ACCEPTANCE OF TECHNOLOGY INNOVATIONS IN PUBLIC EDUCATION: FACTORS CONTRIBUTING TO A TEACHER'S DECISION TO USE FREE AND OPEN SOURCE SOFTWARE

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Samuel Coleman, M.A.

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Approved by:

Jerold Miller, Ed.D., Chairperson

Ken Kelch, Ed.D.

Alvin Kidd, Psy.D.

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Dedication

To the memory of my grandmother, Dessie Lee Wade.

Her unwavering love and support allowed me to complete this journey.

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To my mother: Thank you for showing me the importance of focus, commitment, and hard work. To my father: Thank you for your support and believing in me. I love you both and I hope I have made you proud.

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Abstract

Use of free and open source software (FOSS) by teachers in public schools is limited. The purpose of this study was to determine whether there were statistically significant differences among teachers who use FOSS in the classroom, teachers who use proprietary software in the classroom, and teachers who do not use software in the classroom at all, with the goal to propose ways to mitigate barriers to implementation of FOSS by teachers in public schools. The research design was quasi-experimental. Independent *t* tests were used to measure differences among the three groups on the following independent variables: age of respondent in years, years of teaching experience, primary subject area taught, level of education, number of years of experience in using technology, number of district training sessions or technology initiatives attended in the previous 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom. The results revealed statistically significant differences only concerning the impact of school site leadership as reported by teachers who used FOSS and teachers who used proprietary software. Recommendations to encourage teachers' use of FOSS included establishing collaborative processes by instructional staff, administration and information technology personnel to identify and assess appropriate FOSS solutions, training opportunities in the use of FOSS in the classroom, and guidelines to monitor and evaluate the effectiveness of the selected software solutions (proprietary and FOSS).

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CHAPTER I

Introduction

School districts across the nation are faced with the increasing cost of providing technology resources for students and staff. Hardware (i.e., desktop computers and laptops) costs are typically amortized over a period of 3 to 5 years, while software costs are ongoing due to annual licensing fees. In some instances, the cost of software can be higher than expenditures for hardware. As federal funding for technology shrinks, school districts must consider alternative solutions to meet technology needs in order to provide functionality and cost savings (State Educational Technology Directors Association [SETDA], 2007).

The California Budget Project (2009) reported on the level of technology funding made available through the American Recovery and Reinvestment Act of 2009. The state of California was poised to receive $70.8 million to support educational technology, including computer and science laboratories, as well as technology training for instructors. Since there are 1,131 school districts in California (California Department of Education, 2013), the allocation was slightly less than $70,000 per district. It should be noted that some school districts might be entitled to more or less funding depending on size; however, the funding for educational technology is limited. The Information Technology Strategic Plan 2013–2014 detailed decreases between 2009 and 2013 due to reduced funding in the following areas: number of computer servers, wide-area networks, and overall satisfaction with online services (California Department of Technology, 2014).

Proprietary (non-free) software is the most commonly utilized software installed on most of the world's computers (StatOWL, 2014.). Common examples of proprietary software include Microsoft Office Suite®, Adobe Illustrator®, and Final Cut Pro®. Proprietary software is defined as "computer programs that are exclusive property of their developers or publishers, and cannot be copied or distributed without complying with their licensing agreements" (BusinessDictionary.com, 2014, para. 1). Given the prevalence of proprietary software being pre-installed on most desktop computers, many school districts use it by default.

Proprietary software limits a school's ability to adapt, modify, or give away the software to students (Free Software Foundation, 2014). Such restrictions are contained in End User Licensing Agreements (EULA; Webopedia, 2014). This lack of access limits or prohibits teachers and educational institutions from customizing the software to fit specific teaching and learning objectives, limits or denies equitable access to software resources for students who cannot afford such software for use at home, and limits a teacher's freedom to provide instruction using such software, due to cost constraints.

Many teachers are locked into using proprietary software, given that it is installed on most computers that are purchased by educational institutions. However, free and open-source software (FOSS) could be a viable alternative to proprietary software.

FOSS allows the user access to a program's source code and the right to adapt, modify, and redistribute the software without cost or restriction (Free Software Foundation, 2014). Teachers and school districts alike can benefit from software that has no licensing fees and no restrictions on the use, modification, and redistribution of the software. FOSS can provide teachers and educational institutions the freedom to customize the software, provide equitable access to software resources for all students for use at home, and provide instruction using such software, without the cost associated with proprietary software licensing costs. Despite the inherent advantages associated with FOSS, few teachers are making the choice to use FOSS versus proprietary software in the classroom.

Statement of the Problem

The problem addressed by this study is that FOSS implementation in public schools among teachers is limited.

Purpose of the Study

The purpose of this study was to determine whether there are statistically significant differences among teachers who use FOSS in the classroom and teachers use proprietary software in the classroom, then to utilize this information to propose ways to mitigate the barriers to implementation of FOSS by teachers in public schools.

Research Questions

This quantitative study was designed to identify factors that contribute to a teacher's decision to use FOSS in the classroom. Eight research questions were posed.

1. Is there a statistically significant difference in age in years between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

2. Is there a statistically significant difference in years of teaching experience between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

3. Is there a statistically significant difference in primary subject area taught between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

4. Is there a statistically significant difference in the level of education between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

5. Is there a statistically significant difference in number of years of experience using technology between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

6. Is there a statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

7. Is there a statistically significant difference in the positive impact of school site leadership on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

8. Is there a statistically significant difference in the impact of school district technology policies on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

Research Design and Methodology

The research design was quasi-experimental. This quasi-experimental approach allows for testing independent variables between groups without the need for any preselection process. The following categories served as independent variables: age of respondent in years, years of teaching experience, primary subject area taught, level of education, number of years of experience using technology, number of district training sessions or technology initiatives attended in the past 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom.

A survey was administered via QuestionPro.com™ to teachers who were employed by the San Diego Unified School District (SDUSD) and the Sweetwater Union High School District (SUHSD). The survey contained items pertaining to age of respondent in years, years of teaching experience, primary subject area taught, level of education, number of years of experience of using technology, number of district training sessions or technology initiatives attended in the past 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom.

Data analysis included independent *t* tests to determine whether there were significant differences in mean scores among teachers who use FOSS in the classroom, teachers who use proprietary software in the classroom, and teachers who do not use software at all in the classroom.

Significance of the Study

School districts can use the information in this study to identify factors that lead teachers to use or not to use FOSS software. School districts could examine the feasibility of FOSS applications that could replace more costly proprietary software, determine cost-effective ways to introduce FOSS to teachers who have yet to try it, understand and mitigate barriers to implementation, and determine what current district technology policies are influencing teachers to consider FOSS. The potential cost savings to a school district associated with implementing FOSS could be substantial.

Definition of Terms

End user. A person who makes use of a product after it has been developed, marketed, and sold.

End user licensing agreement (EULA). A license used in connection with proprietary software. The EULA describes the restrictions that the software creator imposes on the end user. Typically, these restrictions prohibit sharing, copy, modifying, and/or redistributing the software.

Free and open-source software (FOSS). Computer software whose code is available under a license that permits users to use, modify, and/or add to the functionality of the software and to redistribute it. For the purposes of this paper, the following terms are synonymous with FOSS: open-source software (OSS) and free libre open-source software (FLOSS).

Hardware. Computer equipment designed to make use of software that enables it to perform a given job or task.

Proprietary software. Software for purchase that has restrictions on use, copying, modification, and redistribution, as dictated and enforced by the software creator.

Software. The programs (instructions) that a computer uses to perform a specific job or task.

CHAPTER II

Literature Review

Researchers have identified benefits and disadvantages of using FOSS in classroom settings. However, to understand the factors that motivate or dissuade K–12 teachers to use FOSS requires an understanding of change theory (CT), diffusion of innovation theory (DIT), and the adoption process in order to create a context to understand the drivers that motivate adoption or rejection of FOSS. This chapter provides a review of the literature concerning the factors that contribute to a teacher's decision to use or not use FOSS in the classroom.

The literature review is organized as follows: (a) a brief history of CT, DIT, and the adoption process; (b) researchers' attitudes associated with FOSS; (c) factors that make FOSS an attractive option for educators; and (d) factors that impede or prevent adoption of FOSS in educational institutions. The chapter concludes with a summary of the review of literature.

A Brief History of CT, DIT, and the Adoption Process

Couros (2004) reported on the history of CT, describing it as "an umbrella term which envelops numerous sub-theories that describe change within various contexts. Change theorists, in general, attempt to understand the change process and provide and build strategies to effect change" (p. 52). Couros elaborated that, within the context of education, CT has influenced the manner in which educational organizations approach the process of change or innovation, as evidenced by the following key assumptions:

(1) Change can be understood and managed,

(2) Planned change is focused upon introducing innovation or innovations to individuals or within a system,

(3) Planned change is value-laden,

(4) Planned change requires people, and

(5) Planned change is complex and often requires multiple approaches and tools. (p. 53)

Couros (2004) cited McGriff's suggestions of the most influential theorists in the field of CT as follows:

> 1) Fullan & Stiegelbauer (1991): The role of the change agent is stressed. The authors consider the impact of organizational change to educational institutions and its impact on teachers, principals, students, district level staff, consultants, parents and community partners.
>
> 2) Havelock & Zlotolow (1995): The Change Agent's Guide—the authors developed a checklist approach to assist an organization with working through the change process. This approach provides educational practitioners with an in-depth under- standing of the change process, along with suggestions on how and when to take appropriate steps to facilitate the change process.
>
> 3) Hall & Hord (1987): Developed the Concerns-Based Adoption Model (CBAM) to provide a personalized approach to address the "seven stages of concern." The stages of concern are: awareness, information, personal, management, consequence, collaboration and refocusing. These stages are designed to understand and support individuals through the change process.
>
> 4) Zaltman & Duncan (1977): In Strategies for Planned Change, the authors provide a variable troubleshooting guide that identified the reasons for acceptance or rejection of a change effort. By identifying the cause for adoption or rejection of a change initiative, practitioners are better able to address and circumvent barriers to change.
>
> 5) Ely (1990a, 1990b, 1976): Ely focused on environmental and contextual barriers to change. The importance of providing environmental supports to a change effort (i.e., training, technical support, and system monitoring) are highlighted throughout his works. (Couros, 2004, pp. 61–62)

A history of CT would not be meaningful without mention of French sociologist Gabriel Tardé (1903), Ryan and Gross (1943), and Everett Rogers (1996). These researchers studied and developed the DIT, which is the precursor to modern CT.

Rogers (1996) reported that the origin of DIT can be traced to French sociologist Gabriel Tardé. Tardé theorized that adoption or rejection of an innovation was due in part to the socioeconomic level of those who would be affected by the innovation. Persons of lesser means tend to be more resistant to change and innovation, whereas persons of higher socioeconomic status tend to embrace change more readily. Tardé's seminal work, *The Laws of Imitation* (Tardé, 1903) introduced use of the S-shaped curve to identify innovations with rapid adoption rates versus those with a less rapid rate or adoption rate. Although Tardé's theory was relatively basic, it proved to be useful and served as a basis for later studies.

