THE EFFECTS OF ONLINE PROFESSIONAL DEVELOPMENT IN TECHNOLOGY

WITH VIRTUAL COMMUNITIES OF PRACTICE ON TEACHERS' ATTITUDES

AND CONTENT INTEGRATION

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Abstract

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Abstract

This quasi-experimental study examined the effects of online professional development

in technology with Virtual Communities of Practice (VCoP) on teachers' attitudes and content

integration. This research study took place completely online. Over a period of nine months

three cohorts of educators from diverse backgrounds and geographical locations took part in a six

week course of online professional development using resources designed by the researcher. The

comparison group in each of the three cohorts accessed content via a course website and

corresponded with the researcher only. The treatment group in each of the three cohorts

accessed content via a course wiki and corresponded with the researcher and with each other as

members of a VCoP. Both groups received the same professional development content. Three

instruments were used for data collection online: A researcher designed Demographic Survey,

the Teachers' Attitudes Toward Computers (TAC) and the Levels of Teaching Innovation

(LoTi), including Computers for Instructional Purposes (CIP) and Personal Computer Use (PCU) subscales. Informal learning, knowledge sharing, and creation are critical if teachers are to practice life-long learning. As technology develops and budgets shrink, the potential for free and low cost professional development with flexible access and just-in-time availability should be investigated. This study proposed to extend knowledge on Virtual Communities of Practice as potential resources for the pursuit of sustained informal professional development to support teaching and learning practices in the context of curriculum and a supportive environment. Findings indicated that teachers' attitudes toward computers on the subscale of interest could be predicted by technology professional development coursework. Professional development in technology with VCoP and without VCoP were determined to be of equal value. Teachers who received professional development online with Virtual Communities of Practice demonstrated the highest level of technology integration with classroom practices.

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APPROVAL PAGE

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INTEGRATION

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Dedication

This dissertation is dedicated to:

Poppy, my grandfather, who planted the seeds of wonder that would flourish and grow into a love of learning that has lasted a lifetime.

Nancyanne Kopp, Miss Moxy, my dear friend and supporter, who understood.

My parents, who taught me perseverance, patience, and the value of setting educational goals.

This personal achievement would not have been possible without the love, support, patience, and sacrifice of my son Matthew and my husband Al who supported me with words of encouragement, home-cooked meals, and folded laundry. Thank you to my family for enduring the hours I was cloistered away and there was no time for anything but reading, writing, and researching, though my heart was with you.

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My heartfelt thanks go out to all of the teachers willing to help a complete stranger with educational research. I will be forever grateful and humbled by the willingness of my colleagues, near and far, to share precious time beyond the school day to learn and within the school day to integrate what they learned, along with candid discussions as they shared challenges and successes with me. Without them, this study would not have been possible. To all of them I am eternally grateful. I hope to meet them again online in the very near future!

Special thanks to all of the administrators who took a leap of faith and agreed to offer the opportunity for this online professional development in technology.

Gratitude and thanks to my committee members, Dr. Pauline Goolkasian, Dr. Frank Labanca, and Dr. Harry Rosvally. If not for Harry's encouragement and faith, I wouldn't be here today.

And finally, to the cast of characters I have come to know and love as The EdD Instructional Leadership program's Cohort 3. These are some of the finest people I have had the honor and privilege to know and to study with. Together, as a community of learners, we worked and supported one another through educational and personal triumphs and challenges.

"Mentors and apprentices are partners in an ancient human dance…It is the dance of the spiraling generations, in which the old empower the young with experience and the young empower the old with new life, reweaving the fabric of the human community as they touch and turn." (P.J. Palmer, 1998, p. 25)

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CHAPTER ONE: INTRODUCTION TO THE STUDY

Traditional professional development for educators is often taught out-of-context, using a format of one-shot workshops (Ball & Cohen, 1999; Blackmore, 2000; Brown, Collins, & Duguid, 1989; Guskey, 2000) to deliver information to teachers, as passive participants, by contracted trainers who are often unfamiliar with district climate, culture, and practices (Cochran-Smith & Lytle, 1999). This type of teacher training has been shown to be ineffective in developing new knowledge and affecting change in teaching and learning (Cochran-Smith & Lytle, 1999; Garet, Porter, Desimone, Birman & Yoon, 2001). Reflection, follow-up, and collaboration with peers seldom take place. As a result, there is a minimal return on time and budgetary investments. Research demonstrates that effective professional development provides opportunities for teachers to construct knowledge situated in context, sustained over time, and purposefully designed to be collaborative for participants (Brown, et al., 1989; Garet, et al., 2001; Lave & Wenger 1991; NSDC, 2010; Schlager & Fusco, 2003; Wenger, 1998).

Advances in Internet-based technologies have created new opportunities for sustained learning and collaboration among teachers as members of local and global online communities. This type of flexible environment encourages integration within a meaningful context through computer mediated instruction and social networking applications (Dede, 2009b; Wenger, White & Smith, 2009). Research was needed to explore the potential of collaborative online professional development for teachers to determine whether or not it impacts teachers' attitudes toward technology and integration of technology innovation.

Rationale

The need to teach students information and communication technology (ICT) while developing 21st-century skills and dispositions has been well documented in both popular and scholarly literature (American Association of School Librarians, 2007; ISTE, 2007b, ISTE 2010; Partnership for 21st Century Skills, 2011; Rotherham & Willingham, 2009; Silva, 2009; Silvernail, Small, Walker, Wilson, & Wintle, 2008). Preparing students with the skills and dispositions they need to achieve academic success and life-long learning requires sustained opportunities for professional development in technology for teachers. Effective professional development is embedded in content and context while grounded in standards, and aligned with district goals. For teachers, the practice of life-long learning is especially significant if instructional practice is expected to impact student knowledge gains and engage all learners (ISTE, 2008; NSDC, 2010).

Current research has demonstrated that traditional one-shot professional development workshops do not appear to have an effect on teachers sustaining implementation of the learning derived from professional development in their classroom instruction (Blackmore, 2000). Professional development is effective when there is a culture of learning, with many teachers participating to create knowledge, implement best practices, and evaluate results (NSDC, 2010). This study examined the effects of online professional development in technology with participation in a Virtual Community of Practice (VCoP) on teachers' attitudes and content integration.

Statement of the Problem

This study addressed the need for sustained, cost-effective, online professional development grounded in sound educational theory and a meaningful context to promote integration of 21st century skills to improve pedagogy. Professional development (PD) offerings are typically created to teach teachers new skills and strategies and develop positive attitudes. Traditionally, PD has not provided teachers enough time to process and practice new learning (Blackmore, 2000).

Professional development is shifting from workshops and in-service training days to ongoing networks that support a culture of collaborative learning, with many teachers participating (NSDC, 2010; Schlager & Fusco, 2003). Follow-up has proven vital in supporting and sustaining change (Steyn, 2005). Teachers need to develop skills over time, discuss experiences with others, build content knowledge, and reflect on their practice (Cochran-Smith & Lytle, 1999; Guskey, 1986; NSDC 2010). If these components are not present, integration is unlikely.

Research regarding Communities of Practice (CoP) for professional growth has been well documented outside the field of teacher education (Brown & Duguid, 1991; Lave & Wenger, 1991; Wenger, 1998). Within the field of education, emerging research on technology integration indicates that teachers need access to research on and modeling of best practices to build knowledge and explore the potential of appropriately used technologies that collaborative use of these technologies can provide (Bull, Thompson, Searson, Garofalo, Park, Young, & Lee, 2008; Greenhow, Robelia, & Hughes, 2009). There is a need to explore the effect of collaborative online professional development in technology for teachers situated in VCoP (Drexler, Baralt, & Dawson, 2008; Zhang, 2009).

Potential Benefits of Research

The proliferation of the Internet and the development of online social networking technologies afford access to knowledge and experience beyond the scope of expertise found within a single school community. Virtual Communities of Practice (VCoP) have the capacity to connect teachers, regardless of experience levels, with colleagues online who share the common goals of improving content knowledge and integration of best practices to positively impact teaching and learning (Kirschner & Lai, 2007; Reynolds, Treahy, Chao, & Barab, 2002; Wenger, White, & Smith, 2009). As members of a VCoP, teachers with Internet access have the ability to collaborate asynchronously with professionals across curriculum areas and grade levels. Using this forum for formal or informal professional development, teachers learn together as they explore new ideas, construct knowledge, and evaluate practice in a community of ongoing discourse (Habhab-Rave, 2008; Hibbert, 2008; Ramondt, 2008; Yildirim, 2008).

This study provided participating teachers with access to researcher-developed online modules that presented instruction on the use of six online resources and applications that they will learn to use within the context of their current classroom practice. Tutorials for the resources presented in each module were accessed online. Links to models demonstrating appropriate use of each application gave teachers ideas as to how they could seamlessly integrate these applications into any of these three areas: teaching and learning, communication, and personal productivity. Participation in the VCoP established for this research and links to additional social networking sites were provided to teachers so that they could collaborate and learn together in a sustained, supportive Virtual Community of Practice.

Definition of Key Terms

The following terms are relevant to this research:

1. 21st-century skills refer to skills outlined in the six standards and performance indicators of the ISTE NETS for Students. (ISTE, 2007b).

2. Attitude is defined by Fishbein and Ajzen (1975) as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (p. 6).

3. Community of Practice, as defined by Wenger, McDermott & Snyder (2002) is a group "…of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p. 4).

4. Professional development, as defined by the National Staff Development Council (Hirsch, 2009) "means a comprehensive, sustained, and intensive approach to improving teachers' and principals' effectiveness in raising student achievement" (NSDC, https://www.learningforward.org/standfor/definition.cfm, "Definition of Professional Development", para.3).

5. Standards for teachers refer to five standards and performance indicators as outlined in the International Society for Technology in Education National Education Technology Standards, ISTE NETS-T (ISTE, 2008, "ISTE NETS for Teachers").

6. Situated learning places "emphasis on comprehensive understanding involving the whole person rather than receiving a body of factual knowledge about the world; on activity in and with the word; and on the view that agent, activity, and the world mutually constitute each other" (Lave & Wenger, 1991, p. 33).

7. Social networking is the practice of expanding knowledge through online communication with others, anytime, anywhere, using interactive technologies (Gunawardena, Hermans, Sanchez, Richmond, Bohley, & Tuttle, 2009).

8. Virtual Community of Practice refers to the blending of virtual learning environments (VLEs) and Community of Practice (CoP) the result of which is the VCoP. It is both a space and a means for teachers to interact with peers in a professional context where they work collaboratively to develop knowledge, attitudes, and skills in a culture of mutual respect to cultivate a deeper understanding of professional practice (Hibbert, 2008).

Research Questions and Hypotheses

This study examined the effect of three moderator variables (years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area) on the six levels of the dependent variable, attitude towards computers (interest, comfort, concern, utility, absorption, and significance). Data were analyzed to determine if a difference existed between years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area with regard to attitude towards technology. Subject areas were designated as either STEM or non-STEM. Subject areas represented by the STEM designation included math, science and technology and those represented by the non-STEM designation included the humanities.

This study also examined the effect of two levels of the independent variable, online professional development (online professional development with and without Virtual Communities of Practice) on two dependent variables, attitudes toward computers, six levels (interest, comfort, concern, utility, absorption, and significance) and

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content integration, three levels (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices). Data were analyzed to determine if a difference existed between online professional development for teachers with Virtual Communities of Practice and online professional development for teachers without Virtual Communities of Practice with regard to attitudes toward computers and content integration. Online professional development (PD) for teachers without Virtual Communities of Practice was conducted asynchronously online via email while online PD for teachers with Virtual Communities of Practice took place asynchronously online using posts to a wiki.

Therefore, by using a systematic approach, this research addressed the following questions:

Research Question One: To what extent and in what manner can teachers' attitudes toward computers (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

Non-directional hypothesis: Years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area will predict teachers' attitudes toward computers (interest, comfort, concern, utility, absorption, and significance).

Research Question Two: Are there significant differences in attitudes toward computer variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

Non-directional hypothesis: There will be a significant difference in attitudes toward computers between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice.

Research Question Three: Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice? Non-directional hypothesis: There will be a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice.

Overview of Methodology

This study explored the effects of online professional development in technology with Virtual Communities of Practice on teachers' attitudes and content integration. Data were collected online using three instruments; a Researcher-designed Demographic Survey, *Teachers' Attitudes Toward Computers* (TAC) by Christensen and Knezek (2009b), and *Levels of Teaching Innovation* (LoTi) by Moersch (2009). Administrators in school districts in the United States, the U.S. Department of State Overseas Schools, and international schools were contacted for this study.

Description of Subject and Settings

This study included teachers who were currently teaching students from kindergarten to grade 12 in U.S. school districts, U.S. Department of State Overseas Schools, and international schools. The participants represented a sample of convenience

comprised of volunteers who were self-selected. Without the use of convenience

sampling, this study would not have been possible. Every effort was made to invite

participants from diverse age, gender, ethnic, and socioeconomic backgrounds.

Participants represented a range of educational backgrounds, teaching experience, content

areas, and experience with technology. Each participant brought a unique personal view

of teaching pedagogy molded by the culture and climate of their school, the community,

parents and administrators they work for, the colleagues they work with, and the children

they teach. They represented geographically diverse schools from rural, suburban, and

urban environments.

Teachers from U.S. public schools and international schools have attained

teaching requirements as established by individual states, provinces, and countries.

Certification indicates proficiency in state mandated competencies that entitle them to be

licensed to teach specific curriculum areas at specified grade levels. They were hired by

local boards of governance to serve the school community.

U.S. Department of State Overseas Schools are affiliated with the U.S. State

Department and follow state-department approved curriculum in kindergarten through

grade 12. These schools operate as independent, non-government institutions. Individual

schools establish their own hiring practices and qualification standards. Teachers are

hired by independently contracted recruitment firms acting on behalf of the schools (The

Office of Electronic Information, Bureau of Public Affairs, 2010).

Instrumentation

Data were collected using three instruments, a Researcher-designed Demographic

Survey, *Teachers' Attitudes Toward Computers* (TAC) (Christensen & Knezek, 2009b),

and *Levels of Teaching Innovation Digital Age Survey* (LoTi) (Moersch, 2009).

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Instruments were administered using two secure online sites. The Researcher-designed Demographic Survey was used to collect information regarding participants' experience as practicing K-12 teachers along with basic facts regarding their participation in technology related professional development (see Appendices A, B, and C for survey samples). Data gathered from the TAC provided information related to teacher attitudes regarding computer use in the general areas of personal productivity, teaching, and learning. The LoTi is a well-established instrument used to collect data regarding the levels of a participant's innovation, integration, and use of technology. The online sites used to administer all three instruments were piloted by this researcher in 2009.

Description of Research Design

This study used a quasi-experimental, quantitative data analysis with a pretest-posttest design. Both groups received the same content for six online professional development modules. The experimental group participated in a VCoP, the comparison group did not (see Appendix D). This design was used with teachers, drawn from a sample of convenience, and formed into non-randomized groups based upon pre-existing school assignments.

Description and Justification of Analysis

Inferential statistical analyses were used to examine the research questions.

Research Question One: To what extent and in what manner can teachers' attitudes toward computers (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

This question was answered through six separate multiple regression procedures using a stepwise model on pre-test results of the Teachers' Attitudes Toward Computers (TAC) survey, with an examination of the variables (years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area). The six subscales of Teachers' Attitude Toward Computers (interest, comfort, concern, utility, absorption, and significance) served as the criterion in each of the analyses. The researcher selected a stepwise multiple regression procedure for statistical analysis rather than an hierarchal approach to allow for variables to be included and excluded in the equation as the strength of the independent variables changed with additional entries into the model (Meyers, Gamst, & Guarino, 2006).

Research Question Two: Are there significant differences in attitudes toward computer variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

A *t*-test was conducted on pretest scores for both the TAC and LoTi to determine whether quality of groups existed prior to the treatment. Since homogeneity of groups was found, a MANOVA was used to conduct a statistical analysis of the dependent

variable, attitude towards computers with six levels (interest, comfort, concern, utility, absorption, and significance). The independent variable, professional development had two levels (online professional development and online professional development with Virtual Communities of Practice).

Research Question Three: Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

A Chi-Square Test for Independence was conducted to compare content integration (categorical Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between the two independent samples, teachers who received professional development online and those who received professional development online with VCoP. This nonparametric statistical test was used to determine whether frequency counts were distributed differently for the two variables, professional development with VCoP and without. Actual observations in the study were compared with expected observations to determine which factors played a significant role in the relationship (Gall, Gall, & Borg, 2007). To determine whether there was a significant difference for each of the levels of content integration, 3 two sample 4x2 Chi-Square Crosstabs were used. The Chi-Square Crosstabs test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level between observed and expected frequencies. In addition, a Cramer's V posttest was used to determine strength of associations after Chi-Square determined significance (Hinkel, Wiersma, & Jurs, 2003).

These research questions were developed by the researcher to explore options to traditional professional development typically offered several times a year, on site, using a one-size-fits-all model for all teachers. Widespread accessibility to computers with Internet service combined with free online resources for teachers and social networking were utilized to create an ideal environment for this study. A comprehensive review of the literature served to provide a research base for the methodology used in this research study.

CHAPTER TWO: LITERATURE REVIEW

To create a context for this study, the review of literature is divided into five main topics. These sections will review the research and literature concerned with the theoretical foundation for this study, teachers' attitudes toward computers, technology content integration, online professional development, and Virtual Communities of Practice.

Theoretical Foundations

The professional development that occurs as participants participate in VCoP is grounded in social constructivist and situated learning theories. Vygotsky's (1978) social constructivism focuses on the cultural aspect of building knowledge, believing that learners gain knowledge through cultural experiences and interaction with more capable others such as peers. Vygotsky's Zone of Proximal Development (ZPD) describes a learner's development in three levels. The first level describes what the learner can do without assistance. The second level, the zone of proximal development, describes developing capabilities or those things that a learner can do with assistance. Capabilities can be developed when a more capable person acts as a social partner and catalyst to the learner's cognitive development. The final level describes those things that the learner cannot do yet (Vygotsky, 1978). The ZPD relates to professional development as it explains the process of instruction that occurs through social interaction. Effective instruction moves the learner towards acquisition of new knowledge and new developmental levels. This progress can be achieved when a teacher or peer with a more advanced level of knowledge than the learner acts as a social partner and catalyst to develop the learner's cognitive development.

