging communities, LUGS).

6. Do you feel that anything can be learned from the 'open' movement in terms of sharing, collaboration and/or production that can be applied to current school or academic culture? If so, what can be learned, and what are the benefits or barriers to this understanding?

7. Are there other things you would like to share with me regarding this study and its purpose? If so, please feel free to go on any tangent you wish.

APPENDIX B: CONSENT FORM

Examining the Open Source Movement
Informed Consent - November, 2004

Dear Colleague,

As a research project for my PhD Dissertation at the University of Regina I am carrying out a study that focuses on studying the open source movement as it relates to educators. The purpose of this study is to gain insight into the adoption practices of technological innovation by teachers. The study will initially focus on a small core of selected Saskatchewan educators who actively participate in open source 'communities', and will move to examine the associated beliefs, values and activities of these participants.

The purpose of this letter is to invite you to participate in this research project. You have been identified as an individual with interest and expertise in this area, and this research would benefit from your participation and insight. Your involvement is likely to include: a) 1-2 face-to-face or computer-mediated interviews lasting approximately 1-1.5 hours each, b) some participation in a secure online-discussion forum over the duration of about 4 months and c) participation in an online questionnaire. Total participation in hours is likely not to exceed ten hours in total.

In the interest of privacy, all precautions will be taken to protect the anonymity and confidentiality of all data collected. Each participant will be given a pseudonym and any data that may act to identify him or her specifically will be removed. Specific data will be accessible to my dissertation advisor and myself only, although of course data collected in the online discussion forum will be available to the participant pool. Participants will have total access to the findings of the study and will be given access to the dissertation and any related published materials. Information received will not be used in any way that is detrimental or demeaning to the participant. Participants will have the opportunity to review their transcripts and to add, alter, and delete information from them.

Also, if you prefer at anytime (up until the publication of the dissertation) to have your real name and activities represented in the study, a form will be provided to opt-out of the anonymity condition I have presented above. By default, however, anonymity and confidentiality will be protected unless otherwise requested by the participant.

I hope that you will agree to participate in this study. However, be aware of your right to refusal and the expressed understanding that if you choose not to participate in the study, this will not reflect negatively on you in anyway, and there will be no resulting issues that would arise from your refusal. Also be aware of your right to discontinue your participation in the study at any time. This is clearly your right.

By signing and dating this consent form, you are acknowledging that the subject of this research and the contents of this consent form have been adequately explained to you, and that you agree to participate in the study. A copy of this consent form will be provided for your records.

_____ _____

Dated Signature of Participant

_____

Name of Participant (please print)

Researcher: _____

Alec V. Couros

I require a copy of this consent form for my records _____ YES _____ NO

This study has been approved by the Research Ethics Board, University of Regina.

If you have any concerns about your rights or treatment as a research participant, you may contact the Chair of the University Research Ethics Board at 585-4775 or by email at research.ethics@uregina.ca. You may also contact my PhD supervisor at cyril.kesten@uregina.ca.

APPENDIX C: SAMPLE INTERVIEW QUESTIONS

Interview with Stephen Downes – Unstructured Interview Questions April 27, 2005

(NOTE: Questions for each participant were slightly different and were based on their initial survey responses. Here is one example of the questions used.)

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1) You've previously offered some of your biographical information including workplace, position and years of experience. I've also noted that on your site, you include a declaration which includes a bit about "a society where knowledge and learning are public goods, freely created and shared, not hoarded or withheld in order to extract wealth or influence." I'm wondering if you could speak to this idea in regards to your position with the National Research Council. I guess I want to get a better idea of how you helped to develop the important (and influential) role you now play.

2) In the online survey (Question #1), you state "open source promotes a wider array of choices, fosters innovation, and supports a network effect." I am wondering if you can give a few examples, or supports for this statement, as you see it. I am particularly interested in the latter two (fosters innovation, supports a network effect). Feel free to speak outside of the realm of software.

3) There seems to be a real anti-dominance stream of consciousness in the open source community. Individuals and groups are not just anti-Microsoft or anti-corporation, they seem to be more against all types of dominance. I may be misreading, but do you support a similar stream of thought? If so, what is your thinking around this, and how do you feel you got to this point in your thinking? I will mention a quote from you which reads, "an unwillingness to submit to the conditions, limits on \'acceptable discourse\', etc."

4) Another interesting quote you submitted in the online survey reads "people around the world are denied the possibility of an education due to the high cost of materials. Open source addresses this directly." I am wondering if you could offer direct examples or speak to the underlying idea of access, which seems to be prominent in this passage.

5) Additionally, regarding open publishing, you write "the concentration of publishing in the hands of a small number of corporations has tended to result in a biased and prejudiced information environment; open source and open content promote democracy of views and opinion." I am wondering if you could speak to this idea, and perhaps bring in older and recent developments such as Wikipedia, OurMedia.org the Open Media Network. And with this, I am hoping you may address a perceived resistance to such forms of knowledge creation by individuals.

6) You mentioned that a possible barrier to open source in schools is the idea that "schools are governed by autocracy". With this, you allude to a time where students may grow resistant to "governance by fiat and may foster the expectation that, in the event of a dispute, they move to another class or start a new class of their own (\'forking\'). Do you think students are more typically bringing in forms of "open thinking" into school? If so, from where, in what forms and how can schools change to adapt ?

7) A while back, I listened to an interview with Alan Levine on the FLOSSE Posse group blog. Levine seems to see that there is a greater potential for open content in schools, rather than open source software. He also mentioned that some larger educational institutions will more likely stick with proprietary solutions due to various reasons (e.g., political pressure, lack of trained technicians, inability for OSS to handle the needs of large institutions). Do you share these same views? What do you see as the potential for open source/open content either K-12 or higher education institutions.

8) Both the theory and practicality of open source software can by 'foreign' to the average teacher. There may be a perceived barrier between talking about "free and open software" and "free and open content" to actually getting down and using it (practicalities). And perhaps, many teachers just don't have the time or drive to adopt, and perhaps just don't see this as something that is important. Do you feel that this is an important concern? Are there ways to move to FLOSS and open content to the disinterested, and to those with 'average' technical skills?

9) One of the bigger ideas I am toying with is to look at what lessons we can learn from open forms of collaboration, and how such models could be potentially adapted/adopted by schools and school districts (admin, teachers, students)? Is there "something there"? What are the biggest ideas that K-12 and higher education could be taking from the open movement? What are the examples we should be looking at? What insight do you have in this area? What are the best things that are happening in the field right now? (What about things like Flickr, Friendster, etc.)

10) Any other questions, ideas, etc? Please feel free to talk away.