Ryan and Gross (1943) built on Tardé's work to explain how innovation is disseminated (i.e., mass communication and interpersonal communication with peers) and how that influences the decision to adopt or reject an innovation. The researchers found that the method used to learn about the innovation had a profound impact on willingness to embrace the innovation. Mass communication provides awareness of an innovation, whereas interpersonal communication from trusted peers provides greater influence over the decision to embrace an innovation or change. Ryan and Gross identified five types of adopters: innovators, early adopters, early majority, late majority, and laggards. They codified five stages in the adoption process: awareness, interest, evaluation, trial, and adoption (Wikibooks, 2013).

Rogers (1996) reported that *diffusion* refers to the process by which an innovation is communicated through certain channels over time among members of a social system. An *innovation* is an idea, practice, or object perceived as new by an individual or other unit of adoption. The diffusion of innovations involves both mass media and interpersonal communication channels. Rogers identified a five-stage process that explains the innovation decision framework: (a) knowledge of innovation, (b) attitudes toward innovations,

(c) adoption—decision to adopt or reject the innovation, (d) implementation—testing an innovation's usefulness, and (e) confirmation—evaluating the value or benefit of the innovation. Rogers also identified five concerns with respect to adoption of an innovation: (a) relative advantage: Is the proposed innovation better than the current option? (b) compatibility: Is the proposed innovation compatible with current goals? (c) complexity: Is the proposed innovation more complex than the current option? (d) trial ability: Is there an opportunity to perform a trial of the new innovation without risk? and (e) observability: Is there an opportunity to evaluate the effectiveness of the innovation (i.e., evaluate successful implementations of the innovation)?

Based on the foregoing, individuals and organizations will embrace an innovation or change when it can satisfy the individual's or organization's perception that added benefit will be derived.

Researchers' Attitudes Associated With FOSS

Some researchers have observed that educational institutions have limited knowledge and awareness of the benefits of FOSS. Glance, Kerr, and Reid (2004) reported on the scarcity of information available to education institutions with respect to FOSS. They referred to various studies and reported positive findings in terms of the functionality, reliability, robustness, security, and scalability of FOSS compared to comparable proprietary software. Educators who are not aware of the benefits of FOSS limit their options in accessing technology that can provide benefits to their organizations.

Hepburn and Buley (2006) noted that few educational professionals are aware of the benefits associated with FOSS. Without understanding how the technology can be used and the variety of software offerings, from basic applications such as office productivity software to specialized curriculum applications, wide-scale implementation of FOSS in learning environments will progress slowly.

Abel (2006) reported that “approximately one third of the market (32% of U.S.-based colleges and universities) has not yet given serious consideration to open source software” (p. 21). Factors identified as causal were lack of resources needed to implement, an unclear upgrade path for software, and satisfaction with current software. Kim and Baylor (2008) identified other reasons for low FOSS interest among college administrators. They reported that college administrators’ attitudes toward FOSS were influenced by a lack of concern due to ambivalence, concerns about requirements for integration in the classroom, ease of implementation, and impact on students. Even when teachers have training and skills needed to implement the technology effectively, some simply choose not to do so.

Van Rooij (2010) reported that open source software (OSS) is recognized by the U.S. government as a cost-saving alternative to proprietary software. Van Rooij (2010) noted that, despite the advantages that FOSS provides to educational institutions, wide-scale adoption of FOSS for instruction and learning has had limited success.

Haymes (2008) reported that many researchers are enthusiastic about the use of FOSS in education. However, Haymes related that “the dirty little secret of technology in education is that a lot of it doesn’t get used effectively—or at all” (p. 67). Bauer and Kenton (2005) added that “research in the past decade has shown that computer technology is an effective means for widening educational opportunities, but most teachers neither use technology as an instructional delivery system nor integrate technology into their curriculum” (p. 519). Bauer and Kenton stated, “Many teachers have come to appreciate the limitless possibilities that web sites and creative software can add to their traditional classroom teaching methods” (p. 21). However, Zhao and Cziko (2001) reported that few instructors integrate technology into their curriculum and instructional practice. They added that, despite evidence of educational benefit associated with technology integration, few instructors use technology effectively. They reported that many instructors who are provided equipment and training elect to not use technology in their classroom.

Some researchers’ attitudes regarding the future of FOSS have been positive. In a study of attitudes with respect to FOSS among college professors and administrators representing a group of 4,130 U.S.-based higher education institutions, Abel (2006) reported that 26% of institutions indicated that the presence of open-source applications in their institutions would be substantial in 3 years. This percentage increased to 55% for those who had already implemented an open-source application and 69% for those who considered open-source initiatives as higher priority among all information technology initiatives. Among the respondents, the most viable FOSS applications that were viewed as drop-in replacements for proprietary software were Moodle™ (course management systems comparable to Blackboard®), Open Office® (a word processing suite comparable to Microsoft Office®, and uPortal—collaboration software comparable to Microsoft SharePoint®).

Becker (2000) reported that a teacher’s level of proficiency and personal use of technology can be used as an indicator regarding the teacher’s likelihood of integrating technology in the classroom. Becker pointed out that teachers who are proficient with computer technology, compared to instructors with limited or no technical proficiency, make use of technology on a personal level and are more inclined to use this technology in more comprehensive and sophisticated ways to enhance student learners' engagement and instructional outcomes.

Hepburn (2005) reported that perceptions regarding FOSS concern not only its use but also the software's reputation. Given the extensive FOSS options available, quality can vary. Hepburn identified factors that affect the quality of FOSS: (a) the organization or company supporting development of the software, (b) the level of resources afforded to the development team, (c) the number of developers working on the project, (d) whether the software makes use of a graphic user interface, and (e) whether the software is developed with a nontechnical end user in mind. These factors will determine ease of implementation, user experience, ease of use, and customer support.

Hepburn and Buley (2006) reported that fear and uncertainty can affect an organization's willingness to make use of FOSS, in part due to possible issues of integration with existing systems. They advised that careful consideration be given to software acquisition, implementation, maintenance, monitoring, training, and accountability. Using currently owned computer software reduces the likelihood of being held accountable for critical system failures. However, such circumstances stifle innovation and risk taking that can reap significant benefits, such as lowered cost, increased efficiency, and greater scalability.

Given the perceived risks associated with implementing FOSS, Tsou and Smith (2011) described ideal times to consider FOSS. Some of those contexts concerned individual users, such as when teachers want to experiment with an application without financial impact or when students want to use an application on their home computers. Other contexts for adopting FOSS concern institutions, such as when school computer department administrators make use of non-Windows® operating systems, such as Mac OS X™ or Linux™, when commercial applications do not have the needed functionality available in an open-source application, or simply when access to a proprietary application would take too much time.

Moyle (2003) reported on the misconception that proprietary software vendors ensure or guarantee their software. Some proprietary software producers disclaim the merchantability and performance of their software. For example, the Microsoft Software License Terms (Microsoft, 2013) include disclaimers concerning the scope of license, support services, warranty, and limitations on and exclusion of remedies and damages:

> 1. SCOPE OF LICENSE. The software is licensed, not sold. This agreement only gives you some rights to use the software. Microsoft reserves all other rights. . . .
>
> 2. SUPPORT SERVICES. Because this software is “as is,” we may not provide support services for it. . . .
>
> 3. DISCLAIMER OF WARRANTY. The software is licensed “as-is.” You bear the risk of using it. Microsoft gives no express warranties, guarantees or conditions. You may have additional consumer rights under your local laws which this agreement cannot change. To the extent permitted under your local laws, Microsoft excludes the implied warranties of merchantability, fitness for a particular purpose and non-infringement. . . .
>
> 4. LIMITATION ON AND EXCLUSION OF REMEDIES AND DAMAGES. You can recover from Microsoft and its suppliers only direct damages up to U.S. $5.00. You cannot recover any other damages, including consequential, lost profits, special, indirect or incidental damages. This limitation applies to anything related to the software, services, content (including code) on third party Internet sites, or third party programs; and claims for breach of contract, breach of warranty, guarantee or condition, strict liability, negligence, or other tort to the extent permitted by applicable law. It also applies

> even if Microsoft knew or should have known about the possibility of the damages. The above limitation or exclusion may not apply to you because your country may not allow the exclusion or limitation of incidental, consequential or other damages. (pp. 1–2)

The excerpts from the Microsoft EULA are important to note. First, the scope of the license informs the purchaser of the software that he/she has not purchased the software but a license to use the software, with limited usage rights. This factor is significant because this distinction affects how and for what purposes the software can be used. Next, the Support Services section informs the end user that the software is provided as is, thus freeing Microsoft from the obligation to provide support for the software. Further, the Disclaimer of Warranty states that the end user bears all risks of loss if he or she chooses to use the software. The only protection and recourse available to the end user are those protections available via local laws that cannot be modified by the EULA. Limitation on and exclusion of remedies and damages are limited to $5. Such limitations are not uncommon for proprietary software.

Factors That Make Adoption of FOSS an Attractive Option for Educators

School leaders in K–12 educational institutions, as well as in institutions of higher learning, are under increasing pressure to find ways to reduce the cost of providing instruction to students while ensuring that students have access to information technologies (Hirsch, 2006). Hirsch advised schools to consider using Linux, a FOSS operating system comparable to the Microsoft Windows operating system, in light of its desktop versatility. Using Linux as an alternative to Windows can provide significant cost savings for K–12 school districts and institutions of higher learning, given that Linux has no licensing costs.

Moyle (2003) reported on the sustainability of FOSS when compared with proprietary software options. Proprietary software requires a licensing fee to be paid for each computer on which the software is installed. Such a model is incremental in nature and does not provide an affordable scale. Moyle noted that, in some instances, proprietary software vendors provide some form of discount via a volume license that allows a lower cost per installation of software. However, FOSS does not impose that limitation. Because FOSS has no licensing fees, unlimited installation of software generates zero licensing costs and frees institutions from the cost of proprietary software. FOSS provides alternatives that allow for unrestricted use and freedom to mix and match pre-owned proprietary software with FOSS applications to address needs without incurring additional licensing costs (Northwest Educational Technology Consortium [NETC], 2003).

FOSS has the potential to provide significant benefits to educational institutions. Deek and McHugh (2008) reported on the impact of FOSS on educational institutions, from K–12 school districts to universities. The benefits included costs savings, increased access and learning opportunities in computer programming and other academic subjects, and providing educational institutions with free tools to support administrative and management functions.