This type of cognitive development is embedded in situated learning and the formation of Communities of Practice. Lave and Wenger (1991) describe learning as a social process that thrives as the learner participates with others who share an area of interest or passion through a Community of Practice (CoP). They reject the notion that learners, regardless of age, are vessels to be filled. Rather, they propose that thinking, learning, and meaning take place through the social interactions of people of all ages and abilities. Communities of Practice are grounded in "relations among persons, activity, and world over time…" (Lave & Wenger, 1991, p. 98). Members of these communities continually seek to gain knowledge, help each other, and work together through sustained participation.

These communities have existed since the beginning of human interaction. Each of us belongs to communities of practice at home, work, or school, whether we are aware of them or not. A Community of Practice, as defined by Wenger, McDermott & Snyder (2002) is a group

> "…of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis". (2002, p.4)

As a result, each of us can apply knowledge of the CoPs that we interact with on a daily basis to a new framework in which an informal community of learners was developed for the purpose of professional development. Within this context, a community has three dimensions: (1) mutual engagement, (2) a joint enterprise, and (3) a shared repertoire. Membership in a community is a matter of mutual agreement and is voluntary (Wenger,

1998). Learning gives rise to Communities of Practice, a practice produced by its members through the negotiation of meaning (Wenger, 1998).

Wenger (1998) described participation in such communities in terms of peripherality or marginality, of which there are four categories: "full participation (insider); full non-participation (outsider); peripherality (participation enabled by non-participation, whether it leads to full participation or remains on a peripheral trajectory), and marginality (participation restricted by non-participation, whether it leads to non-membership or to a marginal position)" (p.167). Legitimate peripheral engagement described this transitory state in which participants in the community transition between levels of participation as social practice linked with learning (Lave & Wenger, 1991). By its very nature, engagement in practice inevitably progresses through various stages over time as members change, bringing new thoughts and ideas, and transfering learning from the experiences of more knowledgeable members. Wenger explained: "Because communities of practice define themselves through engagement in practice, they are essentially informal" (Wenger, 1998, p.118).

For participation in a CoP to be beneficial educationally, learners must have a level of engagement and be able to invest themselves in the process. Each participates independently and allowed the formation of identity within the community, which in turn allowed them to interact within the community and engage with other members. Social relationships combined with authentic learning activities to enable participants to take charge of their own learning. Wenger describes "generational encounters" in which people of all ages interact and learn from one another through social engagement to

create and exchange community knowledge while developing their own individual capabilities (Wenger et.al, 2002).

Communities of Practice have identities that are driven by the purpose of the community. They are self-reflective and redesign themselves through an evolutionary process that is dependent upon focus and membership. Each community has a coordinator who takes on a leadership role to organize events and create opportunities for members to connect. Five stages have been associated with the process of community development: (1) Potential in which a common ground for connectedness is found, (2) Coalescing which requires trust-building activities that enable formation of relationships, (3) Maturing which involves shifting to clarify the community's focus, role and boundaries, (4) Stewardship to maintain a lively, engaging, relevant focus, and (5) Transformation in which membership is rejuvenated or comes to a close (Wenger et al., 2002).

Moving the CoP to an online environment changes it into a Virtual Community of Practice (VCoP). These communities evolved online based on people's passion and potential to learn together in what Wenger et al., (2009) call digital habitats, "where community and technology intersect" (p.11). Because this community existed in an online environment, the moderator's role was linked with the role of technology steward. The steward was responsible for integrating a viable platform that was used for VCoP engagement such as wikis, content management systems that are open source (Moodle), or fee based (Blackboard) content management systems. This platform typically includes tools and features such as modes of communication (asynchronous or synchronous), archiving of artifacts, and may include multimedia capabilities to support the habitat.

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Nine orientations for digital habitats were outlined including (1) Meetings, (2) Open-ended conversations, (3) Projects, (4) Content, (5) Access to expertise, (6) Relationships, (7) Individual participation, (8) Community cultivation, and (9) Serving a context (Wenger et al., 2009). It is more than likely that a VCoP integrated more than one of these orientations.

Teachers' Attitudes Toward Computers

In a recent report of *Teachers' Use of Educational Technology in U.S. Public Schools: 2009*, two key findings were reported:

Ninety-seven percent of teachers had one or more computers located in the classroom every day, while 54 percent could bring computers into the classroom. Internet access was available for 93 percent of the computers located in the classroom every day and for 96 percent of the computers that could be brought into the classroom. The ratio of students to computers in the classroom every day was 5.3 to 1.

Teachers reported that they or their students used computers in the classroom during instructional time often (40 percent) or sometimes (29 percent). Teachers reported that they or their students used computers in other locations in the school during instructional time often (29 percent) or sometimes (43 percent).

(National Center for Education Statistics Institute of Education Sciences, 2009, p. 3)

These key findings indicate that access to technology is no longer the primary factor in technology use in public schools. Teachers' attitudes toward computer technology influence teachers' perceptions of the role of technology and the likelihood of

its adoption as a teaching tool (Al-Zaidiyenn, Mei, & Fook, 2010; Isleem, 2003; Knezek & Christensen, 2008; Liu & Szabo, 2009). Researchers have documented attitude as a contributing factor to whether or not teachers use technology in their teaching practice (Kluever, Lam, & Hoffman, 1994; Kutluca, 2010; Liu & Szabo, 2009).

Isleem (2003) investigated factors related to the perceived level of computer use for instructional purposes by technology education teachers in Ohio public schools including, attitude toward computers as tools for instructional purposes. A researcher-designed survey was used to gather data from technology education teachers ($n = 1,170$) in 525 public middle and high schools within the state of Ohio during the school year 2002-2003.

The descriptive analysis of survey results suggested that teachers were generally positive in their attitudes toward computers as tools for instructional purposes. Over 90% of respondents reported positive attitudes toward email as an effective communication tool, expressed that they were not fearful about computer use, and agreed computers can make learning easier and more efficient. More than 50% of respondents reported frequent negative attitudes toward computers related to the delivery of lessons using computers and the expectation that all high school teachers use computers (Isleem, 2003).

Al-Zaidiyeen, Mei, and Fook (2010) investigated the attitudes of Jordanian teachers toward technology, specifically Information and Communication Technologies (ICTs) and obtained similar results. In this survey-based study, the team used two separate questionnaires, the Technology Level of Use developed by Isleem (2003) and Teacher Attitudes toward ICT Scale developed by Albirini (2006). Data were collected from 465 public school teachers in Jordan. Survey results were analyzed using

descriptive statistics. Positive attitudes toward computers were demonstrated by more than 50% of participants who recognized the positive aspects of computers in organizing work, getting information quickly, as time savers, and in providing advantages in teaching. However, negative attitudes toward computers were directed toward computers based on their use to enhance students' learning, make subject matter more interesting, or on their being faster to accomplish tasks than doing things by hand (Al-Zaidiyeen, Mei, & Fook, 2010).

Dissertation research was conducted by Raulston with the purpose of analyzing the attitudes and perceptions of teachers following the implementation of a teacher laptop initiative (Raulston, 2009). A total of 284 teachers participated in this study during the first year and 143 teachers returned to participate in data collection during the second year. Participants' ages ranged from 22 to 69, with teaching experience that ranged from one to more than 25 years. Of this self-selected sample of convenience, 40% of participants taught all subjects, while the remainder taught Math, Science, English/Language Arts, Social Studies/History, PE Art, Music, Counselor Education, Foreign Language, Media, Special Education, Gifted Education, and other (Raulston, 2009).

This mixed-method research design was used to collect quantitative data using a pre- and posttest design and qualitative data by conducting focus group interviews. Two instruments, the Teachers' Attitudes Towards Computers (TAC) (Christensen & Knezek, 1997), and the Stages of Adoption of Technology (Stages v1.1) (Russell, 1995) were used for the quantitative portion of this study. Raulston selected three of the nine TAC subscales for this study, as each of the subscale may be administered as stand-alone

instruments. The subscales she selected for the purpose of her study included interest, comfort and significance. Both instruments were administered online. A group of 40 teachers were purposefully selected from the original sample for the qualitative portion of this study (Raulston, 2009).

The pre- and posttest data collected using the Stages of Adoption of Technology instrument were analyzed using a Kruskal-Wallis test to determine if there was significance on teachers' perceptions, in conjunction with a Mann-Whitney U post hoc test to compare groups from the two semesters, to determine whether or not the use of computers for classroom instruction was impacted by the teacher laptop initiative. Raulston used a Kruskal-Wallis test and a Mann-Whitney U post hoc test on data collected from a demographic statement on self-reported use to determine if a laptop initiative can increase the amount of time a teacher uses computers in the classroom for instruction. A one-way ANOVA and Bonferroni post hoc adjustment were used for the analysis of three TAC subscales including comfort, interest, and significance, to examine teachers' perceptions of computer significance impacted by a teacher laptop initiative. The researcher analyzed qualitative data for emerging themes using data gathered through transcriptions of video recordings of focus groups (Raulston, 2009).

Regarding the impact of the laptop initiative on teachers' perceptions of their use, Raulston's analysis using the Kruskal-Wallis test indicated a significant difference ($p < $ .001) between two rankings among the three semesters. As a result, the researcher used a Mann-Whitney U post hoc test which indicated mean differences from semester 1 ($M = $ 4) to semester 2 ($M = 5$) and finally semester 3 ($M = 6$), indicating an increased ability to integrate technology into their teaching practices. To determine whether or not the use of

computers for classroom instruction was impacted by the teacher laptop initiative, Kruskal-Wallis test was implemented ($p < .001$) with mean values ranging from ($M = 257.41$) to ($M = 426.70$) indicating significance at the $p \leq .000$ level. Because significance was found, a Mann-Whitney U post hoc test was conducted. This test indicated an increase in the use of computers for instruction from semester 1 (36.6%) to semester 2 (56.1%) to semester 3 (70.4%) (Raulston, 2009). A one-way ANOVA analysis of three TAC subscales (comfort, interest, and significance) to examine teachers' perceptions of computer significance impact by a teacher laptop initiative indicated neither a significant difference between semesters nor on interest or significance subscales between semesters. Analysis of data for the comfort subscale indicated a significant difference between the three semesters. As a result, a Bonferroni post hoc adjustment was conducted. This test indicated significance between semester 1 and semester 2 ($p \leq .000$) and semester 1 and semester 3 ($p \leq .004$) indicating a significant increase in teachers' comfort of use (Raulston, 2009). Several themes emerged from focus group interviews regarding preparation of students for the 21st Century including "preparing students for the future, enhancing teaching opportunities, creating better teachers, convenience for lesson planning, improving organization and communication skills, changing the way of teaching, and teachers becoming role models" (Raulston, 2009, p. 52-53).

It is interesting to note that attitude continues to play a role in teachers' readiness to adopt and use technology in the classroom and as an integral part of their teaching practice three decades after the arrival of computer technology in schools. Findings point toward teachers' positive attitudes regarding adoption of technology for personal

productivity use, but still indicate shortcomings when it comes to computer integration for teaching and learning. Theoretical beliefs underpinning teaching practice may limit teachers who adhere to a behaviorist learning model and provide direct instruction in contrast with those who practice a constructivist approach and inquiry-based learning (Liu & Szabo, 2009; Roblyer, 2006). However, Watson (2001) believed that:

> Firstly, teachers will tolerate a considerable negative experience if they have a real passion for something and secondly that the sage on the stage role is doomed when IT becomes part of the classroom mix and we need to prepare teachers for this…If the use of information technology in teaching and learning is to result in any fundamental or lasting educational change, a different model of professional development is required. (p. 181)

Technology Content Integration

In the 1980s the focus of educational research shifted from possession of hardware and available access for student and teacher integration of technology into practices of teaching and learning (Barron, Kemker, Harmes, & Kalaydjian, 2003). Two research studies, focused on technology integration and innovation took place during this time frame. Both of these research studies were significant in creating momentum for educational reform through the integration of educational technology. They acted as catalysts in the movement toward student centered learning and higher order thinking skills (Barron, Kemker, Harmes & Kalaydijian, 2003; Sandholz, Ringstaff, Dwyer, & Apple, 1991).

The Apple Classrooms of Tomorrow (ACOT) provided a variety of unprecedented classroom technology for teachers and students in elementary and

secondary school classrooms to support learning across the curricula. Project goals

included increasing teachers' knowledge of theory based teaching and learning,

developing technological expertise, and sharing new-found knowledge with peers.

Findings from this qualitative study of 32 teachers from five schools across four states

suggested that technology innovation encouraged collaboration among colleagues.

Teachers with a high level of collegial interaction were more likely to adopt technology

and were quicker to integrate technology into their classroom practice. As they reflected

upon the ACOT experience, researchers identified the significance of innovation taking

place within the context of the work environment as critical components of technology

adoption (Sandholz et al., 1991). They reported that "Change occurs most quickly in

environments where innovation and collegial interaction are operating simultaneously,

each enhancing the other" (Sandholz et al., 1991, p. 22).

Dr. Christopher Moersch (1995) developed the Levels of Technology

Implementation (LoTi) scale, which was aligned with the work of Hall, Loucks,

Rutherford, and Newlove (1975); Thomas and Knezek (2008); and Sandholtz et al.,

(1991). This original version of the LoTi was designed to assess teachers' levels of

technology implementation. The purpose of collecting such data was to inform the

design and implementation of professional development in technology for teachers.

Professional development would be designed to increase teachers' implementation level,

based on eight levels of LoTi scores ranging from Level 0: Non-use, indicating a focus on

teacher-centered instruction to Level 6: Refinement, indicating student-centered

instruction focused on a high level of technology used to promote higher thinking skills

and levels of engagement. These LoTi scores were based upon the overall LoTi

instrument, consisting of three subscales: the Levels of Teaching Innovation (LoTi), Computers for Instructional Practices (CIP), and Personal Computer Use (PCU). The LoTi acronym represents both the LoTi subscale and the overall instrument consisting of the LoTi, CIP, and PCU subscales (Barron, Kemker, Harmes & Kalaydijian, 2003).

In 1998, the International Society for Technology in Education (ISTE) released the first National Education Standards for Students (NETS-S). The NETS-S were created to provide a framework upon which to build educational and instructional goals for effective use of information and communication technology (ICT) within the context of real-life skills (Thomas & Knezek, 2008). The 1998 NETS-S was replaced by the NETS for Students 2007 in conjunction with 2007 Student Profiles (ISTE, 2007b). These standards and performance indicators were supplemented with student profiles modeling samples of appropriate student activities that would indicate performance achievement. NETS for Students were followed by NETS for Teachers (NETS-T) in 2000 (ISTE, 2000) with the addition of Essential Conditions (ISTE, 2007a) documenting conditions to be supplied by districts for implementing technology effectively in 2007 and a revision to the NETS-T in 2008 (ISTE, 2008).

In 2008, the integration of technology into the curriculum was the focus of a quantitative cross-sectional study conducted by Liu and Szabo. Their sample of convenience included in-service teachers who were enrolled in summer courses as graduate students at a Midwestern public university in the USA. The study took place over a four-year span, from 2004-2007. The sample participating in the study and completing research instruments totaled 83 in 2004, 64 in 2005, 63 in 2006, and 65 in 2007 ($n = 275$) (Liu & Szabo, 2009).

The SoC Questionaire (Hall, George, & Rutherford, 1977) was used to collect data regarding teachers' concerns about innovation. The instrument measures seven stages of concern: Stage 0 - Awareness, Stage 1 - Informational, Stage 2 - Personal, Stage 3 - Management, Stage 4 - Consequence Stage 5 - Collaboration and Stage 6 - Refocusing. The SoC Questionnaire (Hall et al., 1977) consists of 35 items on an 8-point Likert scale ranging from 0 - not true of me now to 7 - very true of me. The high numbers indicate a high level of concern, low numbers indicate a low level of concern and 0 indicates irrelevancy (Liu & Szabo, 2009).

Percentile scores for the entire group (n= 275) indicated intense concerns in Stage 1 - Informational ($M = 82$), Stage 2 - Personal ($M = 81$), and Stage 6 - Refocusing ($M = 77$). Average concern was found in four other stages: Stage 0 - Awareness ($M = 57$), Stage 3 - Management ($M = 62$), Stage 4 - Consequence ($M = 50$), and Stage 5 - Collaboration ($M = 61$). There were no stages indicating low concern. Mean percentile ranks for teachers in all three groups ($n = 275$) were used to determine three levels of perception of implementation status including beginning or inexperienced ($n = 40$), intermediate or experienced ($n = 207$) and advanced or renewing ($n = 28$) (Liu & Szabo, 2009). A Chi-Square was conducted to determine whether each of the three user groups achieved the same median score in each of the seven stages of concern. Statistically significant results were reported in five of the seven stages: Stage 1- Informational ($p = .02$), Stage 3- Management ($p = .00$), Stage 4 - Consequence ($p = .05$), Stage 5 - Collaboration ($p = .00$), and Stage 6 - Refocusing ($p = .00$) (Liu & Szabo, 2009).

The findings provided by Liu & Szabo (2009) indicated a need for sustained professional development and sustained support for teachers as they moved through these

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stages of concern as they worked to integrate technology into their specific curriculum areas. Teachers indicated concern regarding the benefits of technology integration on student achievement. The researchers determined part of that concern may have been attributed to a lack of knowledge regarding tools or methods of instruction to effectively integrate technology. These findings led the researchers to conclude that integration of technology into the curriculum is a long process. This process demanded a tremendous commitment of time and energy on the part of teachers as they learned and practiced new technology skills while developing dispositions for integrating technology to benefit student learning (Liu & Szabo, 2009). Limitations of the study were due to the lack of evidence regarding homogeneity of groups in addition to a lack of random sampling and therefore inability to generalize findings to the general population. The issues regarding teachers' concern about integrating technology revealed by this study still warrant further study.