Regarding total cost of ownership of software, FOSS can have an advantage over proprietary software alternatives. Wheeler (2004) reported that FOSS has made possible significant cost savings due to its greater reliability versus proprietary software, better performance, security, and lack of licensing fees that allow for limitless scalability and ability to use less powerful computer platforms or older computer systems, thus reducing equipment acquisition costs. As the number of systems used by an organization increases, FOSS becomes exponentially advantageous with respect to cost when compared to proprietary software licensing costs, even when proprietary software vendors provide volume discounts.

Buchanan and Krasnoff (2005) reported that FOSS provides the benefit of not restricting how the software is used, unlike comparable proprietary software offerings. This latitude allows for installation of software on additional computers without the licensing fees associated with proprietary software and thus allows for limitless scalability. Proprietary software requires the purchase of additional software licenses or, in some instances, blanket software licenses to cover a specific number of computers. The fact that FOSS does not impose this restriction allows for scaling to accommodate unforeseen needs.

Sasikumar (2009) described learning institutions and FOSS as being congruent in the belief that knowledge is to be shared. Examples of FOSS that have been developed by learning institutions include but are not limited to Moodle (Modular Object-Oriented Digital Learning Environment, Open University of the United Kingdom), Sakai (digital course management system, University of Toronto), and .LRN (digital course management system, Massachusetts Institute of Technology).

Sharp and Huett (2005) emphasized FOSS as a public good, affirming (a) collaborative knowledge construction; (b) control, freedom, and flexibility, all of which support innovative teaching; (c) equitable access to technological resources for all students; and (d) increased learning opportunities for students.

Becker (2000) reported on the benefits of integrating technology in the classroom. Becker noted that, under the following conditions, student learning outcomes could be enhanced: (a) Teachers are trained and at ease with technology, (b) teachers are provided with a class schedule that allows time for them to prepare and for students to make meaningful use of the technology in core course content, (c) an ample number of computers provides students with access, and (d) teachers' goals align with a student-focused instructional approach.

Becker (2000) also reported on the benefits of FOSS. In the case of teachers who make use of communication and data-based activities for students, students engage in more academic tasks during free time, thus increasing overall time spent on academic tasks. This process has a twofold benefit: (a) students spend more time working on required course content, and (b) students practice useful nonacademic skills, Internet search and retrieval, typing, and critical thinking. Such an approach allows a student to explore related topics that may not be covered during class sessions due to time constraints.

Buchanan and Krasnoff (2005) reported that many FOSS applications provide good interoperability with proprietary software. Open Office Suite, for example, can open, create, and save common file formats native to Microsoft Office Suite®, including docx, pptx, xlsx. This flexibility allows for files created with Open Office to be opened with Microsoft Office, and vice versa. Open Office provides the same functionality as Microsoft Office, including a word processor, spreadsheet, a presentation tool, and database application.

Hepburn (2005) commented on the potential of FOSS to be used as a tool to address some social and ethical issues related to the use of proprietary software. FOSS comes with no licensing cost, thereby making it accessible to all students. Eliminated is the burden of purchasing expensive software applications or pirating software to perform basic tasks such as word processing or database construction by making use of proprietary file formats associated with course requirements. This accessibility provides equal opportunities for students to take advantage of critical technology resources and for teachers to enhance core curriculum. Lack of access to FOSS technology serves to increase the digital divide between those who have the resources to pay for proprietary software technology and those who do not.

Van Rooij (2010) reported that educators respond in a positive manner to FOSS implementation when the implementation addresses the following: (a) awareness of how FOSS will enhance teaching and learning, (b) ease of use, and (c) demonstrated benefit to the instructor with appropriate training and support being provided. The implementation should be a collaborative effort that takes into consideration the fears, concerns, and uncertainty associated with any change.

Van Rooij (2010) also reported that technologists at educational institutions have reservations regarding FOSS implementation due to the difficulty in determining the cost. The transitional cost associated with moving from a proprietary software solution to FOSS include but are not limited to (a) few formal support vendors; (b) the need for specialized, highly skilled personnel; (c) unfamiliarity with tools needed to migrate data from proprietary systems to FOSS systems; and (d) limited interoperability with existing proprietary systems. When compared with existing installed proprietary software solutions, FOSS implementation might not prove to be feasible.

Tong (2004) reported that FOSS provides the dual benefit of freeing educational institutions from the need to pay for licensing fees associated with proprietary software and discouraging piracy of proprietary software by students. When FOSS is used by educational institutions, teachers can make copies of the software available to students, thereby providing the same tools that students use at school for use at home at no additional cost.

FOSS in many instances can be downloaded from the Internet for trial testing. Its lack of fees allows for users to test software prior to full-scale implementation. This testing period provides an opportunity for an organization’s stakeholders to conduct a needs assessment or a feasibility study, to set up a trial machine, or to do any variety of tasks necessary to determine whether the software in question will address a specific set of needs (British Educational Communications and Technology Agency [BECTA], 2005).

Hepburn and Buley (2006) described the following approaches to testing and analysis of FOSS:

1. Free and Open Source Software Applications on Windows. FOSS counterparts can be installed in place of commercial software and successfully run on the existing commercial operating system, such as Windows or Mac OS X. This approach significantly reduces software costs and releases schools from commercial software restrictive licensing agreements that limit how the software may be used.

2. Linux and Windows. The Linux operating system can be installed on a school’s computer alongside Windows (or the Mac OS X). The hard drive of the computer is divided, allowing space for both operating systems and their applications. When a user boots the

computer, she or he may choose the FOSS or commercial operating system to use. This approach saves little or no money since it still retains the existing commercial software. Further, this approach provides little motivation for users to try the less familiar FOSS option.

3. All Open Source Software. The most technically straightforward way to introduce OSS is to replace all commercial operating systems and software with Linux and open source applications. In this rapid conversion to OSS, the cost savings are dramatic.

Older hardware that is no longer able to run the latest operating systems and software applications can be pressed into service when a FOSS operating system such as Linux or Unix is used. These operating systems and associated software applications require less system resources and processing power to function. The conservation of resources creates opportunities for more students to have access to computers while decreasing computer disposal costs and environmental impact (BECTA, 2005).

FOSS affords teachers and students the ability to influence the design and use of FOSS (Lin & Zini, 2005). Many FOSS developers encourage teachers and students to provide valuable feedback and suggestions for improvements to the software used in the learning environment. Such open communication among software developers, programmers, and users allows software to evolve more quickly to meet the needs of the end user.

Moore (2002) reported that FOSS initiatives such as the Open Knowledge Initiative and the Open Course Ware project have the potential to provide flexible course management software solutions that facilitate collaboration among educational institutions. Moore noted that institutions such as Stanford University, Massachusetts Institute of Technology, The University of Pennsylvania, and Dartmouth College are working collaboratively in development of FOSS.

Factors That Impede or Prevent Adoption of FOSS in Educational Institutions

Advances in technology have improved instructional methodology; however, Kim and Baylor (2008) indicated that many teachers do not take the steps to incorporate proprietary software or FOSS effectively, even when they are provided with the technology and training. The authors suggested that, in order for FOSS to have a greater opportunity to be implemented in more educational environments, preservice teacher training must focus on teachers' exposure to various technologies that could be incorporated into instruction and on teachers' motivation to implement the technologies. This change in teacher training could present a formidable challenge, as it involves instructors' values, pedagogical approaches, and levels of comfort and proficiency with technology.

Van Rooij (2010) reported on the friction among subcultures with regard to implementation of FOSS. Van Rooij identified educators (charged with providing instruction) and technologists (charged with implementing, monitoring, and maintaining computer hardware, networks, and technology infrastructure) as having non-aligned interests with respect to the integration of technology at an educational institution. Educators are focused on the tools needed to provided instruction. Typically, educators have little concern for the challenges associated with the operations required to make things work. Technologists have little concern for the interests of educators regarding technology solutions that do not align with established software solutions. Further, technologists are concerned with adherence to established solutions and protocols that facilitate easier systems monitoring and fewer service calls.

Becker (2000) wrote about challenges to technology integration in the classroom. He noted that issues with scheduling could limit the depth and complexity of classroom assignments that a teacher can provide to students. In a typical high school, a class session lasts slightly less than an hour. Providing access to a sufficient number of computers to meet the needs of a classroom (approximately 20 students) would require a trip to a computer lab. Given the time required to record attendance, escort a group of student to a computer lab, and get students seated and logged in might allow only a fraction of the class period to engage in meaningful learning activity. A computer lab is typically a shared resource among a variety of classrooms, requiring advanced scheduling usually days or weeks ahead of time. Given these challenges, many instructors access technology resources sparingly.

Becker (2000) added that another major barrier to technology integration is curriculum coverage. Due to annual required student testing, many teachers are under pressure to cover large amounts of course content. Such pressure runs contrary to integration of technology in the classroom. Becker noted that the use of technology appears to be more beneficial in providing in-depth, constructivist style learning opportunities for students. As administrators' expectations increase, teachers tend to avoid in-depth learning on a few topics and instead adopt the mile-wide, inch-deep approach in covering instructional course content. This approach provides students with exposure to high-stakes test material but depth of understanding in a given content area may not be fully realized.

Haymes (2008) reported on barriers to technology adoption in learning institutions. Haymes related that the convergence of knowledge production and easy access to information via the Internet run contrary to and weaken the traditional role and importance of an educator. Haymes identified the following concerns that educators have regarding technology adoption: (a) unfamiliarity with the technology, (b) unrealistic expectations with respect to the new technology, (c) perceived difficulties in using the new technology, (d) perceived lack of support, and (e) no perceived value gained in adopting the new technology. Given the perceived risk that new technology poses to educators, many elect to avoid new technology completely.

Becker (2000) reported that technology integration in the classroom is consistent with a constructivist approach to teaching. Constructivist theory asserts that learning occurs when a student is able to build on previous knowledge and life experience in meaningful ways. Such an approach runs counter to the following traditional instructional methods: (a) use of an approved curriculum or textbook, (b) direct instruction (i.e., teacher lecturing the class), (c) written tests or quizzes to demonstrate retention of course content, and (d) mastery demonstrated on written tests. Given the pressure on instructors to increase test scores, making use of new instructional methods that incorporate instructional technology may prove to be a risk that few educators are willing to take.

Bauer and Kenton (2005) reported that technology integration in learning institutions is impeded by poor planning, lack of teacher training, and lack of computer hardware. They noted that students typically have insufficient time to use technology to receive meaningful levels of benefit. Educators are not provided additional time for training and integration of technology into the course curriculum. Many of these concerns have their nexus in not identifying the role that technology could serve in the classroom, with the result that technology in the learning environment is used only for menial tasks by the instructor.

Eichelberger (2008) reported on challenges that a learning institution must address in the adoption of a FOSS learning management system: (a) approaching change in a manner that addresses the fear, uncertainty, and distrust that instructors harbor regarding technological change; (b) providing adequate support via training and opportunities for stakeholders to offer input and feedback; and (c) working collaboratively with staff to manage the expectations associated with the new technology. Eichelberger noted that attitudes ultimately determine acceptance or rejection of an innovation or change initiative. Such attitudes are influenced by an institution's previous practice regarding not only previous technology initiatives but also the staff and instructors' perception of the organization's level of concern for them.