In Israel, researchers Shamir-Inbal, Dayan, and Kali (2009) recognized the need to improve technology integration in education. They designed, implemented, and evaluated a three-year socio-constructivist Teacher Professional Development (TPD) model to support school teachers in assimilating online technologies into their school culture. Using a mixed-method research study they worked with four schools and a total of 45 teachers. Three schools received the TPD model and mentor (treatment) in support of integrating information and communication technology (ICT) into schools while teachers in the fourth school (control) worked to integrate ICT on their own, without the TPD model or the mentor. Specific goals of the TPD model were to encourage teachers to create, manage, and maintain their own class websites using a Learning Class

Management System (LCMS). The study was funded by the ministry of education

including six hours of bi-weekly individual guidance for teachers per school and

resources designated to one whole-school and one district teacher workshops. Schools

allocated two hours per week for leading-teachers to provide support to their peers

(Shamir-Inbal, Dayan, & Kali, 2009).

Initially, all teacher participants were considered novices and the mentor acted as

the facilitator. Researcher Tamar Shamir-Inbal fulfilled the mentor's role. The

researchers developed a rubric to analyze teacher-designed online activities. The

Analyzing Online Activities (AOA) Rubric was used to quantify the quality of online

data while providing a framework for teachers as they designed their classroom activities

that focused on technology integration. A total of 25 online activities were evaluated to

determine the quality of the activities at the beginning and end of the three-year study.

The Wilcoxon's rank sum test, a non-parametric analysis, was used to analyze the data

collected using the AOA Rubric. Findings indicated significant differences in five of the

six constructs measured by the AOA rubric including Added Value of the Technology,

Required Level of Thinking, Peer Learning, Making Contents Accessible, Scaffolding for

Rich Artifacts, and Embedded Assessment (Shamir-Inbal, et al., 2009).

The frequencies of teachers' updates to class websites were analyzed at the school

level by the researchers, using a 5-point scale from 1: Informational websites posted one-

time and not maintained to 5: High frequency updated on a regular basis. Data were

collected from the end of the first year of the treatment and monitored once every two

months until one year after the treatment ended. The data were analyzed using an index

calculating the average frequency of meaningful updates of all technology adopting

teachers in relation to the total number of teachers in the school (Shamir-Inbal, et al., 2009). Activity on all three school websites significantly increased throughout the treatment period and for the following year, indicating that sustained support resulted in improved integration of ICT into teaching practice. December through April were peak months for online activity. Activity slowed between the periods of September to October and May to June. The researchers attributed this slow down to the high workload teachers experience in the beginning and end of the year. Teachers in the control school maintained consistently low rates that characterized the end of the first year for the treatment schools (Shamir-Inbal et al., 2009).

Teacher turnover was calculated by these researchers using an index that tallied the total of newcomers and dropouts in relation to the total of newcomers, dropouts, continuers, and comebacks. By the end of year three, School A ($n=22$) experienced a 41% turnover, School B ($n=21$) experienced a 69% turnover, and School C ($n=12$) experienced a 54% turnover. However it is important to note that even in light of this turnover of teaching staff, the level of participation increased in schools A and B from 10 to 19 and 1 to 17 participants, respectively (Shamir-Inbal et al., 2009). Clear expectations, proper tools, time to work during the school day to integrate technology within context, and an on-site trainer to provide sustained support combined for a successful professional development experience.

In the state of Florida, Barron, Kemker, Harmes, and Kalaydjian (2003) conducted a large scale study of technology in K-12 schools to determine the extent to which individual teachers in a large school district were using technology as a tool for their students' education. In particular the research addressed the use of technology as a

classroom tool for research, communication, productivity, and problem-solving, as outlined by the International Society for Technology in Education (ISTE) in the National Technology Standards for Students (NET-S) across grade levels and subjects. Their sample was created as a randomly selected matched sample ($n = 2,156$, 17% male, 83% female) with a diverse range of subject areas taught and years of teaching experience (Barron et al., 2003).

A researcher-designed survey was used to determine teachers' use of technology in the classroom with a focus on four teaching modes in NETS -S including the use of technology as a tool for research, communication, productivity, and problem solving/decision-making. This survey was piloted by the researchers, who used psychometric information and comments collected from participants to guide minor revisions to form the final instrument. Instrument validity was established by a panel of experts. One school of each matched pair received a web-based survey while all others received paper copies. Teachers responded on a 5-point frequency scale. The response rate was 35% (Barron et al., 2003).

A significant difference ($p = .004$) was found across three levels: elementary teachers 29%, middle school teachers 23%, and high school teachers 20%. Odds ratios revealed elementary teachers were twice as likely to use technology as problem solving or communication tools than high school teachers. A statistically significant difference ($p = .008$) was found among the three levels when teachers used the computer as a communication tool with their students. Odds ratios revealed that elementary school teachers were more likely to use computers as a communication tool than were high school teachers. A statistical significance also was found across levels for the use of the

computer as a research tool with the proportion of elementary school teachers at 32%; middle school, 34%; and high school 40% (Barron et al., 2003, p. 500 - 502).

A statistically significant difference (p = .0006) was found across subject areas when teachers used computers as a research tool for students. Science teachers accounted for 51% of use, social studies teachers 44%, English teachers 30% and math teachers 24%. No statistically significant differences were found between the subject groups when computers were used as productivity tools or communication tools (Barron et al., 2003).

Researchers from the National Center for Education Statistics Institute of Educational Sciences (2009) reported advances in access but integration of technology to promote teaching and learning of 21st century skills continued to be a slow and complex process (Inan & Lowther, 2010). In their study of K-12 technology use, Inan and Lowther attributed higher levels of technology integration to teachers' readiness (perception of capabilities and skills required to integrate technology into classroom instruction), beliefs (perception of technology's influence on student learning and achievement and impact on classroom instruction and learning activities), and computer availability. Readiness was influenced by teachers' demographic characteristics, computer proficiency, and school characteristics. Technical support and computer availability significantly influenced teachers' beliefs. The researchers also examined demographic characteristics including age and years of teaching, both of which were reported to have significant negative influences indicating computer proficiency decreased as age and years of experience increased. Overall, their findings supported the

need for professional development to develop computer proficiency and improve readiness to integrate technology into classroom practices (Inan & Lowther, 2010).

These findings extended the research conducted seven years earlier by Zhao, Pugh, Sheldon, and Byers, (2002) that funded and followed a group of K-12 teachers as they attempted to implement grant proposals to integrate technology into their teaching practices. The focus of the study was to identify factors that facilitated or hindered teachers' use of technology in their classrooms through an examination of three domains: innovator, innovation, and context which translate into the teacher, the project, and the context. The findings of this study indicated that teachers must have basic realistic understandings of what a specific technology can and cannot do in addition to how the technology may be used to support teaching and curricular goals. They should recognize limitations and seek the support necessary to make integration successful.

The researchers lamented most professional development efforts as being ineffective in their ability to develop knowledge about the technology and regarding their school culture involving technology. They called for PD programs that "direct individuals to reflect on their own beliefs about teaching and technology, as well as to consider the real-world limits that exist in today's classrooms…" (Zhao et al., 2002, p. 512). As a result of their study, the team suggested that teachers take an evolutionary approach to integration of appropriate technologies.

Straub (2009) investigated technology adoption through the lens of adoption theories. He was interested to determine why some individuals chose to adopt a technology while other resisted. He questioned what influence social context had on individuals' decision to adopt. He suggested that the characteristics of each innovation

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were specific in terms of ease of use, compatibility with lifestyle, and the context of the adoption be it at work or with individuals acting as facilitators of change (Straub, 2009). Education reform demands a change in teaching habits and adoption of innovations, specifically in the area of technology. The use of technology changed teaching from a traditional lecture format focused on the teacher to a student centered format, causing disconnect for teachers. He concluded that there was no one model that could account for teachers' concerns related to technology adoption due to the multitude of personalities, experiences, and theoretical beliefs held by teachers as a group. He suggested a need for research investigating how individuals understand, adopt, and learn technology outside of the formal organization, exploring informal voluntary methods to initiate adoption of technology (Straub, 2009). This work directly related to the findings of Darling Hammond, Wei, Andree, Richardson, and Orphanos (2009) who describe U.S. teachers' "strong individualistic ethos" (p. 11). They describe instruction with the metaphor of an "egg crate model" where teachers spend their days isolated in a single room (Darling Hammond et al., 2009, p. 11).

Online Professional Development

Guskey (2002) defines professional development (PD) as "systemic efforts to bring about change in the classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students" (p. 381). Professional development offerings are typically created at the top level of administration and filtered down to teachers as passive receptors of information despite the fact that research has documented this practice to be ineffective (Ball & Cohen, 1999; Borko & Putnam, 1997; Cochran-Smith & Lytle, 1999; Garet, Porter, Desimone, Birman & Yoon, 2001; Yildirim, 2008).

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Teachers have participated in professional development willingly or unwillingly, as mandated by an employer or freely chosen in the pursuit of knowledge for one's own benefit, on both formal and informal levels (Hibbert, 2008). Current economic challenges combined with fundamental changes to teaching and learning and lifestyles, have enticed institutions, consultants, and individuals to explore the possibilities for professional development online. Effective context, process, and content should be modeled on the standards for effective traditional in-service professional development as recommended by the National Staff Development Council (2010).

A report from the National Center for Educational Statistics Institute of Educational Sciences in 2009 presented statistics for teachers who had participated in professional development activities for educational technology by the hour in the 12-month period prior to the survey: 13% (none), 53% (1-8 hours), 18% (9-16 hours), 9% (17-32 hours), 7% (33 or more hours). The same teachers also provided data regarding the technology-related professional development they had received: 81% reported "it met my goals and needs", 88% reported "it supported the goals and standards of my state, district, and school", 87% agreed that "it applied to technology available in my school", and 83% agreed that "it was available at convenient times and places." Yet the same teachers reported that the following activities prepared them (to a moderate or major extent) to make effective use of educational technology for instruction: 61% for professional development activities, 61% for training provided by school staff responsible for technology support and/or integration, and 78% for independent learning (National Center for Educational Statistics Institute of Educational Sciences, 2009, p. 4) indicating that learning on their own prepared them the most.

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The discrepancy between the data reported for technology-related professional development and data for activities that prepared teachers to make effective use of educational technology for instruction raises the question as to how effective the professional development is in teaching appropriate technology applications that may be integrated into teaching and learning practices. It is also interesting to note that the largest percentage, 78%, of teachers reported independent learning as the most effective way to make use of educational technology for instruction (National Center for Educational Statistics Institute of Educational Sciences, 2009). In a cautionary statement, Wubbels advised uses of technology must start with clear pedagogical reasons of what is needed, particularly in regard to Web 2.0 technology, and how that technology can be used to benefit learners and their teachers (Wubbels, 2007).

Garet et al. (2001) examined the relationship between features of professional development identified in literature and self-reported change in teachers' knowledge and skills and classroom teaching practices. They created a set of scales to describe characteristics of activities assisted by the Eisenhower Professional Development Program, a funding source for a wide range of professional development activities, by integrating and operationalizing ideas in literature on "best practices" in professional development. The scales were used to empirically test characteristics to examine their effects on teacher outcomes. Data were collected using a Teacher Activity Survey. Researchers randomly subsampled two teachers for each activity for a total of 1,027 teachers.

Research focused on high-quality professional development based upon three core features including the form and duration of the activity in addition to "the degree to

which the activity emphasized the collective participation of groups of teachers from the same school, department, or grade level" (Garet et al., 2001, p. 920). They also examined the degree to which the activity had a content focus, the extent to which the activity offered opportunities for active learning and the degree to which the activity promoted coherence by incorporating experiences consistent with teachers' goals and aligned with state standards and assessments, and through encouragement in continuing professional communication between teachers (Garet et al., 2001).

Results provided confirmation regarding "best practices" in professional development. Teachers reported that sustained, intensive PD that focused on content and provided opportunities for active learning in context had stronger impact and was more likely to produce enhanced knowledge and skills than shorter PD. When compared to traditional activities, reform activities of a longer duration, focused on collective participation, and core features proved more effective. Researchers recommended that districts focus funding on high-quality professional development experiences to affect teacher learning and foster improvements in classroom practice (Garet et al., 2001).

To date, professional development in technology is not a priority for teachers with only 14% indicating they needed PD to use technology in the classroom (Darling-Hammond et al., 2009). This is in sharp contrast with the work of researchers, including Cuban, Kirkpatrick, and Peck (2001) who discovered that teachers, working in Silicon Valley schools, did not have enough time to incorporate computers into daily teaching, nor did they have enough time to take classes to learn how to use technology. Through their research they discovered less than 10% of teachers used computers in their classrooms at least once a week (serious use), between 20-30% used computers once a

month (occasional use), and well over half were non-users. Only on rare occasions were computers used for student centered activities such as online learning or multimedia projects. Less than 5% of teachers integrated computers into daily teaching (Cuban, 2001, p. 133).

Nine years later, David and Cuban reported that even though access to technology is critical to accessing educational opportunities that have never been possible before, the potential of the effective use of computers for teaching and learning has not yet come to fruition. The authors cite statistics from Louisville, Kentucky where, after $30 million dollars were spent on technology, two-thirds to three-quarters of the teachers still do not regularly use computers in their lessons. In Chicago, public school officials describe computer use as rudimentary adding that most schools have not substantially integrated technology into students' coursework, even though philosophically students and teachers believe that technology affords certain advantages for teaching and learning (2010, p. 158). David and Cuban conclude: "Technology can enhance teaching and learning only if the teacher sees the connection to the lesson, knows what to do with it, and decides it is better for students than the existing lesson" (David & Cuban, 2010, p. 160).

Borko (2004) analyzed research on teachers' professional development to determine what is known about the impact of professional development on teaching and learning and important directions and strategies for extending knowledge. Her analysis presumed a situational perspective on knowing and learning that was conceptualized as socially participatory using knowledge as an aspect of participation in social practices.

She identified four key elements in professional development systems:

- The professional development program;

- The teachers, who are the learners in the system;

- The facilitator, who is a guide to teachers as they construct new knowledge and practices; and

- The context in which the professional development occurs (Borko, 2004, p. 4).

Borko used a three-phase approach to examine "research conducted on a small number of high-quality professional development programs to illustrate major themes and findings" (Borko, 2004, p. 4). In Phase 1, research focused on individual PD at a single site with interest in the program and teachers as learners. Phase 2 studied a single program facilitated by more than one facilitator at more than one site focusing on relationships among facilitators, program, and teachers as learners. Phase 3 focused on comparisons of multiple PD programs at multiple sites, examining relationships among facilitator, program, teachers as learners, and context (Borko, 2004).

It is the first phase of her research that is of particular interest, as it provided evidence that intensive professional development helps teachers increase knowledge and change instructional practices. Borko focused on three characteristics: "subject matter knowledge for teaching, understanding of student thinking, and instructional practices" (2004, p. 5). It was determined that creating student communities of learners to support student learning was unrealistic if teachers were not members of communities themselves. Though development of teacher communities was difficult and time consuming, teachers welcomed the opportunity to discuss ideas and share materials.

Teachers also discovered they were better at understanding problem-solving strategies and came to see their own classrooms as places for their own learning as well as students' learning (Borko, 2004).

Rebecca Adams (2010) conducted a mixed-method study with eight elementary teachers over a span of nine months to explore online professional development for K-12 teachers. Choice, community building, and extended learning over time were identified by the researcher prior to the study as perceived strengths of online communities (Adams, 2010). The researcher sought to determine how these strengths supported teachers' professional development and learning community.

The researcher fulfilled the role of facilitator during this professional development, providing a face-to-face introduction to the course and online course site. Teachers chose to learn about differentiated instruction (DI) using a single text on differentiated instruction as the basis for their work. A blended model in which teachers first worked together then moved to the online course site was used to deliver course content. The course consisted of 10 sessions, with each session focused on one section of the book provided for DI. The products of this coursework were added to each teacher's PDP portfolio as part of his or her professional district evaluation, which may account for some level of active participation on the part of teachers in this study (Adams, 2010).

Data were collected using a pre-course survey, interviews, pre-course and post-course Classroom Practices Inventory, included in the DI book, mid-year and end-of-year focus groups, online discussions and text chat, online journal, teacher logs, WebCT Track Students feature, and teachers' PDP documents (Adams, 2010). Instruments used for the quantitative portion of the study included the pre-course survey and pre-and post-course

Classroom Practices Inventory (CPI). The pre-course survey supplied data regarding

self-ratings for technology use and comfort, attitudes toward professional development

and the Internet. The CPI, included in the text, consisted of 18 questions with Likert-type

scale responses from 0 (irrelevant) to 5 (the statement is very true of me now). CPI data

analysis were reported with a Wilcoxon Ranked Sum Test results that were not

significant ($p =.068$), which the researcher attributed to small sample size (Adams, 2010).

A phenomenological case study was used to analyze qualitative data. Adams

analyzed online discussions, text chats, journals, interviews, and focus group transcripts

for domain analysis and analysis of emerging themes. Surveys, interviews, focus groups,

feedback from participants, teacher journals, research log, WebCT data, and Classroom

Practices Inventory (CPI) were used to triangulate data. Themes from interviews, focus

groups, online discussions, text chats and CPI responses indicated that the participants

felt the online community had changed their classroom practice, personal teaching

approaches, and the way they thought about their teaching. Teachers found flexible work

time, ongoing opportunities for development, and thoughtful reflection beneficial. At the

end of the year, all teachers wanted more online PD (Adams, 2010).

Limitations of the study included a small sample size and lack of information

regarding the reliability and validity of instruments used in quantitative research. Adams

recommended more research on the convenience of an online environment in building a

learning community in schools with other online models including a fully integrated

blended professional development model. She felt the full potential of asynchronous

discussion had not yet been fully explored (Adams, 2010).

Web 2.0, or the socially interactive web, may be leveraged to develop scalable, sustained professional development at low or no cost that is accessible 24 hours a day, 7 days a week. Wikis in particular provided an easily accessible workspace with a small learning curve for both users and facilitators. Participants were able to create and share knowledge through text and multimedia posts that may be edited, critiqued, and reflected upon by members of the wiki. This type of interactive collaborative workspace facilitated the sharing of online and offline resources in an asynchronous environment (Cress & Kimmerle, 2008; Dlouhá & Dlouhý, 2009; Robertson, 2008; Yates, Wagner & Majchrzak, 2009).

Robertson (2008) conducted a study of wikis for educational use within a blended university course of study and based within the context of a problem- and group-based learning course focused on workplace learning as part of a teacher education program. The sample of 20 students contained 11 teachers and 9 professionals. The group used face-to-face classes to form assigned groups, learn to access and use the wiki, and discuss and ask questions about their case study. Participants, working in groups, then used the wiki to collaboratively develop a staff training plan that addressed a given specific scenario over five weeks (Robertson, 2008).

Both of the instruments used for data collection, the post-course survey focused on ease of access and use and the 12-month follow-up survey focused on continued and expanded use of wikis for postgraduate work, were designed by the researcher. Post-course surveys were mailed to the homes of all participants. A total of 14 (70%) were returned (Robertson, 2008). Ten participants found access easy, nine found use easy. Flexibility of use and work time were cited as primary positive factors for wiki use. Ease

of editing was viewed as a positive by some, but a negative by others who were not happy having content editing without first having a discussion regarding changes. Eleven participants responded to the 12-month follow-up survey. Nine indicated they would like to see wikis used in both the current and other courses and two agreed to continued use in the current course but were unsure regarding the use of wikis in future courses (Robertson, 2008). This study identified the potential of wikis as a platform for collaborative work in an asynchronous online environment that provided access to participants anywhere, anytime.

Teach Web 2.0 Consortium was developed by researchers Drexler, Baralt, and Dawson to provide educators with a face-to-face community for the purpose of assessing Web 2.0 tools to determine their use as viable tools for teaching and learning. The group, formed by researchers in an independent school consisted of Pre-K to 12 teachers who participated in bi-weekly hour long meetings as part of a professional development initiative. A wiki was used as the primary tool for both communication and resource sharing. The wiki was selected due to the flexibility it provided for collaborative work (Drexler et al., 2008).

Drexler, Baralt, and Dawson (2008) administered a survey to teachers, administrators, and support faculty ($n = 84$) participating in the consortium. Results of this survey enabled researchers to categorize respondents into technology ability levels, which would help in the formation of the collaborative group. Informal interviews supplemented survey data. After analyzing these data, concerns were identified related to participants' knowledge, skill, motivation, or incentive, environmental factors, management factors, and interpersonal relations (Drexler et al., 2008). The Teach Web

2.0 Consortium was designed to address concerns by establishing an environment that encouraged independent learning while teachers contributed to group efforts following a framework established for wiki contributions. A SWOT (Strengths, Weaknesses, Opportunities, Threats) brainstorm analysis was implemented for resource selection. Teachers worked with the group bi-weekly to brainstorm ideas and share sites with faculty. This process was established based upon minor adjustments made to the process used by a small pilot group. In addition, participants were expected to complete an additional hour of online work outside of the face-to-face meetings in which teachers ($n = 44$) and administrators ($n = 7$) participated (Drexler et al., 2008).

At the end of one year of work, 17 face-to-face meetings, and the development of a strong resource base, it was decided to open participation in The Teach Web 2.0 Consortium with the Internet community. As a result, group membership grew to include 51 face-to-face and 31 online participants in addition to other members who used the site as a resource (Drexler et al., 2008). Members used the Web 2.0 tools gathered by the consortium to support student learning in the areas of literacy, communication, collaboration, and inquiry (Drexler et al., 2008).

Researchers indicated that they had hoped the levels of collaborative input would have been better as the year progressed, but participants relied on moderators for content. They felt that the face-to-face members maintained the most passive roles in the community. The researchers believed the model did succeed in introducing Web 2.0 applications into teaching and learning through a community of knowledge building Drexler et al., 2008).

Research drawn from a four-year large-scale mixed methods research project in the UK by Day and Gu focused on Variations in Teachers' Work, Lives, and Effectiveness (VITAE) involved 300 teachers in 100 primary and secondary schools in seven Local Authorities. This research focused on teachers' professional life phases, their identities, and how these related to teachers' capacities to sustain their commitment and effectiveness over the span of their careers in different contexts. Data on teachers' perceived effectiveness were collected twice a year through semi-structured, face-to-face interviews. Additional data were gathered periodically from document analysis, interviews with school leaders and pupils, and baseline test results at the beginning of the year followed by national curriculum results at the end of the year. This mixed-method approach was selected to identify teachers as either effective or ineffective over the course of their career and determine factors that contributed to these results (Day & Gu, 2007, p. 429).

The researchers maintain that life phases and identities have mediators that are in a constant state of flux in "three dimensions: the personal (lives outside of school); the situated (related to lives in school); and the professional (related to their values, beliefs and interactions between these and external policy agendas)" (Day & Gu, 2007, p. 424). Day and Gu believed this to be significant in light of the many reforms and initiatives being imposed upon teachers around the world and the resulting impact on teachers in terms of stress and morale. They questioned how to provide the best support for teachers' professional learning and development needs as they negotiate the stages of their careers to remain effective and have a positive impact on student achievement (Day & Gu, 2007).

The researchers concluded that a sense of commitment built through positive community relationships is fundamental to effectiveness and linked to teachers' aptitude and attitude to professional development. They identified two mediating factors for teachers: 1. their sense of positive professional identity and 2. their professional life phases. However, they found that one in three teachers did not have a positive sense of identity (Day & Gu, 2007, p. 430) which the researchers linked to ineffective teaching practice.

Day and Gu identified several discrete professional life phases that they derived from empirical data and an extensive review of literature. The researchers identified key influences on teachers' perceived effectiveness and professional learning needs during each of these phases. This information can be used to guide the formation of teacher professional development.

In the early stages a strong sense of professional identity may be linked to strong content knowledge and support from more experienced colleagues. Within 4-7 years teachers who were confident and motivated took on leadership roles and additional responsibilities. While these additional responsibilities provided improved self-efficacy initially, the heavy workloads taxed teachers' time and ability to manage effectively. Those with strong management skills maintained self-efficacy and effectiveness. However, as time went on, those without support from colleagues suffered losses of self-efficacy, effectiveness, and identity. The mid-career period provided evidence for the need for balance between the heavy workloads found in both their professional and personal lives. Teaching effectiveness was maintained by those who found differentiated professional development to meet needs related to self-efficacy, effectiveness, and

emotional well-being. Those without this type of support lost motivation and effectiveness. Teachers who mastered this stage and continued on to retirement age were successfully engaged in teaching and leadership roles, but still faced challenges of time management and personal adversities that come with aging and aged family members. Some lost motivation while others accepted challenges that built upon their strengths as managers. In-school support from colleagues, administrators, and support programs played a significant role in their commitment and effectiveness while those without support suffered disillusionment and fatigue. The majority of participants in this study (74%) continued to learn and develop as effective professionals. However, for 26% of the sample, this was not the case. As a result, one in four students received instruction from ineffective teachers. The researchers suggest the need for collegial support that maintains a climate of learning and provides continued opportunities for professional learning (Day & Gu, 2007).

Informal learning related to professional development was an area of focus for Barab, Jackson, and Piekarsky (2006) during their discussion of embedded professional development as situated in their work on the Quest Atlantis Project, a 3D multiuser environment for students ages nine through 12. They discussed the benefits of embedded PD that developed naturally out of every day teaching needs rather than being imposed. Their interpretation of embedded PD described experiences that involved implementation, individual and collaborative work that was reflective, and allowed practice to evolve as it was situated within the context of authentic daily practice (Barab, Jackson, & Piekarsky, 2006).

Barab, Jackson, and Piekarsky (2006) referred to the work of Donald Schön regarding the practice of reflection. The authors described reflection-in-practice as a process of reflecting on experiences as they occur. This process involves thinking about the experience and associated feeling as well as associated theories in use. This type of reflection informs our decisions and actions during the time in which the experience takes place. Reflection-in-practice involves reflecting on an experience after it has taken place and examining it from the position of an outside observer, yet still involves feelings and a theoretical basis for making sense of and learning from the experience (Barab et al., 2006, p. 166). Using this type of reflection enables teachers to frame a challenging situation in such a way as to create new paradigms in which the integration of technology as a process can be aligned with instructional content goals (Schön, 1983).

Virtual Communities of Practice

Researchers are finding that as the educational paradigm shifts from a teacher-centered to a student-centered focus, PD also needs to model this shift through teacher engagement with a focus on teachers as creators of knowledge (Hibbert, 2008). The interactive nature of information and communication technology (ICT) combined with Web 2.0, or the social web, provides such a forum in an environment without walls that bypasses traditional issues of access and boundaries for the purpose of collaboration and professional learning. Rheingold spoke of the transformative power that information technology has for bringing people together to do and create new things. His experiences with virtual communities began when Usenet reigned cyberspace and FAQ's were the way to share and distribute knowledge. He spoke of the ease of access and influence of today's social web formed by members who develop reputations of cooperation and trust

with powerful results (Rheingold, 2002). As an online forum for professional

development, Virtual Communities of Practice, using social networking as a platform,

may provide teachers with sustained access to resources not readily available within a

local district or school, at the time of need (Dede, Ketelhut, Whitehouse, Breit &

McCloskey, 2009).

The use of technology and social networking to develop Communities of Practice

are described in The National Education Technology Plan developed by the U.S.

Department of Education (2010). The *Executive Summary* entitled *3.0 Teaching: Prepare*

and Connect included the following goals:

 3.1 Expand opportunities for educators to have access to technology-based

content, resources, and tools where and when they need them.

Today's technology enables educators to tap into resources and orchestrate

expertise across a school district or university, a state, the nation, and even around

the world. Educators can discuss solutions to problems and exchange information

about best practices in minutes, not weeks or months. Today's educators should

have access to technology-based resources that inspire them to provide more

engaging and effective learning opportunities for each and every student.

3.2 Leverage social networking technologies and platforms to create communities

of practice that provide career-long personal learning opportunities for educators

within and across schools, pre-service preparation and in-service educational

institutions, and professional organizations.

Social networks can be used to provide educators with career-long personal

learning tools and resources that make professional learning timely and relevant

as well as an ongoing activity that continually improves practice and evolves their

skills over time. Online communities should enable educators to take online

courses, tap into experts and best practices for just-in-time problem solving, and

provide platforms and tools for educators to design and develop resources with

and for their colleagues. (U.S. Department of Education, 2010)

Virtual Communities of Practice can provide this forum, enabling a shift in focus

from traditional professional development to an online community based upon

asynchronous communication in a dynamic, informal environment driven by member

needs and grounded in National Staff Development Council standards. The National

Staff Development Council standard identified Learning Communities as: "Staff

development that improves the learning of all students organizeing adults into learning

communities whose goals are aligned with those of the school and district" (2010, p. 5).

The U.S. Department of Education Technology Plan supported this shift in professional

learning as stated in the Executive Summary: "Episodic and ineffective professional

development is replaced by professional learning that is collaborative, coherent, and

continuous… with the expanded opportunities, immediacy, and convenience enabled by

online environments full of resources and opportunities for collaboration" (2010,

"Teaching: Prepare and Connect", para. 25).

Use of VCoP in education is relatively new and mirrors use in the business

community where Communities of Practice (CoP) and VCoP for work within business

organizations have been used successfully for years (Brown, 1988; Dede, 2009a, Dubé,

Bourhis, & Jacob, 2003; Ellis, Oldridge, & Vasconcelos, 2002; Keown, 2009a, 2009b;

Pór, 1997; Restler & Woolis, 2007). Based on social learning theory, VCoP show great

promise for the development of professional knowledge based on collaboration, open-ended questions, and problem-solving within a real-world context. In education, there is a specific focus to create a CoP in the virtual (online or web-based) realm to reduce the feelings of isolation, trepidation that teachers feel as they are either overwhelmed by new policy and initiatives, alone in early adoption of technology, or on the other extreme, intimidated by a lack of understanding about the use of technology by connecting teachers with colleagues throughout the global community. VCoP have the potential to fill the need for collegial, job-embedded professional development that fits into a teacher's busy schedule, is available 24 hours a day, seven days a week, and is accessible for just-in-time assistance (Dede, 2009; Hargreaves, 2000; Hamburg, Engert & Petschenke, 2007; Keown, 2009a & 2009b; Restler & Woolis, 2007; Snider, Gershner, & Shapely, 2002; U.S. Department of Education, 2010; Watson, 2001).

From an administrative perspective, VCoP provide a platform that is ongoing, scalable, sustainable, and available at little or no cost. With proper facilitation, VCoP can be used to fill the void often found in more traditional forms of professional development which typically lack active participation, inquiry needed for the development of new knowledge and understanding, and topics that are relevant throughout the phases of a teacher's professional life (Barab, Jackson, & Piekarsky, 2006; Borko, 2004; Day & Gu, 2007; Dede, 2009; Hargreaves, 2000). Examples of successful large scale formal VCoP include The Math Forum through Drexel University (Renninger & Shumar, 2004) and Tapped In through SRI International (Schlager, Fusco, & Schank, 2004).

Duncan - Howell (2009) described this collaborative learning environment as a supportive environment that offers opportunity for changes through personalized

learning. Because collaboration is sustained, teachers seeking to solve real-world challenges are motivated to experiment with new practices shared by other community members (Duncan - Howell, 2009). Sustained relationships helped to build trust within the group, an essential element for the development of new ideas.

Through an analysis of message content from members of three online communities Duncan - Howell found that teachers use VCoP as a source of contact with a wider professional body and for discourse and pedagogical support. Teachers' primary areas of concern included pedagogical problems that needed to be solved or pedagogical/professional issues that needed to be discussed. Responses from community members regarding these areas of concern suggested solutions or ideas firmly grounded in authentic classroom-based experiences that members actively applied to their classroom practice. Duncan - Howell (2009) concluded, therefore, that membership in online communities had a positive impact on pedagogy.

The focus of study by Vavasseur and MacGregor (2008) was on professional development that incorporated aspects of just-in-time learning, content-focused inquiry groups, and participation in an online community of practice. Their mixed-method comparative case study took place over a span of four months. Their participants were drawn as a homogeneous purposeful sampling from two middle schools that were similar in terms of location and commitment to professional. Members from each school included teachers in sixth, seventh, and eighth grades in English, language arts, math, science, and social studies, including resource teachers and the principal from each school. A needs assessment completed by the schools' principals and teachers provided the content for the professional development which would focus on implementing

technology with new curriculum. Technology would be used as a tool for productivity, research, and communication embedded into curriculum topics. Teachers were also provided with the ISTE NETS for students and teachers (Vavasseur & MacGregor, 2008).

The professional development consisted of a blended model, using face-to-face meetings with work that continued online. Face-to-face sessions were conducted two times per week during team planning time. Both teachers and principals participated in online activities designed to facilitate teacher collaboration and principal support. Two groups were formed in each school for online work. Math and science teachers formed one team and English and Social Studies teachers formed the other. The online community was held on Blackboard Courseware Management System where discussion boards, email, and external links were located on each group's page. The online community was used to discuss topics pertaining to the face-to-face training. The researchers, acting as moderators, provided prompts, drawn from the needs assessment on a periodic basis (Vavasseur & MacGregor, 2008).

Quantitative data were gathered from two sources, a teacher efficacy survey administered to all teachers and a technology enhanced unit assigned as a culminating project. The teacher efficacy survey was designed by the researchers. This Likert-type scale survey with 32 items was adapted from six instruments and pilot tested for reliability and validity. The purpose of the survey, administered at the beginning and end of the PD, was to determine the level of teacher expertise in using technology, the perceived value of technology in the instructional process, teacher efficacy in using technology, and general teaching efficacy. Qualitative data were gathered using two

sources, focus group interviews at the end of the PD with all teachers and the online threaded discussions between teachers and their principal (Vavasseur & MacGregor, 2008).

An independent means t-test was conducted on scores for the technology enhanced unit plan scores determined by the state's educational technology center. Vavasseur and MacGregor found a significant difference between the means for overall quality ($p = .046$) and in technology integration ($p = .003$). A MANOVA was conducted to determine the difference between the two schools on efficacy survey pre-and posttest scores. The Wilks' Lambda F $(4, 23) = 3.3$, $p = .026$ revealing a significant difference between the two schools in teachers' teaching efficacy. However, both schools demonstrated an increase from pre- to post-assessments on their perception of the value of computers in teaching. An analysis of the online threaded discussions revealed that teachers posted between two to 16 times at School A and two to 12 times at school B. The mean number of postings for Principal A was 11.5 and Principal B was 15.5 (Vavasseur & MacGregor, 2008).

The researchers attributed the successful integration of technology to the structuring of the community. They identified factors contributing to this success as the use of the needs assessment to determine focus, participation by the principals, and facilitation of the online community accompanied by prompts and resources, and effective online communication. The short period of time the online community was observed was considered to be a limitation of the study. Researchers suggested examination of an extended period of time to determine if more time would permit a stronger sense of community to develop or be sustained (Vavasseur & MacGregor, 2008).

Hibbert (2008), using case study methodology, explored personal learning of teachers participating in VCoP in reading. She was curious to know if participation in online courses would foster critical reflective practice and personal and professional growth. In addition she questioned how online learning would evolve into a virtual community of practice. Data sources for the study included documents, field notes, and the investigator's journal. Hibbert found that the processes of talking through online discussions and writing combined to support learning. Her study revealed that gaps between theory and practice were explored and more clearly understood by discussion involving a variety of perspectives. She described this shift as moving beyond competencies to teachers as knowledge producers and knowledge workers who pursued their own intellectual development. As VCoP bonds strengthen, teachers created relations of "mutual, professional accountability" (Hibbert, 2008).

The VCoP provided the platform for teachers to engage in professional discourse as teacher and learner. They deliberated about their practice while they were immersed in it. Teachers were challenged to examine their roles as "mentor, supportive friend, devil's advocate, challenger, and sympathizer" (Hibbert, 2008, p. 144). They developed an appreciation for new ideas and perspectives while examining their own. Some struggled with the transition from isolated problem solvers to supported collaborative community members. The VCoP provided teachers with access to sustained, collaborative, professional communities (Hibbert, 2008).