Zhao and Cziko (2001) identified three major themes regarding barriers to technology adoption in the classroom: (a) Teachers lack faith that the use of technology can provide an improvement compared to traditional instructional methods used; (b) teachers feel that integrating technology would be disruptive to current instructional methods and models; and (c) teachers lack faith that they possess the requisite skills and resources to use the technology effectively. Zhao and Cziko applied perceptual control theory to explain a teacher's behavior regarding technology integration in the classroom. This theory is a framework that identifies an individual's goals, perception of how things should be, and the methods used to influence or move toward a desired outcome. The authors explained that teachers' decisions to adopt or reject technology hinge on their individual goals, their perception that technology can help to achieve or hinder fulfillment of their goals, and their belief that they are capable of accessing and using technology appropriately.

Nakagawa et al. (2007) commented that, while students have embraced and benefited from FOSS, some teachers have let fear, anxiety, lack of support, and limited resources prevent them from wide-scale adoption of FOSS in the classroom. The researchers recommended that teacher training programs focus on developing transferable skills that teachers can use to adapt to changing technological innovations. The key is not to focus on a particular hardware or software platform; instead, teachers and students can work with various technologies to develop a core skill set that allows for easy transfer to new technologies.

Van Rooij (2009) reported that large for-profit organizations interested in implementing open-source operating systems and applications can access technical support and training from large technology firms (e.g., Redhat Corporation and IBM). The focus of such vendors is to provide enterprise support with a focus on infrastructure (web servers, mail servers, and wide-area networks). However, options for small business and educational institutions are limited or nonexistent.

A recurring element in failed FOSS implementations includes omission of a point person to act as a pedagogical change agent (Kim & Baylor, 2008). This person can provide key functions to support a successful transition to FOSS. First, this person should have expertise to address concerns and answer technical questions. Second, the point person can mentor, motivate, and encourage teachers as they implement the software. Third, the point person can work as a collaborator with other stakeholders, such as administrators at the school or at district level, who are involved in the transition. This change agent holds stakeholders together and facilitates dialog and interaction among them. In short, the change agent acts as a leader and champion for the project.

Tiene (2002) noted that lack of a point person to mentor teachers and champion the project will negatively affect a school's shift to FOSS. Likewise, overlooking the importance of teachers' roles in implementation of a FOSS solution would be a critical error. Key elements that require careful consideration by administrators and mentors include teachers' levels of enthusiasm, technical proficiency, and skill in integrating the technology and their willingness to embrace the technology.

When stakeholders are not included in the planning and implementation of FOSS, resistance and ambivalence can be expected (Hepburn & Buley, 2006). It is essential for all stakeholders to understand the benefits, costs, implementation processes, potential pitfalls, and support options available to ensure a smooth transition to FOSS. Particular attention must be paid to instructors who provide front-line support to students. Such instructors need additional training and support to form a group of educational technologists who can provide specialized support and solutions in a learning environment.

In addition to practical issues that can affect implementation, such as adequate staffing and training, more abstract challenges must be overcome, as well. Hepburn (2005) noted that "the mind share (the level of consumer popularity) that MS [Microsoft] and other proprietary companies enjoy needs to be challenged. This is not necessarily easy to do" (p. 5).

Kim and Baylor (2008) emphasized the importance of perception in implementation of technology innovations such as FOSS. They identified attributes that determine whether a technical innovation is viewed as positive or negative: (a) relative advantage: Is this better than current software solution? (b) compatibility: Is this consistent with my values and needs? (c) complexity: Is this easier or more difficult than the current software solution? (d) trial ability: Can I experiment with new software without hassle or headache? and (e) observability: Can I see a difference between the current and new software solutions? Failure to consider the impact of these attributes can result in barriers to implementing FOSS solutions.

Institutions that are contemplating a move to FOSS must consider support not as a one-time consideration or a service support plan from a vendor but rather as something that will change as the organization shifts and evolves (BECTA, 2005). This plan requires careful consideration of both current and anticipated needs. Thought should be given to the costs associated with unforeseen events, such as a vendor going out of business, changing needs, new hardware, or levels of transitional support required. In many instances, a comprehensive technology plan should be developed.

Farber (2004) listed the following concerns as barriers to wide-scale adoption of FOSS: (a) limited options for commercial support, (b) lack of a long-term development plan, (c) functional limitations with free software, (d) licensing restrictions, and (e) uncertainty regarding free and open-source developers.

Buchanan and Krasnoff (2005) reported that expertise required to install, configure, troubleshoot, and provide ongoing support for FOSS might prove expensive or difficult to acquire. Support options for FOSS are not as plentiful as for proprietary software. Support for FOSS is largely relegated to email lists and website support forums; however, there are options from Red Hat Corporation, Canonical Corporation, and IBM Corporation.

Moore (2002) indicated that educational institutions should consider the cost of implementing and maintaining a FOSS solution compared to the cost of implementing a proprietary software solution. Moore noted that, in some instances, the FOSS solution could be more expensive due to increased labor costs. Alterman (2004) commented that FOSS is nothing more than a vehicle that FOSS vendors use to sell training and back-end support.

According to Hepburn (2005), successful implementation of FOSS requires access to knowledgeable technical support. The necessary technical knowledge depends largely on the level of implementation. For example, knowledge required to set up a single desktop in a classroom is significantly different from the technical expertise required to support a school district in a FOSS implementation. Finding technical support from an outside vendor or setting up in-house support could prove to be time consuming and expensive, even though beneficial in the long run. Green (2004) added that the greatest proponents for FOSS adoption were research universities that had the resources to support its adoption: IT support, cheap or free labor from graduate and postdoctoral students, and collaborative projects funded by large companies and/or the federal government.

Lakhan and Jhunjhunwaia (2008) identified drawbacks associated with implementation of FOSS: (a) difficulties for beginners to set up software; (b) the limited value of available source code; (c) the potential incompatibility of FOSS and existing software components; (d) the dependence of FOSS programs on volunteer developers, potentially resulting in inconsistent software updates and upgrades; and (e) possible loss of support for the software.

Van Rooij (2007) identified challenges associated with FOSS implementation due to divergent views held by those who use the software in the classroom and those who are charged with implementing and supporting those systems. Educators and technologists have different points of view regarding any technology innovation. Educators' primary focus is on software applications and associated tasks to provide instruction to students; technologists typically focus on the server and infrastructure—the point at which support for system-wide information technology services is provided. This responsibility includes establishing computer labs, providing and maintaining Internet connectivity, supporting web services, and so on. Such divergent views and responsibilities can affect how costs of implementing and maintaining new technologies are perceived and the overall value of a transition to FOSS. Educators tend to be excited about access to free software, whereas technologists focus on the time, effort, and resources required to build, provide for, and maintain the hardware and to vet the software installed on the systems to ensure system security.

Van Rooij (2007) concluded that failure to monitor and compare costs associated with current proprietary software solutions, as well as FOSS transition costs, could perpetuate the notion that FOSS is a good idea in theory but not in practice. This perception will not lead to adoption of FOSS as an alternative to proprietary software solutions.

Waters (2007) reported that, even under fiscal pressures, some educational institutions are reluctant to make the change to FOSS.

> While cost is important, it can't be the deciding factor, quality is essential. If a free alternative is not as good or better than a commercial product, quality must win out over price. We must never treat schoolchildren as second-class citizens. We who care about education must always put children first. (Thornburg, as cited in Waters, 2007, p. 3)

Moore (2002) wrote that some educational institutions reject FOSS due to the perception that embracing low-cost or no-cost technology solutions would ultimately result in fewer resources (e.g., state and federal funding) to acquire, maintain, and upgrade technology. Moore made the case that, as more stakeholders become aware of the benefits of FOSS, educational institutions will be under greater scrutiny to justify the cost, access, and level of service to technology resources that they provide to staff and students.

Chapter Summary

Researchers' attitudes associated with FOSS indicate limited awareness of the availability and benefits associated with FOSS. When individuals and organizations are aware of FOSS, receptivity is mixed. Factors that influence perceptions held by educators and learning institutions with respect to FOSS are fear that low or no cost for the software implies low quality, fear of adopting FOSS due to uncertainty, and a belief that commercial software providers guarantee their software.

Factors that make FOSS an attractive option for educators include low or no licensing costs for the software, no restrictions on use of the software, and a philosophical approach associated with FOSS that harmonizes with the values associated with the sharing of knowledge and collaboration. FOSS provides the ability to integrate with existing software and increased opportunities for innovative teaching and learning, eliminating the need for pirating software and the added benefit of running software that is stable and reliable.

Factors that impede or prevent adoption of FOSS in educational institutions include lack of motivation, fear of the unknown, lack of technical support and training, and failure to involve all stakeholders in planning and implementing a FOSS solution.

FOSS appears to be a resource that can add value for students, educators, and educational institutions. The challenge is to create greater awareness of the benefits that FOSS can provide. As awareness of FOSS increases, many of the negative attitudes and barriers to implementing FOSS will be identified and addressed.

CHAPTER III

Research Methodology and Procedures

This chapter revisits the research problem and hypothesis and provides a description of the research design of the study. The chapter also includes a description of the population, procedures, data sources, validity and reliability measures, and analyses used.

Restatement of the Problem

The problem addressed by this study was that FOSS implementation in public schools among teachers is limited.

Research Questions

1. Is there a statistically significant difference in age in years between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

2. Is there a statistically significant difference in years of teaching experience between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

3. Is there a statistically significant difference in primary subject area taught between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

4. Is there a statistically significant difference in the level of education between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

5. Is there a statistically significant difference in number of years of experience using technology between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

6. Is there a statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

7. Is there a statistically significant difference in the positive impact of school site leadership on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

8. Is there a statistically significant difference in the impact of school district technology policies on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom?

Research Design and Methodology

The research design was quasi-experimental to allow for testing of independent variables among groups without the need for any preselection process. The following categories served as independent variables: age of respondent in years, years of teaching experience, primary subject area taught, level of education, number of years of experience using technology in the classroom, number of district training sessions or technology initiatives attended during the past 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom.

The survey (Appendix A) was administered via QuestionPro.com to teachers who were employed by the SDUSD or the SUHSD. The survey contains items pertaining to age of respondent in years, years of teaching experience, primary subject area taught, level of education, number of years of experience using technology in the classroom, number of district training sessions or technology initiatives attended in during the past 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom.

The data analysis used independent-samples *t* tests to measure differences in mean scores among teachers who use FOSS in the classroom, teachers who use proprietary software in the classroom, and teachers who do not use software at all in the classroom.

Population

The target population for this study was all teachers credentialed by the state of California and currently employed by the SDUSH or SUHSD. Study participants were solicited via email. All school sites in the cited school districts were invited to respond to the survey.