In New Zealand, Keown used a mixed methods design with a combination of grounded theory, narrative, and action learning-action research methodologies. The purpose of his study was to determine the effectiveness of a VCoP for teacher

development in the area of Social Science to implement complex curriculum change. He was also interested to learn if the VCoP model would be viable, create a community in a short period of time, and result in changes in teaching practice. His sample was drawn from "a mix of convenience, opportunistic and snowball sampling, and confirming/disconfirming case strategies" (Keown, 2009b, p. 68). Ultimately, his sample contained 37 educators enrolled in three online modules from 2003 to 2004. Each took part in a least one aspect of the online program. Five teachers participated in module 1, nine in module 2, and twenty-three in module 3. The study took place over 18 months (Keown, 2009b).

Sampling techniques were used for qualitative data analysis due to the large amount of data. The techniques used in this study were a combination of theme, time, and individual/group techniques. The most important source of data was gathered from online text, including the exercise dialogue and discussion section of the online record for each module, which was analyzed in addition to messages posted by particular illustrative individuals or groups. Triangulation of data occurred through respondent validation in face-to-face group discussions and a final questionnaire that included closed and open-ended questions. A second source of data was focus group discussion. These discussions took place at the end of each module. Face-to-face contact for discussions was difficult to arrange. Therefore, a convenience sample was necessary. In total, 58% of study participants were included in these discussions. The third set of data was collected from questionnaires used to elicit post-intervention data from participants. Continuous comparisons and triangulation techniques were employed (Keown, 2009b).

The social science topics were presented using a seven-step framework designed to give teachers a clear format for each module. Content was developed with reading materials, professional knowledge, reflective thinking, online dialogue, and classroom trialing. Each module dialog was grounded in a consistent five step format (Keown, 2009a, p.298). The VCoP used a blended model that integrated face-to face meetings with virtual meetings taking place on an online content management system with the researcher acting as moderator (Keown, 2009a).

Keown reports four major findings: manageability, catering for individual differences, establishing a strong discussion and dialogue culture, and identification of areas for further development. Two factors identified as critical to manageability were the timeline for module completion, which had begun at four weeks in Module 1 but extended to six weeks by Module 3, and the number of entries reduced from three to two. Changing these factors increased activity and participation and improved the quality of professional discussions. Wide differences in participation with modules require flexibility and respect. Participation followed Wenger's participant levels ranging from core, to active, to peripheral (Wenger et al., 2002). The researcher found that in the third module ($n = 23$) there were five core members, eleven active members, and seven peripheral members (Keown, 2009b, p. 226-228). Dialogue was appreciated by participants who found community discussions and networking of like-minded professionals to be highly valuable along with reflective thinking (Keown, 2009b, p. 229-230). While overall responses for the VCoP model were positive in light of the aspect of community, emphasis on reflection and sharing and situated and activity aspects, several aspects were identified as in need of improvement. Participant-identified areas of

weakness including grouping, group interaction, some of the readings and materials within the modules, timing, and reading and writing approach (Keown, 2009b, p. 232).

Gray studied the experiences of coordinators of the Alberta Community Adult Learning Councils "to understand to what extent participants' experiences in an online environment constituted a community of practice" (2004, p. 21). She also sought to "understand the nature of the informal learning that occurred, motivations for participation, and the role played by the moderator in the community" (Gray, 2004, p. 21). Participants for this qualitative study included 43 council coordinators who voluntarily participated in the online community for a period of one year. A WebCT content management site including: a website, private and public discussion forums, an interactive calendar, private email, and live chat, were established for the purpose of this study (Gray, 2004).

The researcher filled the role of moderator. To address subjectivity and strengthen credibility, she kept a self-reflective journal. Data collection sources included a review of online discussion forum postings, live chat transcripts, email correspondence between participants and the moderator; a participant survey consisting of 16 multiple choice and seven open ended questions; and individual on-site interviews with 11 participants selected using purposeful sampling techniques. These data were analyzed using Wenger's (2001) Communities of Practice framework as a guide (Gray, 2004).

Findings suggested the formation of a Community of Practice and served for a tool for informal learning situated in the context of the coordinator's everyday work experience. Participation in the community also served to define the identity of the practice itself. Motivating factors included the opportunity to learn new skills and work

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practices, social and professional connections with colleagues, and a reduction of

isolation due to geographic location. These findings also suggested that the moderator's

role was integral in enhancing community functioning through technical support,

maintenance of group process, nurturing social aspects of the community, and facilitating

learning (Gray, 2004).

Conclusion

This review of the literature began with an examination of theoretical foundations

grounded in Vygotsky's Zone of Proximal Development (1978) and Lave and Wenger's

theory of situated learning. Both theories speak to the social-constructivist nature of

learning that takes place through social interaction and sharing of knowledge and

information between individuals. This sharing, from one person to another, may result in

the formation of a Community of Practice in which knowledge is shared and new

knowledge is created. The balance of the review focused on attitudes toward computers,

technology content integration, professional development, and Virtual Communities of

Practice. Teachers' attitudes toward computers are rooted in pedagogy and personal

beliefs about teaching and learning. How teachers integrate technology into their content

area is dependent upon their attitudes and the amount and quality of the professional

development they receive. Traditionally, one-shot professional development was offered

in most districts and was not a catalyst for technology integration. Professional

development that is provided in context, involves sustained process and that is based on

content is effective in enhancing integration of technology. Sustained, collaborative

professional development within the context of a teachers' content area that fits into

teachers' busy schedules can be can be found online in Virtual Communities of Practice.

CHAPTER THREE: METHODOLOGY

The effects of online professional development in technology with virtual communities of practice (VCoP) on teacher's attitudes and content integration were studied. Research for this study was conducted asynchronously online. Data were collected through two sites using three online instruments. Participants were drawn from schools in the United States, U.S. Department of State Overseas Schools, and international schools.

Research Questions and Hypotheses

Research Question One: To what extent and in what manner can teachers' attitudes toward technology (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

Non-directional hypothesis: Years of teaching experience, professional development in technology experience, and STEM or non-STEM subject area will predict teachers' attitudes toward computers (interest, comfort, concern, utility, absorption, and significance).

Research Question Two: Are there significant differences in attitudes toward technology variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

Non-directional hypothesis: There will be a significant difference in attitudes toward technology between teachers who receive professional development online and

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those who receive professional development online with Virtual Communities of Practice.

Research Question Three: Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice? Non-directional hypothesis: There will be a significant difference in content integration between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice.

Setting, Sampling Procedures, and Research Sample

Setting

This research study took place asynchronously online. Correspondence with participants during the study was accomplished using email and posts on the course website for the comparison group cohorts and through email, private wiki messages, and postings on the course wikis for the treatment group cohorts. Six professional development modules in technology (see Appendix D) were delivered through two online portals in the English language over a six-week period. A Google site website functioned as the portal for all three control group cohorts. A Wikispaces wiki functioned as the portal for all three treatment group cohorts. Each portal was designed to provide access by invitation only and therefore limited access to the members of the intended participating group and the researcher (Gall, Gall & Borg, 2007). All researcher designed resources such as handouts, links, and multimedia presentations were accessed by participants through their respective portals. An email was sent to individual participants

at the start of each module providing the topic, URL, overview of the site, and assurance of support via email with the researcher. The distribution, completion, and collection of all three instruments, for both pre- and posttests, took place asynchronously using secure online sites (Gall et al., 2007).

Sampling Procedures

Initial contact with school administrators was made by telephone, Skype, or email. Correspondence with administrators and participants for the dissemination of information prior to the study and the distribution and collection of electronic consent forms (see Table 1) were accomplished through the use of personalized email to individuals. This method of email use was selected to protect ethical considerations, ensure confidentiality, and decrease the likelihood of the email being flagged as spam (Dillman, Smyth, & Christian, 2009). Both correspondence and conversations focused on defining research objectives such as the time frame, aspect of the topic, time commitment, and assurance of ethical treatment (Gall et al., 2007).

Table 1

Sampling Procedure Overview

Stage	Action	Requests	Participation
1	Administrator Invitation to Join	604	30
2	Letters of Consent to Administrators	30	30
3	Letters of Consent to Teachers	204	194

Research Sample

The study included 115 teachers, from U.S. school districts in the northeast ($n =$ 74) and from the US Department of State Overseas Schools ($n = 39$), and international schools ($n = 2$). These schools represented a variety of rural, suburban, and urban locations. School populations were representative of diverse culture, ethnicity, and socioeconomic variations.

The participants represent a sample of convenience comprised of volunteers who were self-selected. Schools were contacted as a result of random Internet searches and contacts discovered through postings on listservs, email, telephone calls, Skype, micro-blogging, and both face-to-face and online social networking. U.S. Department of State Overseas Schools were randomly selected from the school directory and person-to-person networking. Every effort was made to form a representative sample so that results may be generalized to teachers working in a K-12 setting. Tables 1 – 7 provide a clear picture of the research sample presented in descriptive data including gender, area, age, years of

experience, professional development course experience in technology, and STEM and non- STEM subject assignment.

Table 2

Sample Characteristics by Gender

Gender	Frequency	Percent
Male	12	10.4
Female	103	89.6
Total	115	100.0

Table 3

Sample Characteristics by Environment

Area	Frequency	Percent
Rural	18	15.7
Suburban	55	47.8
Urban	42	36.5
Total	115	100.0

Table 4

Sample Characteristics by Age Range

Age Range	Frequency	Percent
21-25	1	.9
26-30	14	12.2
31-35	17	14.8
36-40	16	13.9
41-45	19	16.5
46-50	17	14.8
51-55	11	9.6
56-60	11	9.6
60-65	8	7.0
65-70	1	.9
Total	115	100.0

Table 5

Sample Characteristics by Years of Teaching Experience

Teaching Experience	Frequency	Percent
1-5	21	18.3
6-10	25	21.7
11-15	23	20.0
16-20	19	16.5
21-25	16	13.9
26-30	5	4.3
31-35	4	3.5
36-40	1	.9
41-45	1	.9
Total	115	100.0

Table 6

Sample Characteristics of Technology Professional Development Coursework

Number of Course Sessions	Frequency	Percent
1-5	55	47.8
6-10	29	25.2
11-15	12	10.4
16-20	5	4.3
21-25	4	3.5
26-30	0	0
31 or more	10	8.7
Total	115	100

Table 7

Sample Characteristics of Department Assignments

Department Assignment	Frequency	Percentage
English	23	20.0
Math	18	15.7
Science	14	12.2
Social Studies	9	7.8
Art	3	2.6
Music	2	1.7
Health	3	2.6
Special Education	10	8.7
Reading	12	10.4
Library Media Center	11	9.6
Guidance Counselor	3	2.6
Other	7	6.1
Total	115	100.0

This sample was convenient as participants were teachers who worked in a school setting. The descriptive data illustrates the diversity of individuals in the areas of gender, environment, age, years of teaching experience, technology professional development coursework, and STEM or non - STEM subject area. Intact grouping occurred, as some participants worked together in the same school while others were the solitary representative of their school.

Instrumentation

Data were collected using three instruments, a Researcher-designed Demographic Survey, *Teachers' Attitudes Toward Computers* (Christensen & Knezek, 2009b), and *Levels of Technology Innovation Digital Age Survey* (Moersch, 2009). The Researcher-designed Demographic Survey and the TAC instruments were administered using a secure online site, SurveyMethods.com, which had been piloted by this researcher in 2009 (Dillman et al., 2009; Gall et al., 2007) to ensure the site was easily accessible to users with a variety of computer skill levels. The LoTi was administered using the secure site provided by LoTi Connection, Inc. The LoTi was not piloted by this researcher, as it is a commercially distributed instrument used by schools over the past 20 years (Moersch, 2009).

Researcher-designed Demographic Survey

Demographic data were collected using an online survey created by the researcher (see Appendix C). Each participant was instructed to self-report data including age, years of experience, professional development in technology experience, and primary department assignment. Average completion time for the questionnaire was less than five minutes.

Teachers' Attitude Toward Computers

The *Teachers' Attitudes Toward Computers* v6.1 (TAC) instrument consists of 51 questions assessing nine subscale constructs. Individual subscales may be administered alone or in combination with others (Knezek, Christensen, Miyashita, & Ropp, 2000). For the purpose of this research study, six of the eight TAC subscale constructs were used, including interest, comfort, concern, utility, absorption, and significance (see

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samples Appendix A). Two subscales, accommodation and interaction, of the TAC were removed from the study. This is a well validated, reliable instrument for the self-assessment of teachers' attitudes toward computer technology (Christensen & Knezek, 2009b). Data were gathered through an online questionnaire. Participants required 10 to 15 minutes to complete this Likert-type instrument.

The *Teachers' Attitudes Toward Computers* questionnaire was originally "derived from 14 well-validated computer attitude survey instruments representing 32 unique subscales" (Christensen & Knezek, 2009b, p. 143). At its inception, the TAC, was a 284-item questionnaire. The instrument was administered to 621 educators, K-12, in Texas, Florida, New York, and California during the two year period from 1995 to 1997 (Christensen & Knezek, 2009b). Both an exploratory factor analysis and a content analysis of responses led the authors to conclude that a 7-factor structure could adequately represent teachers' attitudes toward computers. Reliability estimates (Cronbach's Alpha) for this initial group of educators ranged from .85 to .98 when 10 to 30 items were used to form a subscale for each construct (Christensen & Knezek, 2009b).

The TAC has been refined twice since its inception. Through each of the refinement stages, the authors recognized the importance of maintaining ties to historically significant measurement indices, such as instruments by Gressard and Lloyd (1986), Reece and Gable (1982), Raub (1981), and Delcourt and Kinzie (1993). The fifth version of TAC integrated additional indices and marker items which increased the number of subscales from seven to nine. Reliability for TAC version 5.0 ranged from .84 to .95 based on a sample of convenience comprised of 1,296 Texas K-12 educators (Christensen & Knezek, 2009b).

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During this refinement period, the researchers tested subsets of the original pool of 284 well-validated questions in various parts of the world. Researchers using the Spanish and Dutch translations of the TAC, used in Mexico and the Netherlands respectively, concluded that the subscales maintained their historical identities in a multinational context (Christensen & Knezek, 2009b).

In the second refinement period, international use and large scale use in Texas prompted Christensen and Knezek (2009a) to develop a shorter version of TAC that would continue to maintain historical ties and reliability. In 2001 the authors confirmed reliability of TAC version 6.1, a 51-item instrument with nine subscales. The authors reported subscale reliabilities ranging from .87 to .95 (Christensen & Knezek, 2009b). International investigations demonstrated acceptable reliabilities among translated forms.

Levels of Teaching Innovation

The *Levels of Teaching Innovation* (LoTi) *Digital Age Survey* (Moersch, 2009) for teachers is an online instrument consisting of 37 questions assessing three subscale constructs (see Appendix B) that include Levels of Teaching Innovation (LoTi), Personal Computer Use (PCU), and Current Instructional Practices (CIP). For the purpose of this research study, the LoTi framework was used to measure teachers' integration of ICT with students, as demonstrated in the ISTE National Educational Technology Standards for Teachers (NETS-T) (ISTE, 2008). The PCU framework was used to measure teachers' fluency level using digital tools and resources for student learning. The CIP framework was used to measure teachers' Current Instructional Practices using technology (Moersch, 2009). The LoTi is designed to facilitate planning professional development for teachers by identifying areas of need. For the purpose of this research

study it was used to assess teachers' level of integration before and after the treatment. Participants required approximately 20 minutes when completing this valid and reliable Likert-type instrument.

Aligned with the CBAM (Concerns Based Adoption Model) developed by Hall and Loucks (1979) to examine the process and progression of change, Moersch (1995) field-tested the original LoTi, which focused on technology related to instruction and assessment, in the mid-1990s. The second generation of LoTi was known as the DETAILS Survey (Determining Educational Technology and Instructional Learning Skill Sets). Stoltzfus, of Temple University, conducted an empirical analysis of this predecessor to the LoTi determine construct validity in 2006. She determined that the DETAILS Survey contained statistically reliable and valid constructs.

Stoltzfus (2009) demonstrated criterion validity for the current LoTi through an analysis using the Texas Teacher School Technology and Readiness (STaR) Chart. The STaR Chart measured four levels of teacher technology implementation and progress, which aligned with the LoTi. The two part statistical analysis compared within-school frequency distribution of STaR Chart and LoTi scores using separate z tests for proportions. An assessment of concurrent criterion-related validity was also conducted, as data were collected during the same time period. Results of the correlation analysis revealed a strong significant positive association between the STaR Chart and core LoTi levels ($r_s = .704$, $p < .0001$). The corresponding Pearson's correlation coefficient ($r = .767$ $p < .0001$) supported this finding. Stoltzfus (2009) findings indicated that the two instruments shared a robust degree of overlap in what they measure, thereby providing initial evidence of the core LoTi levels' criterion-related validity (Stoltzfus, 2009).

External validity has been demonstrated over the past 15 years by the large number of researchers, administrators and teachers who have used LoTi to accurately evaluate teaching innovation (Moersch, 2010).

In 2000, Schechter investigated the internal consistency reliabilities of the LoTi. For this purpose Cronbach's alpha, measured on a scale from 0 to > 1.0, with the criterion as established by Huck and Cormier (1998) suggested that > .70 is the accepted standard for reliability estimates. Schechter determined that overall the LoTi demonstrated fairly high levels of internal consistency. The reliability estimates for each of the three components were reported as the LoTi at > .7427, the PCU at > .8148, and the CIP at >.7353 (Schechter, 2000, p. 63).

Description of the Research Design

This study used a quasi-experimental, quantitative data analysis with a pretest-posttest design. Both groups received six online professional development modules. The treatment group participated in a VCoP, the comparison group did not (see Appendix D). This design was used with teachers, drawn from a sample of convenience and formed into non-randomized groups based upon pre-existing school assignments.

This study provided participating teachers in the comparison and treatment groups with researcher-designed modules they used to learn six online resources and applications within the context of their current classroom practice. Individual teachers were required to create a product for each module that they integrated into their practice within the context of their curriculum area for communication, personal productivity or teaching and learning.