Data Sources

All data used for the study came from primary data sources. The survey and recruitment of survey participants were approved by the SDUSH and the SUHSD.

Validity and Reliability

The survey items were constructed in consultation with the dissertation chair, reviewed by the dissertation committee and Question Pro.com, and deemed to be valid and reliable.

Procedures

Addressing the research questions required the following: a review of literature, creation of research and null hypotheses, and consent from the SDUSH and the SUHSD, the dissertation committee, and the Alliant International University Institutional Review Board to perform the study. Letters granting consent to conduct the research are contained in Appendix B.

Data Collection

The data collection process started with constructing a survey designed to address the research questions. Following is a list of the research questions, with the associated survey items designed to gather the data needed to address them.

Research Question 1 asked, Is there a statistically significant difference in age in years between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 2 was, What is your age in years as of your last birthday? The rationale for this item was to determine whether age plays a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 14 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 2 asked, Is there a statistically significant difference in years of teaching experience between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 3 was, How many years have you been teaching? The rationale for this item was to determine whether years of teaching experience play a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 14 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 3 asked, Is there a statistically significant difference in primary subject area taught between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 4 was, What subject area do you teach? The rationale for this item was to determine whether subject area taught plays a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 14 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 4 asked, Is there a statistically significant difference in the level of education between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 5 was, What is your current level of education? The rationale for this item was to determine whether level of education plays a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 14 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 5 asked, Is there a statistically significant difference in the number of years of experience using technology between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 6 was, How long have you used technology in the classroom? The rationale for this item was to determine whether the number of years of experience using technology plays a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 4 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 6 asked, Is there a statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 7 was, How many district technology trainings and or initiatives have you participated in during the last school year? The rationale for this item was to determine whether district technology training and/or initiatives play a factor in a teacher's likelihood of using FOSS in the classroom. Survey Item 14 was, Do you currently use Free and Open Source Software in your classrooms?

Research Question 7 asked, Is there a statistically significant difference in the impact of school site leadership on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 14 was, Do you currently use Free and Open Source Software in your classroom? Survey Items 6, 21, and 32 were, Rate the impact that school site leadership has in your implementation of technology in your classroom. The rationale for these items was to determine whether the impact of school site leadership plays a factor in a teacher's likelihood of using FOSS in the classroom.

Research Question 8 asked, Is there a statistically significant difference in the impact of school district technology policies on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Survey Item 14 was, Do you currently use Free and Open Source Software in your classroom? Survey items 17, 22, and 32 were, Rate the impact that district technology policies have had in your implementation of technology in your classroom. The rationale for these items was to determine the impact of school district technology policies on a teacher's likelihood of using FOSS in the classroom.

Two school districts were solicited to request approval to access their teachers district wide to participate in the survey: SDUSH and SUHSD. After approval was granted by the districts, the individual school sites were contacted by email.

After the survey was reviewed and approved by the doctoral committee, it was uploaded to QuestionPro.com. Instructions were provided on how to access the survey and the email address of the researcher in case anyone had questions regarding the survey. The website was used to conduct the survey and to collect survey results.

Survey recipients were invited to respond online between January 19 and March 9, 2015 at their convenience. At the conclusion of the survey administration period, survey links were disabled and the data were compiled for processing and analysis.

Data Analysis

Data analysis consisted of descriptive and inferential statistical methods. Following is a listing of each research question, a description of the statistical approach used, and a brief explanation of its purpose.

Research Question 1 asked, Is there a statistically significant difference in age in years between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences in the ages of the groups.

Research Question 2 asked, Is there a statistically significant difference in years of teaching experience between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences among groups in years of teaching experience.

Research Question 3 asked, Is there a statistically significant difference in primary subject area taught between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? A qualitative statistical approach was used, due to the small sample size, to determine whether there were statistically significance differences among groups regarding primary subject area taught.

Research Question 4 asked, Is there a statistically significant difference in the level of education between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences among groups in level of education.

Research Question 5 asked, Is there a statistically significant difference in number of years of experience using technology between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences among groups in years of experience using technology.

Research Question 6 asked, Is there a statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences among groups in levels of training or participation in initiatives.

Research Question 7 asked, Is there a statistically significant difference in the positive impact of school site leadership on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences in the impact of school site leadership on technology use in the classroom.

Research Question 8 asked, Is there a statistically significant difference in the impact of school district technology policies on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The inferential approach used the *t* test to determine whether there were statistically significant differences in the impact of school district technology policies on technology use in the classroom.

Chapter Summary

The approach used in this study was described. The study incorporated a quasi-experimental research design. Participants responded to a survey. Responses were collected, compiled in a database, and analyzed with PSPP® (a free and open source alternative to SPSS®). The analysis was based on *t* test scores to measure differences in means on the variables among teachers who use FOSS in the classroom, teachers who use proprietary software in the classroom, and teachers who do not use software at all in the classroom.

CHAPTER IV

Results

This chapter presents information regarding exclusions to the study, a restatement of the problem, the research hypotheses, statistical analysis for each hypothesis, and the results. Unless otherwise stated, all analyses were performed with PSPP statistical software, an open-source clone of SPSS, and LibreOffice Calc, an open-source clone of Microsoft Office Excel.

Exclusions

Fourteen respondents reported that they used only proprietary software in the classroom, 60 respondents reported that they used FOSS in the classroom, and 1 respondent reported not being a software user. The single non-software user was classified as an outlier. Further, the single non-software user failed to complete the survey, making it impossible to use the data; therefore, this person's data were omitted from analysis. This resulted in two comparison groups, 14 proprietary software users and 60 FOSS users, for a total sample of 74 respondents. Note that the teachers who self-identified as FOSS users did not indicate that the use of FOSS in the classroom excluded use of proprietary software. Given the apparent imbalance of FOSS users in settings where proprietary software tends to dominate, it appears that the FOSS users most likely make use of both proprietary software and FOSS.

Restatement of the Problem

The problem addressed by this study was that FOSS implementation by teachers in public schools is limited.

Research Question 1: Results and Analysis

Research Question 1 asked, Is there a statistically significant difference in age in years between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Age was the independent variable. Results were analyzed using an independent-samples *t* test. The difference between the mean age of the FOSS group (44.83 years, *SD* = 9.62) and the mean age of the proprietary software group (49.19 years, *SD* = 10.52) was not significant, *t* = -1.57, *df* = 72.

Research Question 2: Results and Analysis

Research Question 2 asked, Is there a statistically significant difference in years of teaching experience between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Years of teaching experience was the independent variable. Results were analyzed using an independent-samples *t* test. The difference between mean years of teaching experience of the FOSS group (16.75, *SD* = 8.55) and the mean years of teaching experience of the proprietary software group (18.93, *SD* = 10.55) was not significant, *t* = -0.84, *df* = 72.

Research Question 3: Results and Analysis

Research Question 3 asked, Is there a statistically significant difference in the frequency of primary subject area taught between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Given the small sample size of teachers per subject area, qualitative analysis of the data was conducted. More teachers used FOSS across all subject areas (*n* = 60) than used proprietary software across all subject areas (*n* = 14). Given the small sample size and minimal information provided on the survey by the two groups, any conclusions drawn regarding these data would be suspect.

Research Question 4: Results and Analysis

Research Question 4 asked, Is there a statistically significant difference in the level of education between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The independent variable level of education was assigned numerical values (1 = BA/BS, 2 = MA/MS, 3 = Ed.D./Ph.D.). Results were analyzed using an independent-samples *t* test. The difference in level of education of the FOSS group (1.83, *SD* = 0.46) and the proprietary software group (1.94, *SD* = 0.44) was not significant, *t* = 0.85, *df* = 72.

Research Question 5: Results and Analysis

Research Question 5 asked, Is there a statistically significant difference in the number of years of experience using technology in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? Years of technology experience was the independent variable. Results were analyzed using an independent-samples *t* test. The difference in years of experience using technology between the FOSS group (28.21, *SD* = 6.65) and the proprietary software group (30.93, *SD* = 5.38), was not significant, *t* = 1.47, *df* = 71.

Research Question 6: Results and Analysis

Research Question 6 asked, Is there a statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The independent variable was the number of training sessions or initiative attended by the teachers. Results were analyzed using an independent-samples *t* test. The difference between number of sessions or initiative attended by the FOSS group (2.39, *SD* = 2.73) and the proprietary software group (3.44, *SD* = 5.10) was not significant, *t* = -1.09, *df* = 70.

Research Question 7: Results and Analysis

Research Question 7 asked, Is there a statistically significant difference in the impact of school site leadership on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The independent variable was the teachers' reported impact of school site leadership on technology use in the classroom. Responses were assigned numerical values as follows: 1 = *Poor*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average,* 5 = *Exceptional*. Results were analyzed using an independent-samples *t* test. The difference between ratings of administration's impact by the FOSS group (2.79, *SD* = 1.11) and the proprietary software group (3.69, *SD* = 0.48) was not significant, *t* = -2.86, *df* = 63.

Research Question 8: Results and Analysis

Research Question 8 asked, Is there a statistically significant difference in the impact that school district technology policies have had on technology use in the classroom between teachers who use FOSS in the classroom and teachers who use proprietary software in the classroom? The independent variable was the teachers' reported impact of school district policies on technology use in the classroom. Responses were assigned numerical values as follows: 1 = *Very Restrictive,* 2 = *Somewhat Restrictive,* 3 = *Neutral,* 4 = *Somewhat Supportive,* 5 = *Very Supportive*. Results were analyzed using an independent-samples *t* test. The difference between ratings of the impact of district policies on technology use in the classroom between the FOSS group (2.88, *SD* = 1.14) and the proprietary software group (2.56, *SD* = 1.15) was not significant, *t* = 1.00, *df* = 74.

Summary of Research Findings

Research Question 1: There was no statistically significant difference in age in years between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 2: There was no statistically significant difference in years of teaching experience between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 3: There was no statistically significant difference between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom

Research Question 4: There was no statistically significant difference in the level of education between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 5: There was no statistically significant difference in the number of years of experience using technology in the classroom between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 6: There was no statistically significant difference in the number of district technology training sessions and/or initiatives attended by teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 7: There was a statistically significant difference in the impact of school site leadership on technology used in the classroom between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Research Question 8: There was no statistically significant difference in the impact of school district technology policies on technology used in the classroom between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom.

Chapter Summary

Survey respondents included 14 teachers who used proprietary software, 60 teachers who used FOSS, and 1 respondent who self identified as a non-software user and did not complete the survey. This respondent was classified as an outlier and the responses were excluded from analysis, resulting in comparison of dichotomous groups: FOSS users and proprietary software users. Results of *t* tests for Research Questions 1, 2, 4, 5, 6, 7, and 8 and results of qualitative analysis of responses related to Research Question 3 indicated no statistically significant differences in the two groups according to age, years of teaching experience, subject area taught, level of education, years of experience using technology in the classroom, participation in technology training during the previous 12 months, or perceived impact of school district technology policies on decisions to use FOSS. However, there was a statistically significant difference in mean scores between groups with regard to the impact of school site administration in implementing technology in the classroom.