Participants in the VCoP (treatment group) were expected to work collaboratively as they shared ideas and sought assistance from community members through asynchronous written communication on the group wiki. Participation was initiated and nurtured through the posting of reflective questions by the researcher, acting as facilitator. Reflective questions were designed to assist in the development of discussions focused on the understanding, application, implementation, and evaluation of each application or resource presented in every module. Members were asked to explain how they integrated or anticipated integrating applications or resources within the context of their teaching practice in their particular grade level and curriculum area. They shared resources and finished products with one another. They were encouraged to take risks and experiment with the technology presented in each module to positively impact teaching and learning, communication, and personal productivity. As a result, they built a supportive collaborative environment with a shared purpose and common goals as they work together to integrate appropriate uses of technology.

Participants in the group without VCoP (comparison group) were expected to work individually as they shared ideas and sought assistance from community members through asynchronous written communication with the facilitator via individual email. Participation was initiated and nurtured through the posting of reflective questions on the course website by the researcher, acting as facilitator. Reflective questions were designed to assist in the development of correspondence focused on the understanding, application, implementation, and evaluation of each application or resource presented in every module. Members were asked to explain how they integrated or anticipated integrating applications or resources within the context of their teaching practice in their

particular grade level and curriculum area. They shared resources and finished products

with the facilitator. They were encouraged to take risks and experiment with the

technology presented in each module to positively impact teaching and learning,

communication, and personal productivity.

Data Collection Procedures and Timeline

The following timeline provides an overview of the procedures followed over the

nine month research study period, from the initial contact with school administrators to

determine interest to the conclusion of data collection.

Table 8

Data Collection Procedures and Timeline

Event	Data Collection Procedure	Date
Request Superintendent's interest in study participation	Email, telephone, Skype, letter	Cohort 1:August – September 2010; Cohort 2: November 2010; Cohort 3: January 2011
Received Institutional Review Board (IRB) approval		October 2010
Request Teachers' interest in participation in study		Cohort 1:September – October; Cohort 2: November 2010, Cohort 3: January 2011

Event	Data Collection Procedure	Date
Distribution and collection of Superintendent/ Director/ Principal consent (Appendices E and F)	Email, FAX	Cohort 1:October 2010, Cohort 2: November 2010, Cohort 3: January 2011
Distribution and collection of consent forms from teachers (Appendix G)	Email	Cohort 1: October 2010, Cohort 2: November 2010, Cohort 3: January 2011
Distribution of information required for Pretest surveys:	Email to individual participants; available for 5-10 days	Cohort 1: November 2010, Cohort 2: January 2011, Cohort 3: March 2011
Pretest data collected November 2010, Cohort 1; January 2011, Cohort 2; March 2011, Cohort 3	Data collected electronically	Cohort 1: November 2010, Cohort 2: January 2011, Cohort 3: March 2011
Distribution of Introduction and Modules 1 through 6	Email to individual participants	Cohort 1: November 2010, Cohort 2: January 2011, Cohort 3: March 2011
Distribution of information required for Posttest surveys:	Email to individual participants; available 5-14 days	Cohort 1: December 2010, Cohort 2: February 2011, Cohort 3: April 2011

Event	Data Collection Procedure	Date
Posttest data collected electronically	Data collected electronically	Cohort 1: December 2010, Cohort 2: February 2011, Cohort 3: April 2011

Data Analyses

Inferential statistical analyses were used to examine the research questions.

Research Question One: To what extent and in what manner can teachers' attitudes toward technology (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

This question was answered through six separate multiple regression procedures using a stepwise model on pre-test results of the TAC, with an examination of the moderator variables (years of teaching experience, technology professional development coursework and STEM or non-STEM subject area) and six levels of the dependent variable attitude towards computers (interest, comfort, concern, utility, absorption, and significance). The researcher selected a stepwise multiple regression procedure for statistical analysis rather than an hierarchal approach to allow for variables to be included and excluded in the equation as the strength of the independent variables changed with additional entries into the model.

Research Question Two: Are there significant differences in attitudes toward technology variables between teachers who receive professional development online and

those who receive professional development online with Virtual Communities of Practice?

A *t*-test was conducted on pretest scores for both the TAC and the LoTi to determine equality of groups prior to the treatment. A MANOVA, was then used to conduct the statistical analysis of the two dependent variables attitude towards computers, six levels (interest, comfort, concern, utility, absorption, and significance) and the independent variable, professional development, two levels (online professional development and online professional development with Virtual Communities of Practice) as homogeneity of groups was found.

Research Question Three**:** Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

A Chi-Square Test for Independence was conducted to compare content integration (categorical Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between the two independent samples, teachers who receive professional development online and those who receive professional development online with VCoP. This nonparametric statistical test was used to determine whether frequency counts were distributed differently for the two variables, professional development with VCoP and without. Actual observations in the study were compared with expected observations to determine which factors played a significant role in the relationship (Gall, et al., 2007). To determine whether there was a significant difference for each of the levels of content integration, 3 two sample 4x2 Chi-Square Crosstabs were

used. The Chi-Square Crosstabs test is an appropriate nonparametric statistical test to determine if significant differences exist beyond the .05 level between observed and expected frequencies. In addition, a Cramer's V posttest was used to determine strength of associations after Chi-Square determined significance (Hinkel, Wiersma, and Jurs, 2003).

Limitations of the Study

As indicated in Chapter One, careful consideration was given to the development of this research study to control for potential internal, external, population, and ecological threats to validity.

External validity

Population validity. Although the sample is one of convenience, participants were drawn from a diverse national and international geographic area. The sample was selected randomly from a defined population (Gall, et al., 2007). Results may be generalized from this sample to a general population.

Ecological validity. An explicit description of the experimental treatment was provided so that other researchers may reproduce it, reducing experimenter effect in the process. Both the treatment and comparison groups received online professional development in technology. Only one group received the treatment, participation in Virtual Communities of Practice. Special treatment was not given to any participants. The treatment was not novel, as teachers had some experience with technology training. The pretest and posttest were only administered once, eliminating the threat of sensitization for each. The posttest was administered immediately upon completion of the

treatment. Results were not generalized beyond the time period in which the study was

conducted.

Internal validity

The study took place over three sessions in a nine-month period. This short time

period was designed to minimize threats due to history, maturation, or experimental

mortality. It was not likely for participants to become test wise, nor did they experience

issues related to changes in instrumentation or scoring, as the researcher scored the TAC

instrument and the LoTi was scored electronically. Due to the nature of technology use

and the fact that groups were not in close proximity to each other, statistical regression

was addressed through treatment and comparison groups and distance. This study used a

sample of convenience, with intact groups. A large sample addressed selection-

maturation interaction. Because the focus of this study was completely technology

driven and included self-selected participants, it was possible that reluctant users of

technology were not adequately represented in the sample. Self-selection in and of itself

may be viewed as a limitation, as participants may be more motivated and self-regulated

than non-participants. Both groups received online professional development in

technology, none of the groups in a single cohort knew each other outside of the study,

nor did participants know if they were in the treatment or comparison group, which

addressed experimental treatment diffusion and compensatory rivalry, and resentful

demoralization of the comparison group. However, history may have influenced

participant focus. During this time period teacher layoffs were announced. Political

unrest in a portion of the world occurred which may have had an effect on International

School participants. An electrical storm took LoTi instrument servers offline, which may

have impacted the number of participants completing the survey in the third cohort.

Experimental mortality was found to be a limitation of this study. A total of 77

participants did not complete the study. This loss of participants can be attributed to

dropping out, missing pretests, and/or missing posttests.

Statement of Ethics and Confidentiality

Permission to participate in this research was sought from superintendents,

directors, school principals, and participating teachers. To assure confidentiality, each

participant was assigned a coded identification number. All data were collected via

email, FAX, and secure online sites. Data will be made available to those participating

administrators who request it.

CHAPTER FOUR: ANALYSIS OF DATA

The purpose of this study was to examine the effects of online professional development in technology with Virtual Communities of Practice on teachers' attitudes and content integration. Two subscales, accommodation and interaction, of the TAC were removed from the study. This action reduced the number of subscales to six, including interest, comfort, concern, utility, absorption, and significance.

Three research questions were addressed:

Research Question One

To what extent and in what manner can teachers' attitudes toward technology (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

Research Question Two

Are there significant differences in attitudes toward technology variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

Research Question Three

Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

This chapter presents the results of this research and its findings in four sections: (a) description of the data, (b) data screening process, (c) descriptive statistics, and (d) analysis of the findings. It contains explanations of the findings and statistical procedures which were grounded by the research questions that were the focus of this study.

Description of the Data

The data analysis in this study used the results of three survey instruments to examine the effects of online professional development in technology with Virtual Communities of Practice on teachers' attitudes and content integration. Survey data were collected using online survey instruments that included a Researcher-designed Demographic Survey, six subscales of the Teachers' Attitudes Toward Computers (TAC), and three subscales of the Levels of Teaching Innovation (LoTi) framework. Data were analyzed using a sample of 115 teachers representing 35 urban, suburban, and rural schools at the elementary, middle, and secondary levels in five countries. Coding was applied to each participant, allowing the researcher to maintain confidential participation while matching the data results for all three surveys. Total scores were calculated for each variable and these scores were used for all statistical analyses.

Data Screening Process

Careful attention was paid to the data screening process as this research study relied on data gathered from three surveys. Data were collected from the Researcher-developed Demographic Survey and the TAC instruments using the Survey Methods online site, downloaded as an Excel file, and imported into SPSS statistical software for screening of data. Data collected with the LoTi instrument were downloaded in comma separated variable (.csv) format, saved in Microsoft Excel, and imported into SPSS

statistical software. These data were sorted using the unique identification number

assigned to each participant and imported into SPSS. A simple visual inspection was not

appropriate for this study because of the large data set. Therefore, data were screened

through the use of statistical software.

Code and Value Cleaning

The data set was examined for missing values. Numerical codes for each value in

the study were examined through the use of frequency tables for each variable (Meyers,

Gamst, & Guarino, 2006). This inspection indicated no unusual attribute code violations

for values used in this study. An inspection of the frequency tables did reveal missing

values for cases in the Researcher-designed Demographic Survey, TAC pretest, TAC

posttest, Levels of Technology Innovation (LoTi) posttest, Personal Computer Use (PCU)

posttest and Current Instructional Practices (CIP) posttest. As a result, a listwise deletion

was performed which resulted in the exclusion of 77 cases. These cases related to all

data for these individual instruments for participants. An overview of deletions for each

instrument is illustrated in Table 9. The deletion of these cases reduced the sample size

from 192 cases to a total of 115 cases. Participants who did not complete one or more of

the pretests or posttests were deleted from the sample. The sample size reduction

resulting from this listwise deletion of 77 cases was not expected to increase the estimate

of measurement error and did not drop the *n* below the level needed for multivariate

procedures (Meyers et al., 2006). The deletion of 77 cases is discussed in the Limitations

section of Chapter Five.

Table 9

Missing Values by Instrument

Instrument	Cohort 1	Cohort 2	Cohort 3
	(*n* = 92)	(*n* = 47)	(*n* = 53)
Researcher-developed Demographic Survey and TAC Pretest	3	0	2
LoTi Pretest	2	0	3
TAC Posttest	4	0	2
LoTi Posttest	5	5	9
Both Posttest Instruments	20	1	9
All Instruments	5	1	6
Total Deletions by Cohort	39	7	31

Case screening of TAC pre- and posttest subscales including interest, comfort, concern, utility, absorption, and significance indicated there were no missing cases, confirming 100 percent participation for a total of 115 participants, 58 in the treatment group and 57 in the comparison group. Case screening of the LoTi posttest subscales including PCU and CIP indicated there were no missing cases, confirming 100 percent participation for a total of 115 participants.

Analysis of Outliers

Data were examined for the detection of univariate and multivariate outliers and statistical assumptions. To identify univariate outliers, an inspection of histograms and boxplots for each variable was conducted (Meyers et al., 2006) on data collected with the Researcher-designed Demographic Survey, TAC pre- and posttest, and the LoTi pre- and posttests including PCU and CIP. An analysis of the demographic data revealed skewness (1.67) in the area of technology professional development coursework (see Figure 1). A decision was made to include these outliers as they are representative of the sample.

Figure 1

Skewness in Technology professional development coursework Histogram
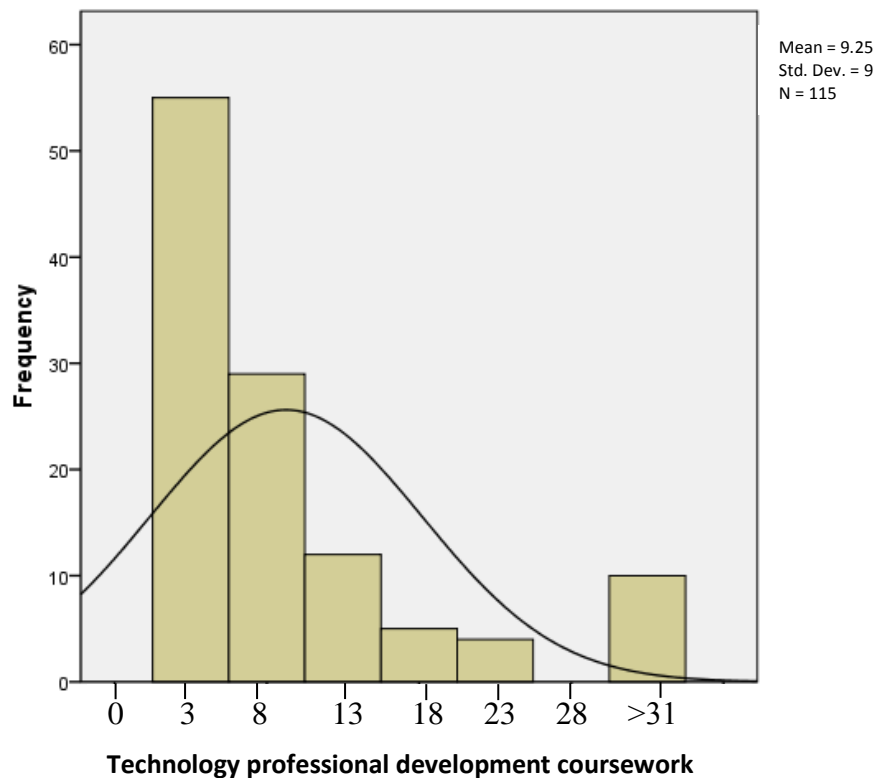
Extreme outliers on two TAC posttest subscales, comfort and concern were discovered. Three outliers were found below the upper lower fence on the boxplot of the comfort subscale. Two of the three outliers were from the treatment group, one from the comparison group. Four outliers were found, one above the upper inner fence and three below the lower inner fence, on the boxplot of the concern subscale. Three of the four outliers were from the treatment group and one from the comparison group. One outlier, from the treatment group, overlapped both subscales. As a result, a total of six outliers were removed from two TAC posttest subscales, comfort and concern. This action resulted in a reduction of the total number of cases from 115 to a total of 109, 58 in the treatment group and 57 in the comparison group.

An inspection of the data collected using the TAC pre- and posttest was , conducted to assess the presence of multivariate outliers by computing each case's Mahalanobis distance. This statistic D^2 measures the multivariate "distance" between each case and the group multivariate mean (Meyers et al., 2006, p. 67). Each case was evaluated using the Chi-Square distribution with an alpha level of .001. Cases reaching this threshold can be considered outliers and may be considered for elimination (Meyers et al., 2006).

Data were screened for multivariate outliers by computing the Mahalanobis distance for each case on the three continuous independent variables technology professional development coursework, years of experience, STEM or non-STEM subject area, and each dependent variable. A second screening for multivatiate outliers was conducted for each case on the two continuous independent variables, PD with VCoP and PD without VCoP, and each dependent variable. None of the Mahalanobis distance

values equaled or exceeded the Chi-Square criterion; therefore it was concluded that there were no multivariate outliers.

An additional assessment of assumptions violations for a regression analysis is to evaluate the residuals scatterplot (Meyers, et al., 2006). Scatterplots for the continuous independent variables technology professional development coursework, years of experience, and STEM or non-STEM subject area, and each dependent variable (TAC pre- and posttest subscales: interest, comfort, concern, utility, absorption, and significance) were evaluated. Additionally, scatterplots for the continuous independent variables PD with VCoP and PD without VCoP and each dependent variable LoTi posttest subscales: LoTi, Personal Computer Use (PCU), and Computer for Instructional Purposes (CIP) were evaluated. "Scatterplots displayed rectangularity within the residuals output indicating the residuals were normally distributed among the predicted dependent variable scores" (Tabachnick & Fidell, 2001b as quoted in Meyers et al., 2006, p. 202). Issues of normality, linearity, and homoscedasticity were effectively monitored and evaluated.

Analysis of Data

Non-random assignment to group was utilized in the formation of the comparison and treatment groups. Participants were members of existing groups (schools) and those groups remained intact. These intact groups were randomly assigned to either the treatment or comparison group. A *t*-test analysis was conducted on LoTi pretest scores in addition to the TAC pretest scores to examine equal variance. Levene's test indicated equal variance at the $p > .05$ level.

There was no statistically significant difference between the means of the treatment group (PD with VCoP) and the comparison group (PD without VCoP) for either pretest. Therefore, equality of groups may be assumed.

Research Question One and Hypothesis One

To what extent and in what manner can teachers' attitudes toward technology (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

Non-directional hypothesis: Years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area will predict teachers' attitudes toward computers (interest, comfort, concern, utility, absorption, and significance).

Six stepwise multiple regression procedures were conducted with Teachers' Attitudes Toward Technology (TAC pretest: interest, comfort, concern, utility, absorption, and significance) as the dependent variables and years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area as the independent variables. As can be seen in Table 10, teacher's attitudes toward computers were highly correlated ($p \leq .05$) with technology professional development coursework. There was no correlation with years of teaching experience. Interest and primary department assignment were highly correlated ($p \leq .05$). Stepwise regression procedures were then followed to determine the extent of these relationships and to what degree prediction may be assumed. The inclusion level was set at the $p < .05$ level, allowing the predictors to be included in the equation only if they were significant at this

level, offering a strong confidence level in assumptions of the predicted variance of the

dependent variable, teachers' attitudes toward computers (Meyers, et al., 2006).

Table 10

Means, Standard Deviation, and Significance Levels for Teachers' Attitudes Toward

Computers Predictor Variables

Criterion Variables	Mean	SD	Years of Experience	Technology PD Coursework	STEM or Non-Stem Subject Area
Interest	4.495	0.560	.449	.000*	.050*
Comfort	1.458	0.513	.339	.005*	.377
Concern	1.834	0.350	.238	.002*	.205
Utility	4.419	0.498	.423	.007*	.214
Absorption	3.53	0.890	.264	.000*	.094
Significance	4.48	0.450	.354	.001*	.097

*($p \leq .05$)

Regression results are summarized in Table 10. Multiple *R* for regression was

statistically significant, F (1,109) =11.97, $p \leq .05$, R^2 adj = .092. One of the three

independent variables, technology professional development coursework, made a

significant contribution ($p \leq .05$) to the prediction of attitudes toward computers on all six

subscales interest, comfort, concern, utility, absorption, and significance. STEM or non-

STEM subject area made a significant contribution ($p \leq .05$) to the prediction of attitude

on the interest subscale. Years of experience did not make a statistically significant

contribution to the prediction of attitudes toward technology (six subscales).

The coefficient table of each model was examined to confirm tolerance values (>.01) and Variance Inflation Factor (VIF) (<10) statistics were within normal bounds, indicating there were no multicollinearity problems (Meyers et al., 2006, p. 212). Results of the regression analysis are presented in Tables 11 through 22. Each table provides a summary of stepwise multiple regression procedures followed for each of the dependent variables for teacher's attitudes toward technology and the independent variables years of experience, professional development in technology, and STEM or non-STEM subject area. Statistical significance was found between each of the dependent variables of interest, comfort, concern, utility, absorption, and significance and the independent variable of technology professional development coursework (see Tables 11 - 22). As no statistical significance was found between the dependent variables of interest, comfort, concern, utility, absorption, and significance and the independent variables of years of experience or STEM or non-STEM subject area, these variables were removed from the analysis, confirming no relationship exists.

Table 11

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Interest,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	3.187	1	3.187	10.925	.001[a]
Residual	32.091	110	.292		
Total	35.279	111			

Note: a. Predictors: (Constant), PD Experience in Technology

Table 12

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Attitude Toward Computers, Interest

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	4.282	.083		51.813	.000
Professional Development in Technology	.094	.028	.301	3.305	.001

Note: R^2 = .090

Table 13

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Comfort,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	1.555	1	1.555	6.069	.015[a]
Residual	28.176	110	.256		
Total	29.731	111			

Note: a. Predictors: (Constant), PD Experience in Technology

Table 14

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Comfort Toward Computers,

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	1.609	.077		20.779	.000
PD Experience in Technology	-.066	.027	-.229	-2.464	.015

Note: R^2: = .052

Table 15

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Concern,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	1.025	1	1.025	8.970	.003[a]
Residual	12.222	107	.114		
Total	13.246	108			

Note: a. Predictors: (Constant), PD Experience in Technology

Table 16

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Attitude Toward Computers, Concern

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	1.961	.052		37.901	.000
PD Experience in Technology	-.053	.018	-.274	-2.993	.003

Note: $R^2 = : .075$

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Table 17

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Utility,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	1.421	1	1.421	5.869	.017[a]
Residual	26.628	110	.242		
Total	1.421	1	1.421	5.869	.017[a]

Note: a. Predictors: (Constant), PD Experience in Technology

Table 18

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Attitude Toward Computers, Utility

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	4.274	.075		56.780	.000
PD Experience in Technology	.063	.026	.225	2.423	.017

$R^2 = .051$

Table 19

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Absorption,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	10.554	1	10.554	14.914	.000[a]
Residual	77.844	110	.708		
Total	88.399	111			

Note: a. Predictors: (Constant), PD Experience in Technology

Table 20

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Attitude Toward Computers, Absorption

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	3.156	.129		24.518	.000
PD Experience in Technology	.171	.044	.346	3.862	.000

Note: R^2: = .119

Table 21

Regression Analysis ANOVA for Teachers' Attitude Toward Computers, Significance,

According to Technology Professional Development Coursework

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	1.886	1	1.886	10.195	.002[a]
Residual	20.345	110	.185		
Total	22.231	111			

Note: a. Predictors: (Constant), PD Experience in Technology

Table 22

Regression Analysis Summary for Technology Professional Development Coursework

Variables Predicting Teachers' Attitude Toward Computers, Significance

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Significance
(Constant)	4.326	.066		65.745	.000
PD Experience in Technology	.072	.023	.291	3.193	.002

Note: R²: = .085

Research Question Two and Hypothesis Two

Are there significant differences in attitudes toward computers variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

Non-directional hypothesis: There will be a significant difference in attitudes toward computers between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice.

A multivariate analysis of variance (MANOVA) was conducted to compare teachers' attitudes toward computers on six different variables (interest, comfort, concern, utility, absorption, and significance) between teachers who had online professional development in technology and teacher who had online professional development in technology with VCoP.

A Wilk's Lambda or two-group between-subjects multivariate analysis of variance (MANOVA) was conducted on the dependent variable with, six levels: interest, comfort, concern, utility, absorption, and significance. The independent variable was online professional development with, two levels: online professional development in technology and online professional development in technology with VCoP. Evaluation of the properties of the data set (e.g., normality, equality of variance-covariance matrices) determined that these data met the necessary statistical assumptions to support the analyses. There was no significant effect of the independent variable, online professional development, Wilks' Lambda = .923, F (6, 102) = 1.414, p = .216. No statistically significant attitude effects ($p \leq .05$) were observed for group (online professional

development or online professional development in technology with VCoP) (See Table 23).

Table 23

Multivariate Analysis of Variance for Attitudes Toward Technology and Online Professional Development in Technology Group

Dependent Variable	F	Significance	Partial Eta Squared
Interest	1.668	.199	.015
Comfort	.036	.851	.000
Concern	2.543	.114	. 023
Utility	.303	.583	.003
Absorption	3.549	.062	.032
Significance	1.304	.256	.012

Research Question Three and Hypothesis Three

Is there a significant difference in content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

Non-directional hypothesis: There will be a significant difference in content integration between teachers who receive professional development online and those who receive professional development online with VCoP.

To determine whether there was a significant difference for each of the levels of content integration (Levels of Teaching Innovation, Personal Computer Use, and Current Instructional Practices), 3 two sample 4 x 2 Chi-Square Crosstabs were used. The Chi-

Square Crosstabs test is an appropriate nonparametric statistical test to determine if

significant differences existed beyond the .05 level between observed and expected

frequencies. In addition a Cramer's V, was used to determine strength of associations

after a Chi-Square analysis determined significance (Hinkel, Wiersma, & Jurs, 2003).

The four cells represent the collapsed version of the criteria used by the LoTi,

PCU and CIP. Although categories on a variable may be collapsed, they cannot be

excluded from a Chi-Square analysis. Therefore, this analysis did not arbitrarily exclude

a category of the response format of the LoTi, PCU or CIP from the analysis, but

systematically redefined the categories from a 6-point response format to a 4-pt format

for all 3 subscales (LoTi, PCU, and CIP). Tables 24-26 show these redefinitions for each

subscale. The decision to collapse categories was carefully motivated, with consideration

for preserving the integrity of the data as it was originally collected.

Table 24

Chi-Square Groups for Levels of Teaching Innovation (LoTi)

Level	Categories
1	0 (non-users), 1 (awareness), and 2 (exploration)
2	3 (infusion)
3	4a (integration-mechanical) and 4b (integration-routine)
4	5 (expansion), and 6 (refinement)

(Moersch, 2009)

Table 25

Chi-Square Groups for Personal Computer Use (PCU)

Level	Category
1	0 (Lack of desire/skill to use digital tools or resources for personal or professional use),
	1 (Awareness of digital tools and resources but little fluency of use for student learning)
2	2 (Little to moderate fluency using digital tools and resources for student learning)
3	3 (Moderate fluency using digital tools and resources for student learning; beginning regular use)
4	4 (Moderate to high fluency using digital tools and resources for student learning with expanding range; model safe, legal, ethical use),
	5 (High fluency using digital tools and resources for student learning; expanding range; advocacy),
	6 (High to extremely high fluency using digital tools and resources for student learning; sophisticated use; leadership role; reflective),
	7 (Extremely high fluency level using digital tools and resources for student learning; sophisticated use of existing and emerging technology; participate in global learning communities)

(Moersch, 2009)

Table 26

Chi-Square Groups for Current Instructional Practices (CIP)

Level	Category
1	0 (Not involved in formal classroom setting), 1 (Teacher directed, traditional, sequential and uniform subject-matter based approach; evaluation data not used to guide instruction)
2	2 (Teacher directed, traditional, sequential and uniform subject-matter based approach; evaluation data is used to guide instruction)
3	3 (Traditional, subject-matter based approach; use of student-directed projects with products based on modality strengths, learning styles, or interests; evaluation data serves as basis for curriculum decision-making.)
4	4 (Subject-matter or learning-based approach to instruction based on content; teacher role may shift to facilitator; student projects primarily student-directed; use of alternate assessment strategies are the norm; moderate differentiation), 5 (Instructional practice learner-based; diversified learning experiences include critical thinking and problem solving; substantial differentiation), 6 (Instructional practice learner-based; diversified learning experiences driven by student questions include critical thinking

Level	Category
	and problem solving; substantial differentiation; student
	performance assessed with a variety of instruments developed
	locally)
	7 (Exclusively learner-based approach to teaching and learning;
	critical thinking and problem-solving skills, diverse learning and
	teaching driven by student questions; student performance assessed
	with a variety of instruments developed locally)

(Moersch, 2009)

As previously stated under data analysis, independence of samples was demonstrated using the LoTi pretest scores. An assumption is that the expected frequencies should be greater or equal to five for 80% or more of the categories. This assumption was met and there were no cells with values of zero. Therefore, the assumptions for the Chi-Square statistical analysis were met.

The analysis of the 4x2 Chi-Square is reported for Levels of Teaching Innovation (LoTi), Personal Computer Use (PCU), and Current Instructional Practices (CIP) using an alpha level of $p \leq .05$. The critical value is based on the assumption of an a priori $\alpha = .05$ with $df = (3 - 1) = 2$. These findings revealed the differences in content integration between teachers who had online professional development and teachers who had online professional development with VCoP.

There is a statistically significant relationship between the observed and the expected number of Levels of Teaching Innovation (LoTi) for teachers who received professional development online with or without VCoP. Since the Chi-Square value of

8.82 exceeds the critical value of 5.991 the result is significant at the $p = .05$ level (see

Tables 27 and 28). There was no statistically significant relationship ($p > .05$) between

the observed and the expected number of levels of Personal Computer Use (PCU). The

Chi-Square value of 3.32 did not exceed the critical value of 5.991 (see Tables 29 and

30). There was no statistically significant relationship ($p > .05$) between the observed and

the expected number of levels of Current Instructional Practices (CIP). The Chi-Square

value of 2.39 did not exceed the critical value of 5.991 (see Tables 31 and 32). There

were no major contributors to the significance of the Chi-Square with standard residuals

higher than the absolute value of 2.

Table 27

Contingency Table for Levels of Teaching Innovation (LoTi) – 4x2 Chi-Square

LoTi	Treatment	Comparison	Chi-Square	Cramer's V Value
			8.82	.283
Level 1	27	34		
R=(O-E)/√E	.11	.01		
Level 2	9	13		
R=(O-E)/√E	.03	.29		
Level 3	4	5		
R=(O-E)/√E	.01	.01		
Level 4	14	3		
R=(O-E)/√E	.26	.42		

Table 28

Contingency Table for Personal Computer Use (PCU) – 4x2 Chi-Square

PCU	Treatment	Comparison	Chi-Square	Cramer's V Value
			3.32	.182
Level 1	34	21		
R=(O-E)/√E	.01	.33		
Level 2	13	11		
R=(O-E)/√E	.29	.03		
Level 3	5	17		
R=(O-E)/√E	.01	.26		
Level 4	3	5		
R=(O-E)/√E	.42	.05		

Table 29

Contingency Table for Current Instructional Practices (CIP) – 4x2 Chi-Square

CIP	Treatment	Comparison	Chi-Square	Cramer's V Value
			2.39	.182
Level 1	12	10		
R=(O-E)/√E	.01	.009		
Level 2	11	5		
R=(O-E)/√E	.001	.15		
Level 3	21	26		
R=(O-E)/√E	.007	.09		
Level 4	10	14		
R=(O-E)/√E	.03	.02		

Since each crosstab involves a nominal variable and an ordinal variable the appropriate measure of association is Cramer's V (see Table 33). Phi is not used because it is only appropriate for 2x2 tables. The Cramer's V value for the Levels of Teaching Innovation (LoTi) was .283 indicating a moderate relationship. This confirmed a significant difference in the level of content integration for teachers who received professional development online with VCoP in LoTi group for professional development online with VCoP. The Cramer's V values were .182 for both Personal Computer Use and Current Instructional Practices, confirming a small relationship with these levels of

content integration and online professional development for both groups with and without

VCoP.

Table 30

Effect Size Measure, Cramer's V

Level of Association	Verbal Description
.10	Small
.30	Medium
.50	Large

(Huck, 2008, p. 471)

Conclusion

The analysis in this chapter focuses on the effects of online professional

development in technology with Virtual Communities of Practice on teachers' attitudes

and integration. This analysis was conducted using data gathered from a sample of

practicing K-12 teachers ($n = 109$). Three research questions guided this analysis.

Research question one was explored using a stepwise regression to determine the

degree to which and the manner which teachers' attitudes toward technology could be

predicted by years of teaching experience, technology professional development

coursework, or STEM or non-STEM subject area. Results indicated that interest ($p = $

.000), comfort ($p = .005$), concern ($p = .002$), utility ($p = .007$), absorption ($p = .000$), and

significance ($p = .001$) could be predicted by technology professional development

coursework in technology. Years of experience did not predict teachers' attitudes toward

computers. STEM or non-STEM subject area was not found to predict teachers' attitudes

toward computers in the areas of comfort, concern, utility, absorption, or significance.

In research question two, a MANOVA (multivariate analysis of variance) was conducted to compare teachers' attitudes between those who had online professional development in technology with Virtual Communities of Practice and those who had online professional development in technology without VCoP. No statistical significance was found for either group in this analysis. Therefore, teachers' attitudes toward computers are affected in the same way, regardless of group. Both forms of online professional development in technology are of equal value.

Question three was examined using 3 two-sample Chi-Square crosstabs to investigate possible differences in content integration between teachers who received professional development online and those who had online professional development with VCoP. A statistically significant relationship between the observed and the expected number of Levels of Teaching Innovation (LoTi) for teachers who received professional development online with or without VCoP. The Chi-Square value (8.82) exceeded the critical value (7.815) producing a significant (p =.05) result. The Chi-Square value of 3.32 for Personal Computer Use (PCU) and 2.39 for Current Instructional Practices (CIP) are both below the critical value and thus indicated no significant relationship. There were no major contributors to the significance of the Chi-Square with standard residuals higher than the absolute value of 2. A Cramer's V posttest confirmed these findings, indicating a moderate (.283) relationship between teachers' content integration for the LoTi, and small relationships (.182) with the PCU and CIP. The moderate relationship between teachers' content integration as demonstrated on the LoTi indicates online professional development in technology with Virtual Communities of Practice resulted in a higher level of content integration than PD without VCoP.

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

Chapter Five provides a comprehensive summary of this research study as well as a discussion and conclusions that extend the prior four chapters of the research study. The Summary of the Study and Findings provides an overview of the entire inquiry and describes the data collection procedures and quantitative methods of analyses of the three research questions that guided this study. The Limitations to the Study section expands upon the limitations discussed in Chapter Three including limitations specific to this study that were beyond the researcher's control. The Implications section provides suggestions for using Virtual Communities of Practice for online professional development for teachers as a result of this study, along with the current literature on VCoPs, attitudes, and technology integration. Finally, the Future Research section explores future research topics that were raised during the course of this investigation.

Summary of the Study and Findings

This section provides an overview of the entire inquiry including data collection procedures and quantitative methods of analyses of the three research questions that guided this study.

Research Question One: To what extent and in what manner can teachers' attitudes toward technology (interest, comfort, concern, utility, absorption, and significance) be explained by years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area?

Six stepwise multiple regression procedures were conducted with teacher's attitudes toward computers (TAC pretest: interest, comfort, concern, utility, absorption,

and significance) as the dependent variables in six separate analyses and years of teaching experience, technology professional development coursework, and STEM or non-STEM subject area as the independent variables. Results indicated teacher's attitudes toward technology were predicted by technology professional development coursework ($p \le .05$) when each of the subscales served as a criterion variable. There was no significant relationship between the six predictor variables and years of teaching experience. Interest was predicted by primary subject area ($p \le .05$).

The importance of teachers' attitudes toward computers as a contributing factor to teachers' content integration use or non-use of technology in their teaching practice (Kluever, Lam, & Hoffman, 1994; Kutluca, 2010; Liu & Szabo, 2009) and the influence these attitudes have on teachers' perceptions of the role of technology and the likelihood of its adoption as a teaching tool (Al-Zaidiyenn, Mei, & Fook, 2010; Isleem, 2003; Knezek & Christensen, 2008; Liu & Szabo, 2009) has been well documented. This research study sought to expand upon current research to determine relationships between teachers' attitudes toward computers in an effort to identify the elements that would predict those with positive or negative relationships. The analysis of Teachers' Attitudes Toward Computers (TAC) pretest data indicated that technology professional development coursework was the greatest predictor of teachers' attitudes toward computers. Years of teaching experience, prior to their involvement in an online professional development course, did not have a significant effect on teachers' attitudes toward technology (Straub, 2009) nor did STEM or non-STEM subject area.

Teachers' attitudes toward technology, including interest, comfort, concern, utility, absorption, and significance, can be predicted by professional development in

technology. This finding reinforces the significant relationship between the positive use of technology by teachers and increased opportunities for professional development with a specific focus on technology. Identification of the specific subject was beyond the scope of this study.

The implication for educators and instructional leaders is that professional development does support teachers in developing positive attitudes regarding the use of computers for teaching and learning over the span of a teachers' career. This information used in conjunction with years of experience as a positive predictor of attitude toward computers would indicate that investment in professional development throughout a teachers' career is money well spent. Combining professional development in creative ways that take advantage of the attitudes of experienced teachers may be an effective way of building programs that are inherently grounded in collaboration between teaching staff of all ages that revolve around technology used for teaching and learning.