CHAPTER V

Discussion

This research study examined factors affecting a teacher's decision to use or not use FOSS in the classroom. Factors examined were age of respondents in years, years of teaching experience, primary subject area taught, level of education, number of years of experience of using technology, number of district training sessions or technology initiatives attended in the past 12 months, impact of school site leadership on implementation of technology in the classroom, and impact of district technology initiatives on implementation of technology in the classroom. This chapter presents a summary of the findings, with discussion and interpretation, for each research question. Implications of the findings, study limitations, conclusions, and recommendations for future research are presented.

Research Question 1

The finding was that there was no statistically significant difference in age between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. It was anticipated that younger teachers would be more inclined to embrace newer technologies. The results did not support expectation. Age appeared to have no significant effect on willingness to embrace FOSS or other technology innovations. School districts would do well to avoid making use of age as a data point in planning or implementation of a technology initiative, to avoid any appearance of age discrimination.

Research Question 2

The finding was that there was no statistically significant difference in years of teaching experience between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. It was anticipated that years of teaching experience could influence a teacher's choice to embrace FOSS in that more experienced instructors would be more likely to embrace the software provided by their school district. More experience typically results in more years working in environments where proprietary software usage is the norm. However, the results did not support this expectation. As in the case of age, years of teaching experience appeared to have no significant effect on willingness to embrace FOSS or other technology innovations. School districts would do well to avoid making use of years of teaching experience as a data point in planning or implementing a technology initiative, to avoid any appearance of age discrimination.

Research Question 3

The finding was that there was no statistically significant difference in primary subject area taught between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. It was anticipated that the teacher's primary subject would influence the decision to make use of FOSS, in that subjects presumed to be more closely related to technology (e.g., math, science) would be an indicator of the type of instructor who would embrace FOSS. The results failed to support this expectation. Upon reflection, it appears that FOSS use in the classroom varied from subject to subject based upon need. For example, an English teacher would most likely make use of an office suite for students to do word processing or perhaps a browser application to access the Internet to conduct research for reports, whereas a math teacher might use the same tools for very different tasks. Thus, any subject matter can make use of FOSS for a variety of purposes to enhance learning and instruction. School districts should make a point to query all classroom instructors, regardless of subject taught, regarding software and ancillary supports to enhance learning and instruction. Further, where practicable, FOSS options should be offered to provide support for learning and instruction while reducing or eliminating expensive proprietary software solutions, as well as providing equitable instruction for all students.

Research Question 4

The finding was that there was no statistically significant difference in the level of education between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. The survey results with regard to level of education were unexpected. Most of the respondent instructors reported having a Master of Arts or Master of Science degree. Upon reflection, it appears that higher levels of education are incentivized by the method used to determine a teachers' pay: higher levels of education result in higher levels of pay. School districts might do well to revisit how teachers move up the pay scale based on the number of college course credits completed or level of degree attained. School districts possibly incentivize specific college courses or courses of study, as well as offer district-sponsored certificate programs designed to introduce or expose instructors to features, advantages, and benefits of FOSS.

Research Question 5

The result was that there is no statistically significant difference in the number of years of experience using technology in the classroom between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. Years of experience using technology could be an effective measure to identify those who could be consulted to determine the current state of technology use at the school site level. Such individuals could also provide insight on teacher concerns and pain points with regard to technology implementation, use in the classroom as well as training and support needs. Further, such experienced teachers could act as point persons at the school site level to address concerns of less knoweldgable teachers and to advocate for school site concerns. Any school district contemplating a new technology initiative would do well to identify and consult the most experienced users of technology at the school site. Identifying and querying the most experienced teachers using technology at the school site level, during the planning phase of any proposed technology initiative, could provide valuable information needed to address potential concerns. Furthermore, such persons should be consulted during implementation and program monitoring/assessment phases to improve the likelihood of success.

Research Question 6

The result was that there was no statistically significant difference in the number of district technology training sessions and/or initiatives attended between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. It had been expected that teachers who had attended technology training more frequently would be more inclined to embrace and use technology and, by extension perhaps, embrace newer technology option such as FOSS. However, the research question did not have a metric to determine an instructor's motivation for attending technology training. Furthermore, teachers who make use of or who are interested in using FOSS typically do not receive technology training or support on FOSS from school districts that standardize proprietary software solutions. In some instances, school districts actively discourage use of software solutions other than those that they provide and support. School districts should provide technology training based on identified needs. This requires querying instructors on technology in current use (FOSS or proprietary), unmet needs, and desired solutions. School districts could solicit teacher input on methods to determine the effectiveness of the technology in use.

Research Question 7

There was a statistically significant difference in the impact of school site leadership on technology use in the classroom between teachers who made use of FOSS in the classroom and teachers who made use of proprietary software in the classroom. During the course of the study it became apparent that the level of perceived impact that school site administrators have in implementation of technology in the classroom was the only significant difference between the two groups. This difference correlates with teachers' propensity to embrace FOSS versus proprietary software. Teachers who perceive that school site administration have less impact on implementation of technology in the classroom (FOSS group) tend to seek technology solutions on their own. The motivation for such behavior could be to address a need that has not been addressed by the school site or school district or to make use of software solutions that are not provided or approved by the school site or school district; or the school site or school district technology procurement process might be too slow and cumbersome for the teachers. Instructors who make use of FOSS might not see the school site administrator as an impediment to implementation of technology in the classroom but also might not see that person as critical to the process because the instructor can find and implement technology solutions independently via FOSS. Teachers who perceive that school site administration has a strong impact on implementation of technology in the classroom (proprietary group) appear to depend, to a greater degree, on site administration for support in implementing technology in the classroom. This perception could be fueled by a school site administrator who is viewed as an active advocate and supporter of instructors in attempting to implement technology in the classroom. Behaviors that a school site administrator might engage in that would serve to reinforce teachers perception could include sending instructors to training, locating funding sources for classroom technology, and ensuring that computer labs are functional and in good repair or that ancillary instructional technology requests from teachers are given top priority.

These results reasonably lead to the conclusion that teachers who embrace FOSS have less dependence on school site administration than teachers who use proprietary software. Furthermore, given that school districts typically do not implement or support FOSS, instructors who make use of FOSS do not look for support from school site administration in the acquisition, installation, use, and maintenance of FOSS solutions. In this instance, the use of FOSS in learning environments that support proprietary software could be an indicator of unmet teacher needs, a teacher's lack of faith in school site administration/school district to provide needed instructional materials, an ineffective procurement process, or poor technical support.

Teaching is a complex process that requires the teacher to provide engaging, meaningful, and relevant instruction, to monitor progress, and to make needed adjustments when students struggle with learning. Failure of traditional methods and tools to support instruction and learning potentially sets the stage for teachers to seek other solutions. In learning environments where proprietary software is provided and supported, voluntary teacher use of FOSS could be an indicator that incumbent software solutions, technical support, and procurement processes have failed to address the dynamic needs associated with teaching and learning. School districts that fail to examine and address the needs of teachers who provide instructional support for students with different learning modalities, special needs, and varying levels of background knowledge, could induce teachers to seek and use alternatives (e.g., FOSS) to support instruction and learning.

The results of the study and elements of the literature review appear to harmonize and support the importance of an effective school site administrator. Van Rooij (2010) report on the friction among subcultures with regard to implementation of FOSS. A supportive school site administrator can have a positive effect on bridging the agendas of educators (charged with providing instruction) and technologists (charged with implementing, monitoring, and maintaining computer hardware, networks, and technology infrastructure).

Concurrently, Becker (2000) and Bauer and Kenton (2005) wrote about challenges to technology integration in the classroom. Noteworthy challenges include a school master schedule that could limit the depth and complexity of teacher preparation periods, instructors' readiness to deliver instruction access to computers, and access to enough working computers on a consistent basis. A effective school site administrator could address these concerns with proper planning and coordination with instructional staff.

Effective school site administration can circumvent the challenge reported by Becker (2000) that curriculum coverage is a major barrier to technology implementation. Understanding school site administrators who focus on improving instruction and learning versus test scores can take pressure off instructional staff, allowing them to take risks, and provide needed mentoring and support.

Eichelberger (2008) reported on challenges that a learning institution must address in the adoption of a FOSS learning management system: (a) approaching change in a manner that addresses the fear, uncertainty, and distrust that instructors harbor regarding technological change; (b) providing adequate support via training and opportunities for stakeholders to offer input and feedback; and (c) working collaboratively with staff to manage expectations associated with new technology. The concerns identified by Eichelberger can be addressed by school site administrators by being supportive of instructional staff, scheduling ongoing professional development opportunities with instructional staff, providing opportunities to solicit feedback, and providing opportunities to collaborate with instructional staff.

Research Question 8

The result was that there was no statistically significant difference in the impact of school district technology policies on technology use in the classroom between teachers who used FOSS in the classroom and teachers who used proprietary software in the classroom. Some school districts discourage use of software other than the software that they provide and support, based on the proclaimed need to protect the district's computers and network from viruses. This claim is dubious, as most school districts make use of spam filtering and virus protection software. It was surprising that FOSS users did not appear to express the opinion that school district policies were restrictive in the use of FOSS. However, it appears that teachers who make use of FOSS do so without the support or perhaps even the knowledge of the school district. In many instances, FOSS applications can be run on proprietary software platforms such as Microsoft Windows or Macintosh OS X operating systems. Further, applications that are installed and run locally on a machine typically are not monitored by school district technology support departments. Teachers who make use of FOSS in these instances are using the software with the understanding that they will receive no support. Teachers have expressed the need to find software solutions when none are available through the school district. Therefore, teachers who make use of FOSS do not appear to be seriously concerned about district policies that do not provide support for current needs because they can access solutions suited to their needs in a timely and cost effective way. School districts would do well to reconsider policies that restrict use of FOSS. Embracing FOSS could allow the district to consider, where practicable, FOSS solutions that can replace expensive proprietary software, better manage software being used on district computer hardware, and provide more equitable access and support to students throughout the district.

Implications of the Findings

Theory. The study's theoretical basis was built on previous work in the areas of CT, DIT, and the adoption process. These theories provided definitions and a framework to facilitate the literature review. The findings of the study are consistent with the theorists cited in the literature review. However, no new theories were discovered or offered in this study.

Research. The results of the study provide insight to individuals and educational organizations regarding factors that may or may not influence a teacher's decision to use FOSS in the classroom. The study reaffirms prior research on change theory by Fullan and Stiegelbauer regarding the role of the change agent; by Havelock and Zlotolow, who developed a checklist to assist in a change initiative; by Hall and Hord, who developed the concerns-based adoption model, commonly referred to as the "seven stages of concern"; by Zaltman and Duncan), who identified reasons for acceptance or rejection of a change effort; and by Ely, who wrote about environmental supports needed to implement and sustain a change effort.

Practice. The results of this study can provide educators and educational institutions with useful information to consider when contemplating implementation of FOSS or any other change initiative. Information in the literature review can inform best practices, relevant theoretical frameworks, and guides that educational institutions can employ in the areas of CT, DIT, and the adoption process during planning, implementing, and progress monitoring phases of a FOSS project. The results can provide information on the importance of well-trained and supportive school site administrators to provide effective leadership, support, and advocacy when making a transition to FOSS. Furthermore, the study can provide insights to assist school districts in determining whether adequate and appropriate instructional technology support is being provided at the school site level.

Limitations of the Study

The researcher planned carefully to obtain a large enough sample to support an appropriate analysis of the resulting data. Two school districts participated in the study. Ninety-four teachers responded to the invitation to participate in the survey; however, 20 surveys were eliminated due to being incomplete. The final number of respondents (74) was greater than the minimum number required (68) per the Institutional Review Board's requisite power analysis. The apparent imbalance of FOSS users versus proprietary software users identified in the survey (60 FOSS users versus 14 proprietary software users) appeared problematic. However, it was noted that the teachers who self-identified as FOSS users did not indicate that their use of FOSS in the classroom was exclusive. It appears that the FOSS users most likely make use of both proprietary software and FOSS.

Conclusions

Based on the results of the study, it appears that voluntary teacher use of FOSS in environments that provide and support proprietary software could indicate that (a) incumbent software solutions have failed to support teaching and learning, (b) information technology support is perceived as nonresponsive, (c) technology procurement processes are perceived as slow and cumbersome, and (d) limited or no funding is available for purchase of classroom technology. Failure to address these concerns could stimulate teacher use of FOSS in the classroom. On the other hand, school districts that are interested in encouraging teachers to use

FOSS should establish a collaborative process (instructional staff, administration, and information technology personnel) to identify and assess appropriate FOSS solutions, provide training opportunities in the use of FOSS in the classroom, and establish guidelines to monitor and evaluate the effectiveness of the selected software solutions (both proprietary and FOSS) with respect to enhancing instruction and learning.

Recommendations for Future Research

To continue this course of study, it is recommended that a longitudinal study be conducted to compare school districts that endorse and support the use of FOSS in the classroom and school districts that endorse and support the use of proprietary software in the classroom, using the following independent variables: (a) technology expenditures for hardware, software, and information technology labor costs; (b) student achievement measures, including graduation rates, number of students engaged in science, technology, engineering, and math (STEM) studies, and number of students taking advanced placement classes; and (c) teacher satisfaction levels with respect to their work. The goal of the study would be to determine whether use of FOSS versus use of proprietary software throughout a school district reveals statistically significance differences in these variables. The outcome of such a study could provide meaningful data to school districts that are challenged by limited funding, faltering student achievement rates, and low teacher morale.

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APPENDIX A

Survey

1. Which school district do you work for?
    Sweetwater Union High School District
    Rialto Unified School District
    San Diego Unified School District

2. What is your age as of your last birthday?

3. How many years have you been teaching?

4. What subject area do you teach? If you teach multiple subject areas, please choose your primary subject area.
    English
    Math
    Science
    Social Studies
    Art
    PE
    Primary
    Not listed

5. What is your current level of education?
    BS/BA
    MS/MA
    Ed.D/Ph.D

6. How old were you when you were first introduced to computers?

7. How many technology trainings have you attended in the last 12 months?

8. What was your first use for computers?
    Video games
    Word processing
    Accessing the internet
    Other

9. Who first introduced you to computers?
    Parent
    Friend/peer
    Classmate
    Elementary school teacher
    Middle school teacher
    High school teacher
    College professor
    Other

10. If a teacher first introduced you to computers, what was that teachers subject area?
    English
    Math
    Science
    Social Studies
    Art
    PE
    Primary (Elementary)
    Not listed
    Does not apply

11. When did you start using computers to support your personal learning?
    Elementary school
    Middle school
    High school
    College
    other

12. Do you use technology in your classroom to support student learning?
    Yes
    No

13. Are you familiar with Free and Open Source Software?
    Yes
    No

14. Have you ever used free and open source software (FOSS) for personal use? Examples of free and open source software include but are not limited to: LibreOffice – a Microsoft Office clone Firefox – a web browser Moodle – a course management system, a Blackboard clone, Ubuntu - a free operating system, comparable to Microsoft Windows or Apples OSX operating system
    Yes
    No

15. Do you use free and open source software (FOSS) in your classroom to support instruction? Examples of free and open source software (FOSS) include but are not limited to:LibreOffice – a Microsoft Office clone Firefox – a web browser Moodle – a course management system, a Blackboard clone, Ubuntu - a free operating system, comparable to Microsoft Windows or Apples OSX operating system
    Yes
    No

16. Please describe why you do not use technology in your classroom. (Select all that apply)?
    Lack of funding
    Lack of training
    Lack of support from school site administration
    Lack of technical support (district IT department)
    Lack of district support (district policies that don't support instructional technology)
    Lack of motivation (I don’t like change)

Lack of motivation (Technology wont make my job easier)
Other

17. How would you rate the impact that school site leadership has had in your implementation of technology in your classroom
    Poor
    Below Average
    Average
    Above Average
    Exceptional

18. How would you rate the impact that district technology policies has had in your implementation of technology in your classroom
    Very restrictive of teachers choice of technology in the classroom
    Somewhat restrictive of teachers choice of technology in the classroom
    Neutral
    Somewhat supportive of teachers choice of technology in the classroom
    Very supportive of teachers choice of technology in the classroom

19. What would it take to encourage you to use technology in the classroom(Select all that apply)?
    Increased technology funding
    Training
    Support from school site administration
    Technical support (district IT department)
    District support (district policies that support instructional technology)
    Peer mentor-ship/support
    Other

20. List the computer software you use in your classroom to support instruction, no more than 5 applications:

21. Describe the barriers or challenges that you face in implementing instructional technology in your classroom. (Select all that apply)?
    Lack of funding
    Lack of training
    Lack of support from school site administration
    Lack of technical support (district IT department)
    Lack of district support (district policies that don't support instructional technology)
    Lack of motivation (I don’t like change)
    Lack of motivation (Technology wont make my job easier)
    Other

22. How would you rate the impact that school site leadership has had in you implementation of technology in your classroom
    Poor
    Below Average
    Average
    Above Average

Exception

23. How would you rate the impact that district technology policies has had in your implementation of technology in your classroom
    - Very restrictive of teachers choice of technology in the classroom
    - Somewhat restrictive of teachers choice of technology in the classroom
    - Neutral
    - Somewhat supportive of teachers choice of technology in the classroom
    - Very supportive of teachers choice of technology in the classroom

24. How old were you when you were first introduced to free and open source software (FOSS)?

25. What was your first use for free and open source software (FOSS)?
    - Video games
    - Word processing
    - Accessing the internet
    - Other

26. Who first introduced you to free and open source software (FOSS)?
    - Parent
    - Friend/peer
    - Classmate
    - Elementary school teacher
    - Middle school teacher
    - High school teacher
    - College professor
    - Other

27. When did you started using free and open source software (FOSS) to support your personal learning?
    - Elementary school
    - Middle school
    - High school
    - College
    - Other

28. Do you use free and open source software (FOSS) in your classroom to support student learning?
    - Yes
    - No

29. List the free and open source software (FOSS) you use in your classroom to support instruction, no more than 5 applications:

30. Which response best describes your experience with Free and Open Source Software
    - Positive
    - Negative
    - Mixed

31. What made your experience with Free and Open Source Software positive?
    - Funding
    - Training
    - Support from school site administration
    - Technical support (district IT department)
    - District support (district policies that support instructional technology)
    - Motivation (I like change)
    - Motivation (Technology will make my job easier)
    - Other

32. What made your experience with Free and Open Source Software negative?
    - Lack of funding
    - Lack of training
    - Lack of support from school site administration
    - Lack of technical support (district IT department)
    - Lack of district support (district policies that don't support instructional technology)
    - Lack of motivation (I don’t like change)
    - Lack of motivation (Technology wont make my job easier)
    - Other

33. How would you rate the impact that school site leadership has had in your implementation of free and open source software (FOSS) in your classroom
    - Poor
    - Below Average
    - Average
    - Above Average
    - Exceptional

34. How would you rate the impact that district technology policies has had in your implementation of free and open source software (FOSS) in your classroom
    - Very restrictive of teachers choice of technology in the classroom
    - Somewhat restrictive of teachers choice of technology in the classroom
    - Neutral
    - Somewhat supportive of teachers choice of technology in the classroom
    - Very supportive of teachers choice of technology in the classroom

35. What do you think it would take to encourage others to use free and open source software (FOSS) in their classrooms.(Select all that apply)?
    - Increased technology funding
    - Training
    - Support from school site administration
    - Technical support (district IT department)
    - District support (district policies that support instructional technology)
    - Peer mentor-ship/support
    - Other

APPENDIX B

Letters of Permission

San Diego Unified
SCHOOL DISTRICT

OFFICE OF RESEARCH AND DEVELOPMENT

Memorandum of Agreement

By and Between
Samuel R. Coleman
and
the San Diego Unified School District
3/2/2015

This agreement is entered into by the San Diego Unified School District (SDUSD) and Samuel R. Coleman for the purpose of researching and sharing information between the parties in a manner consistent with the Family Educational Rights and Privacy Act of 1974 (FERPA) and SDUSD Administrative Procedure Nos. 6525, 6527, and 4930.

BACKGROUND

Samuel R. Coleman is currently a doctoral candidate attending Alliant International University, located in San Diego, California. Mr. Coleman is currently pursuing a Doctorate in Educational Leadership, with a focus on educational technology. Mr. Coleman has worked in public schools since 2001 in a variety of roles: special education teacher, math teacher, technology teacher, site technology coordinator, special education administrator, assistant principal, special education coordinator and high school principal.

PURPOSE OF THE STUDY

The purpose of this study is to determine whether there are statistically significant differences between teachers who use FOSS in the classroom and teachers who do not use FOSS in the classroom and then to utilize this information to propose ways to mitigate the barriers to the implementation of FOSS by teachers in public schools.

SCOPE OF WORK

See attachment, chapter 3 of my dissertation proposal.

I. PARTIES

The SDUSD REPRESENTATIVE is Ron Rode, Director of the Office of Research and Development, Office of the Chief Public Information Officer, SDUSD, who is authorized by the SDUSD to maintain and release student records subject to FERPA and SDUSD policies and procedures. The SDUSD REPRESENTATIVE may also be represented by other district staff. The SDUSD REPRESENTATIVE'S DESIGNEES include Peter Bell, Director of the Data Analysis and Reporting Department.

The APPLICANT is Samuel R. Coleman who is affiliated with Alliant International University.

The SDUSD SPONSOR is Dr. Robert Grano, Director of Educational Technology.

The SDUSD SPONSOR will monitor the research ensuring that research is being conducted as proposed and meets the obligations of this agreement. If necessary, the SDUSD SPONSOR may provide logistical assistance to the APPLICANT.

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II. COMPLIANCE WITH FERPA

A. The APPLICANT will comply with the provisions of FERPA in all respects. For purposes of this agreement, the APPLICANT will use data collected and shared under this agreement for no purpose other than research authorized under §99.31 (6)(iii) of Title 34, Code of Federal Regulations. Nothing in this agreement may be construed to allow either party to maintain, use, disclose, or share student information in a manner not allowed by federal law or regulation. In particular, the APPLICANT will not disclose any data contained under this agreement in a manner that could identify any individual student or the student's parent(s)/guardian(s), per 34 CFR §99.31 (6)(ii)(A), except as authorized by FERPA.

B. The APPLICANT will abide by information redisclosure limitations per 34 CFR §99.33 (a)(1); §99.33 (a)(2). Data that contain personal information from students' education records are protected by the FERPA (20 U.S.C. §1232g) and may not be re-released without consent of the parents or eligible students.

C. The APPLICANT will destroy all data obtained under this agreement when they are no longer needed for the purpose for which they were obtained in compliance with 34 CFR §99.31(6)(ii)(B); §99.35 (b)(2), or returned to the SDUSD REPRESENTATIVE.

III. COST OF RESEARCH

A. The SDUSD REPRESENTATIVE agrees to provide requested data under this agreement, to be billed at district cost.

B. The APPLICANT agrees to pay all other costs associated with the implementation of research activities.

IV. RESEARCH METHODOLOGY

A. The APPLICANT will adhere to a "small numbers" policy of suppressing findings for any group of students numbering fewer than ten, and to require all employees, contractors, and agents of any kind to also abide by such policy. Where "small numbers" reporting becomes necessary, the APPLICANT will request formal consent from the SDUSD REPRESENTATIVE unless prior approval from SDUSD has been obtained.

V. DATA REQUEST AND USE

A. The APPLICANT agrees that the single authorized REPRESENTATIVE to request data under this agreement will transmit all data requests and maintain a log or other record of all data requested and received pursuant to this agreement, including confirmation of the completion of any projects and the return or destruction of data as required by this agreement.

B. The ability to access or maintain data under this agreement shall not under any circumstances transfer from the APPLICANT to any other institution or entity. The APPLICANT may not disclose SDUSD data to parties not identified in Part I without the written consent of the SDUSD REPRESENTATIVE.

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C. No other entity is authorized to continue using SDUSD data obtained under this agreement upon cessation of studies conducted under the direct supervision of the APPLICANT.

D. The APPLICANT will require all employees, contractors, and agents of any kind to comply with all applicable provisions of FERPA and other federal laws with respect to the data shared under this agreement. The APPLICANT agrees to require and maintain an appropriate confidentiality agreement from each employee, contractor, or agent with access to data pursuant to this agreement.

E. The APPLICANT will maintain an original data set of SDUSD data obtained pursuant to this agreement separate from all other data files.

F. Nothing in this agreement authorizes the APPLICANT to maintain data beyond the time period reasonably needed to complete the purpose of the request. Unless authorized in writing by the SDUSD REPRESENTATIVE, all data relating to an individual student must be returned or destroyed when no longer needed for the purposes for which the study was conducted.

G. The APPLICANT agrees that the SDUSD REPRESENTATIVE may, upon request, review the records required to be kept under this agreement.

H. The APPLICANT agrees that the SDUSD REPRESENTATIVE may decline to comply with a request if, in her/his discretion, s/he determines that providing the requested data would not be in the best interest of current or former students in the SDUSD.

I. The APPLICANT agrees that all requests will include a statement of purpose, if not included in the original proposal, for which data are requested and an estimation of the time needed to complete the project for which the data are requested. The parties may agree to accept data requests by electronic mail, telephone, or facsimile.

VI. RESEARCH INSTRUMENTS

A. The APPLICANT agrees to submit to the SDUSD REPRESENTATIVE for review and approval, **at least *two* weeks prior** to administration, all surveys, interviews, assessments, or focus group activities that impact SDUSD staff or students.

VII. RESEARCH PRODUCTS

The APPLICANT intends to present research findings in ✓ written and/or ____ oral format. *(If initialed, continue.)*

A. The APPLICANT will present a **first** draft of either preliminary or endmost research findings generated under this agreement and related methodology to the SDUSD REPRESENTATIVE **at least six weeks prior** to any written or oral presentation thereof. The draft must identify the intended audience and cite specific forums (e.g., journals, conferences, dissertation) in which the findings will be presented.

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B. The SDUSD REPRESENTATIVE agrees to take no longer than **two weeks** from receipt to review the **first** draft of either preliminary or endmost findings, cite inaccuracies, and/or offer revisions that comport with rigorous research methodology.

C. The APPLICANT agrees to submit the **final research product** to the district prior to any written or oral presentation of endmost findings and–after presentation or dissemination–an electronic copy of the final version for posting on the district website.

VIII. TERM OF AGREEMENT

A. The APPLICANT agrees to terminate all research activities (including presentation of the final report) on or before May 15, 2015.

IX. AMENDMENT TO, OR CANCELLATION OF, MEMORANDUM OF AGREEMENT

This agreement expresses the entire agreement of the parties. Any modification or amendment to the agreement must be executed in writing and signed by both the SDUSD REPRESENTATIVE and the APPLICANT.

A. Both the APPLICANT and the SDUSD REPRESENTATIVE agree that the Memorandum of Agreement takes effect upon signature by the authorized representative of each party and shall remain in effect until the termination date identified above, or until canceled or amended by either party upon thirty days written notice.

B. The APPLICANT agrees that the SDUSD REPRESENTATIVE may cancel the Memorandum of Agreement immediately upon violation of any element agreed to herein.

Entered into this 2nd day of March, 2015.

APPLICANT

SDUSD REPRESENTATIVE

SDUSD SPONSOR

10/29/2014 Gmail - RE: Doctoral study

Gmail by Google

sam coleman <dr.samuel.coleman@gmail.com>

RE: Doctoral study

1 message

Tom Gray <Thomas.Gray@sweetwaterschools.org> Wed, Oct 29, 2014 at 7:41 AM
To: sam coleman <dr.samuel.coleman@gmail.com>

Sam, I really do not have any restrictions for the survey. Again you will need to seek the addresses and send the link to the survey through a private process. I cannot provide email access or addresses to you for your survey. Teachers may or may not respond as they would make that choice on their own. You really need no approval to your process. We would NOT send out your survey through district mail. We currently have five staff members who are doing their own Doctoral study and they too cannot use district email to gain access to staff. In some cases they paid for a service to provide the emails they needed in their own district. This avoids all conflicts of interest and endorsements.

From: sam coleman [mailto:dr.samuel.coleman@gmail.com]
Sent: Tuesday, October 28, 2014 7:01 PM
To: Tom Gray
Subject: Re: Doctoral study

Greetings,

Please find attached the items you requested. I look forward to hearing from you.

Sam Coleman

On Tue, Oct 28, 2014 at 6:52 AM, Tom Gray <Thomas.Gray@sweetwaterschools.org> wrote:

https://mail.google.com/mail/u/0/?ui=2&ik=6566a074d5&view=pt&search=inbox&th=14954f0f7b69910e&siml=1495c5bc38e2cfc6 1/3

Please send me a copy of your abstract and research survey. I would need to review them along with the research design. If the study is allowed it would then be your responsibility to contact teachers. I would not be able to use our in house email system to send out the survey. You would need to do whatever ground work would be necessary to acquire those address. Most of them are public, and you can buy list from an outside vendor it that would make it easier.

From: sam coleman [mailto:dr.samuel.coleman@gmail.com]
Sent: Monday, October 27, 2014 9:09 PM
To: Tom Gray
Subject: Doctoral study

Greetings,

My name is Sam Coleman. I am a doctoral student at Alliant International University. I am requesting permission to conduct an online survey with Sweetwater UHSD instructors to act as participants. My study topic is: Factors contributing to a teachers' decision to use free and open source software. My survey can be found at the following link for your review: http://questionpro.com/t/ALIJVZRnjN.

If you questions or concerns regarding my research, please reply to this email or call me at the number listed below. I look forward to hearing from you.

Be safe!

Sam Coleman

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Thanks for the email. I'll get back to you within 24 hours or if you need to contact me ASAP call me at 619-512-2614.

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Thanks for the email. I'll get back to you within 24 hours or if you need to contact me ASAP call me at 619-512-2614.

Curriculum Vitae

Samuel R. Coleman

Executive Summary

Proven education leader committed to a student centered focus, collaboration with parents and staff, and relationship building with the goal of improving student outcomes. Provided educational leadership at the campus level (assistant principal, special educational administrator and principal) and district office (special education program manager).

Professional Background

Los Angeles County Office of Education — **Feb 2012 to June 2014**
Pace School, Buena Vista PAU
Administrator

EdtechGuru — **Sept 2011 to Present**
Rancho Cucamonga California
Educational Advocate

Houston Independent School District — **Feb 2011 to Sept 2011**
Jack Yates High School
Principal

San Diego Unified School District — **June 2009 to Feb 2011**
Special Education Department
Special Education Program Manager Secondary

Sweetwater Union High School District — **July 2007 to June 2009**
Eastlake High School
Assistant Principal

San Diego Unified School District — **Dec 2006 to June 2007**
Kearney High School Complex
Special Education Administrator

Sweetwater Union High School District — **Aug 2001 to Nov 2006**
Various Sites (Palomar HS, Castle Park MS)
Special Education Instructor

Education

Doctoral Program in Educational Leadership, Alliant International University, 2015

National University, Master of Arts in Special Education, 2003

San Diego State University, Bachelor of Science in Economics, 1994

Notable Achievements

Completed the ACSA Superintendents' Academy
Completed the ACSA Special Education Academy
Created and implemented the 1st Bell Intervention System, which improved student achievement scores, increased attendance percentage, and decreased referrals (Eastlake High School 2009 to 2011).
Created the PC Reclamation Project. With donated equipment and student volunteers repaired and repurposed more than 350 computers making use of free and open source software. Engagements included building computer labs for schools, non profit organizations, and providing computers to low income families.
Speaking engagements/visiting lecturer: Southwest Community College 2009, Point Nazarene College 2009, Southern California Linux Conference (2009 to 2012), National Council of Black Scholars (2009).

References

Kim Hopko, Executive Director of Division of Special Educational
Los Angeles County Office of Education
562 803 8306

Dr. Joe Fulcher, Chief of Student Services
San Diego Unified School District
619 260 5461

Dr Neal Donat, Principal
Buena Vista PAU
310 885 1490