Research Question Two: Are there significant differences in attitudes toward computers variables (interest, comfort, concern, utility, absorption, and significance) between teachers who receive professional development online and those who receive professional development online with Virtual Communities of Practice?

A multivariate analysis of variance (MANOVA) was conducted to compare teachers' attitudes toward computers on six different variables (interest, comfort, concern, utility, absorption, and significance) between teachers who had online professional development in technology and teachers who had online professional development in technology with VCoP. A Wilk's Lambda or two-group between-subjects multivariate analysis of variance (MANOVA) was conducted on the dependent

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variable with six levels: interest, comfort, concern, utility, absorption, and significance. The independent variable was online professional development, two levels: online professional development in technology and online professional development in technology with VCoP. Evaluation of the properties of the data set (e.g., normality, equality of variance-covariance matrices) determined that these data met the necessary statistical assumptions to support the analyses. No statistically significant attitude effects ($p \leq .05$) were observed for group (online professional development with Virtual Communities of Practice or online professional development in technology without VCoP).

Literature reviewed for this research study focused on blended models of online and face-to-face or face-to-face professional development in technology (Adams, 2010 ; Al-Zaidiyenn, et al., 2010; Casale, 2011; Duncan-Howell, 2009; Isleem, 2003; Liu & Szabo, 2009; Keown, 2009a, Keown 2009b; Nicholas & Ng, 2009; Raulston, 2009). There were no research studies found comparing two types of online professional development models. However, Raulston (2009) reported that there was no one model that could account for teachers' concerns related to technology adoption due to the multitude of personalities, experiences, and theoretical beliefs held by teachers as a group. The findings of this research study support this notion. Straub (2009) suggested a need for research investigating how individuals understand, adopt, and learn technology outside of the formal organization, exploring informal voluntary methods to initiate adoption of technology. The need for this type of research continues to be of importance as researchers seek to determine the viability of flexible models for computer mediated instruction and social networking applications within a meaningful context (Dede, 2009;

Wenger, White & Smith, 2009). Continuing demands on teachers' personal and

professional lives will continue to focus attention on the importance of flexible work time

and ongoing opportunities for online professional development (Adams, 2010).

There were no significant differences in attitudes toward technology variables of

interest, comfort, concern, utility, absorption, or significance between teachers who

received professional development online and those who receive professional

development online with Virtual Communities of Practice. Therefore, it may be assumed

that both methods for online professional development were of equal value. This finding

supports online professional development and accommodates individual learning

preferences with the option to choose a learning environment that matches their comfort

level whether it is one-on-one instruction through email correspondence with a single

instructor or participation in a VCoP involving collaboration and knowledge building as a

member of an online community of learners.

Research Question Three: Is there a significant difference in content integration

(Levels of Teaching Innovation, Personal Computer Use, and Current Instructional

Practices) between teachers who receive professional development online and those who

receive professional development online with Virtual Communities of Practice?

The analysis of the three 4x2 Chi-Square is reported for Levels of Teaching

Innovation (LoTi), Personal Computer Use (PCU), and Current Instructional Practices

(CIP) using an alpha level of $p \leq .05$. These findings revealed the differences in content

integration between teachers who had online professional development and teachers who

had online professional development with VCoP.

There is a statistically significant relationship between the observed and the expected responses to the Levels of Teaching Innovation (LoTi) for teachers who received professional development online with or without VCoP. Since the Chi-Square value of 8.82 exceeded the critical value of 7.815 the result is significant at the $p \leq .05$ level. There was no statistically significant relationship ($p > .05$) between the observed and the expected number of levels of Personal Computer Use (PCU). The Chi-Square value of 3.32 did not exceed the critical value of 7.815. There was no statistically significant relationship ($p > .05$) between the observed and the expected number of levels of Current Instructional Practices (CIP). The Chi-Square value of 2.39 did not exceed the critical value of 7.815. There were no major contributors to the significance of the Chi-Square with standard residuals higher than the absolute value of 2. As a result, the Chi-Square analysis indicated that the group of teachers who received professional development online with Virtual Communities of Practice demonstrated the highest level of technology integration. These communities, created by people who shared a passion for integrating technology resources into practices for teaching and learning, personal productivity, and communication actively involved participants in sharing successes and challenges, solving problems, and supporting one another. These online resources can be grounded in the International Society for Technology and Education (ISTE) standards and integrated with K-12 curriculum based projects.

Implications

This research study provided additional evidence that can be used by teachers and school leadership to support life-long learning with the goal of impacting student knowledge gains and engage all learners through improvement in teaching practices

(ISTE, 2008; NSDC, 2010) as teachers participate as members of a Virtual Community of Practice. This is especially important as current research indicates that traditional forms of professional development are ineffective in developing new knowledge and affecting change in teaching and learning (Blackmore, 2000; Cochran-Smith & Lytle; 1999; Garet; Porter, Desimone, Birman & Yoon, 2001). Participation in such a community provides teachers with hours of participation that work with busy home and professional schedules to improve effectiveness and self-image (Day & Gu, 2007). Flexible time also affords teachers with opportunities to experiment with and reflect upon successful outcomes and experiences and to share these with members of the community (Barab, Jackson, & Piekarsky, 2006; Liu & Szabo, 2009).

When challenges that block integration are met (Cuban, 2001), teachers can seek support and use input from colleagues to make improvements. When teachers have time to process and practice new learning, the likelihood of successful integration of technology into meaningful opportunities for teaching and learning will be improved (Cochran-Smith & Lytle, 1999; Guskey, 1986; NSDC 2010; Shamir-Inbal et al., 2009). Context plays a key role in the acquisition of knowledge that makes successful integration of ICT possible. Learning to integrate technology that is situated within the context of the teacher's primary subject area with students and can be discussed with colleagues within the context of a VCoP (David & Cuban, 2010; Drexler, Baralt, & Dawson, 2008; Zhang, 2009)

Virtual Communities of Practice provide teachers with professional development that is sustained, taking place within the school day and beyond, and is meaningful because it occurs within the actual context and addresses the realities of teaching. In this

climate of budget cuts and reduced opportunities for participation in professional development, a VCoP offers a forum for personalized interaction with experts at no cost that is accessible anywhere there is an Internet connection. Reductions, such as time spent away from students and missed instruction combined with potential budgetary savings make this option significant from instructional and fiscal vantage points. Informal VCoP can play a critical role in the reduction of isolation by providing teachers with access to expertise beyond the school walls and the school day through social networking platforms that are freely available on the Internet. The VCoP offers a supportive community that encourages collaboration, knowledge building, and the sharing of best practices to positively impact teaching and learning.

Limitations to the Study

This Limitations section expanded upon the limitations discussed in Chapter Three by including limitations specific to this study that were beyond the researcher's control. Every effort was made to control elements of the research study from the onset whenever possible.

Threats to Internal Validity

Teachers' self-reporting of information is subjective. Teachers' may have reported information that did not necessarily match reality or the factors being analyzed. Self-reporting of information for all of the instruments in this study may be considered a limitation.

Experimental mortality, as documented in Chapter Three (see Table 10), resulted in the loss of participants from each Cohort over the nine months during which the study took place. These elements were beyond the control of the researcher.

Teachers who participated in this research study may have been those comfortable using technology to some degree. The true level of each participant's comfort and ability using technology was not known. Because this was a study investigating online professional development in technology, pre-existing knowledge and comfort using technology should be considered a limitation with regard to participation based upon email and wiki posts.

Suggestions for Future Research

Finally, this section explores future research topics that were raised during the course of this investigation. The recommendations presented here are by no means exhaustive. Rather, they present questions that may confirm or continue the investigation of topics related to online professional development in technology with Virtual Communities of Practice on teachers' attitudes and integration.

A study that replicates the format and structure used for this research study, but expands the content and time frame of the course for a longer period of time would provide a better indication of the implications for providing effective professional development using VCoP. The longer time period would provide participants with the opportunity to truly participate as a community of learners. The relationships that form, the patterns of communication, levels of trust and confidence, the projects and lessons developed and integration of technology would contribute to the growing knowledge base on VCoP for teacher professional development. It also would be of interest to learn if the longer period of engagement and support would impact Computers for Instructional Purposes and/or Personal Computer Use.

It is interesting to note, that during the review of the literature, studies found using an online Virtual Communities of Practice for teacher professional development used a blended version that combined face-to-face contact with some asynchronous online work. These researchers developed collaboration and participation in the style of Lave and Wenger's CoP mixed with an online component. No studies were found with a focus on informal VCoP with entirely asynchronous communication. This raises the question as to whether participation in a fully VCoP, taking place entirely online, would provide participants with a different learning experience but with similar success in terms of the integration of the subjects studied. If the fear is the absence of face to face contact, perhaps an online video conferencing platform or an audio platform could be entered into the mix.

Another interesting study would examine the differences between formal and informal VCoP, using the same or a similar format as was used in this research study. This would be possible comparing established formal VCoP such as The Math Forum (Renninger & Shumar, 2004) or Tapped In (Schlager, Fusco, & Schank, 2004) with a VCoP that is structured informally. Or, a comparison of platforms used for delivery, a formal platform such as BlackBoard or an informal platform such as a wiki, blog, and/or ning would provide information as to ease of access, learning environment, and levels of participation. The impact on teachers' attitudes and content integration would be interesting. Time spent on each of these learning platforms that included time of day and duration of time spent over the span of the course could provide valuable information regarding the time spent on online PD in each of these formats and how these factors relate to technology integration and student centered learning.

Research regarding the use of personal learning networks compared with an informal VCoP for teachers' professional development would also be of interest. As both options are informal learning networks, the levels of participation on each and how this participation lends itself to effective professional development would provide information on just-in-time PD in addition to ongoing PD. Access to these resources from school would also be of interest, as many schools maintain strict filters on Internet sites, particularly social networking sites.

A comparison of a mandatory VCoP with a voluntary VCoP and levels of integration and effect on attitude would provide evidence of the need for PD time within and/or outside of a teacher's normal work day. Levels of participation, collaboration, and impact on teaching and learning could be explored. Again, an examination of the time of day, number of hours of participation, impact on lesson development, assessment, and ability to attend to diverse learning needs could provide valuable information for teachers' online professional development. Use of standardized assessments to determine the impact on student learning would also be of interest.

It would also be valuable to study teacher preference of platforms used for professional development. A comparison of a variety of online, face-to-face, and blended models would provide rich information that could be used by administrators and staff to determine how to engage teachers in life-long learning throughout the many phases of their career to benefit student achievement. This information could be used in conjunction with standardized test scores to determine effectiveness of student outcomes.

The call for more rigorous longitudinal quantitative research in education can be applied to the study of VCoP. The random assignment of diverse samples would further

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the knowledge of online professional development. Discovering the implications that learning as a member of a community of learners drawn from a pool of teachers from around the globe will help to determine the potential of VCoP specifically for K-12 teacher education.

Summary

With so many demands on a teacher's time throughout the school day, it becomes a challenge to keep pace with changes to content area curriculum, new mandates, ever-changing initiatives, standardized assessments, and new forms of evaluation. It has been thirty years since educational reforms began and it looks as though restructuring will be unending, especially in the area of technology. Dedicating precious time to meaningful professional development is extremely challenging. Professional development that is worthwhile, provides collaborative support, is ongoing, and situated within the context of a teacher's position is not the typical offering at in-district conference days. With shrinking budgets to fund off-site professional learning, options seem limited.

A thorough investigation of the effects of online professional development in technology with Virtual Communities of Practice on teachers' attitudes and integration revealed that teachers are willing to make adaptations and learn new ways of updating their professional skills within their curriculum areas in regard to technology and content integration when opportunities are presented to them by researchers around the world. As a community formed with experts across grade levels and across curriculum areas, VCoP can provide a viable method for teachers around the world to gather together to form an online community with a shared vision of integrating appropriate technology into curriculum based lessons. There is so much expertise among teaching professionals that

goes untapped among colleagues that could be channeled into a VCoP. Gathering as a

community of learners in a VCoP can provide the opportunity for sustained professional

development at little or no cost. The findings of this research study indicated that

professional development is the great equalizer when it comes to teachers' attitudes about

technology and content integration. All teachers, no matter what phase of life or level of

technology experience, can share their expertise and gain new insights through

participation in a Virtual Community of Practice. Our students are depending on it.

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Appendix A: Teachers' Attitudes Toward Computers Instrument

The Teachers' Attitudes Toward Computers Questionnaire by Dr. Rhonda Christensen and Dr. Gerald Knezek (2009) is constructed of 35 questions with a five point Likert-like response scale ranging from Strongly Disagree to Strongly Agree and semantic differential scale. Questions that used the semantic differential scale were not included in this research study. Sample questions appear below.

Sample Questions:

I want to learn a lot about computers

I would like to learn more about computers

Working with a computer makes me feel tense and uncomfortable

(Christensen & Knezek, 2009, p. 146)

Appendix B: Levels of Technology Innovation Survey

The Levels of Technology Innovation Framework by Dr. Christopher Moersch (2009) contains questions with responses recorded on a Likert-like scale from 0 (Not True of Me Now) to 7 (Very True of Me Now). Sample questions appear below.

Sample Questions:

I would like to use classroom computer(s) but do not have the time

I am not comfortable using a computer

I prefer to use existing curriculum units that integrate the classroom computer(s) with authentic assessments and student relevancy rather than building my own units from scratch

(Schechter, 2000, p. 119)

Appendix C: Researcher-designed Demographic Survey

Please select the response that **<u>best</u>** describes you. Your answers will remain confidential.

Age

_____21-25

_____26-30

_____31-35

_____36-40

_____41-45

_____46-50

_____51-55

_____56-60

_____60-65

_____65-70

Years of Service

_____1-5

_____6-10

_____11-15

___16-20

___21-25

___26-30

___31-35

___36-40

___41-45

Number of classes or workshops you have taken in computer technology

___1-5

___6-10

___11-15

___16-20

___21-25

___26-30

Curriculum Area: the area in which you spend the largest portion of your day

___English

___Math (STEM)

___Science (STEM)

___Technology (STEM)

___Social Studies

___Art

___Music

___Home and Careers

___Physical Education

___Health

___Occupational Therapy

___Speech

___Reading

___Library Media Center

___ Special Education

___Other

Appendix D: Description of the VCoP Treatment and Content

Description of the VCoP Treatment and Technology Content

As stated in the Potential Benefits of the Research, this study provided participating teachers in the treatment and comparison groups with modules they used to learn six online resources and applications within the context of their current classroom practice. Individual teachers were required to create a product for each module that they integrated into their practice within the context of their curriculum area for personal productivity or as a resource for teaching and learning. The ISTE NETS for Students and Teachers was available to participants in both groups.

Participants in the VCoP (treatment group) were expected to work collaboratively as they share ideas and seek assistance from community members through asynchronous written communication on the treatment group wiki. Participation were initiated and nurtured through the posting of reflective questions by the researcher, acting as facilitator. Reflective questions were designed to assist in the development of discussions focused on the understanding, application, implementation, and evaluation of each application or resource presented in every module. Members explained how they used applications or resources within the context of their teaching practice in their particular grade level and curriculum area. They shared resources and finished products with one another. They were encouraged to take risks and experiment with the technology presented in each module to positively impact teaching and learning, communication, and personal productivity. As a result, they built a supportive collaborative environment with a shared purpose and common goals as they worked together to integrate appropriate uses of technology.

The six week professional development module schedule, in which both groups

receive professional development but one participates in a Virtual Community of

Practice, is outlined in the table that follows.

Overview of Treatment and Comparison Groups by Week

Date	Module	Group	Process	Product	Category
October 25	Introduction to PD; Conducting effective searches; Search engines	Group A	Link to treatment group wiki; Intro; Written directions on how to post comments to treatment wiki; Slideshare: Conducting searches; Annotated list of links to search engines; VCoP	Reflect and comment on treatment wiki: What was your favorite search engine and why? What did you learn about search engines/searching that you did not know before? How can you apply this new knowledge in teaching and learning?	Resource for teaching and learning; Personal productivity; Reflection
		Group B	Link to comparison group website; Intro; Slideshare: Conducting searches; Annotated links to search engines	Reflection email to instructor comment on favorite search engine: What was your favorite search engine and why? What did you learn about search engines and searching that you did not know before? How can you apply this new knowledge in teaching and learning?	Resource for teaching and learning; Personal productivity; Reflection

Date	Module	Group	Process	Product	Category
November 1	Internet Safety Resources; Wikis	Group A	Q & A; Tutorial; Exemplar; Reflection; VCoP	Create Wiki	Communication; Collaboration; Personal productivity; Resources for Teaching and Learning
		Group B	Q & A; Tutorial; Exemplar; Reflection	Create Wiki	Communication; Collaboration; Personal productivity; Resources for Teaching and Learning

Date	Module	Group	Process	Product	Category
November 15	Thinkfinity & Bookmarking	Group A	Q & A; Tutorial; Exemplars; Reflection; VCoP	Resource list to support content area teaching and learning; Create Delicious account; Collaborate through Groups; Social networking; Tagging .	Resources for Teaching and Learning Collaboration; Personal productivity; Resources for Teaching and Learning
		Group B	Q & A; Tutorial; Exemplars; Reflection	Resource list to support content area teaching and learning; Create Portaportal account.	Resources for Teaching and Learning Personal productivity; Resources for Teaching and Learning

Date	Module	Group	Process	Product	Category
November 29	Wordle	Group A	Q & A; Tutorial; Exemplars; Reflection; VCoP	Wordle; Reflection post	Resources for Teaching and Learning; Communication
		Group B	Q & A; Tutorial; Exemplars; Reflection	Wordle; Reflection post	Resources for Teaching and Learning; Communication
December 6	Storybird or Mixbooks	Group A	Q & A; Tutorial; Exemplars; Reflection; VCoP	Storybird or Mixbooks; Reflection	Collaboration; Communication; Resources for teaching and learning
		Group B	Q & A; Tutorial; Exemplars; Reflection	Storybird or Mixbooks; Reflection	Collaboration; Communication; Resources for teaching and learning

Date	Module	Group	Process	Product	Category
December 13	Glogster	Group A	Q & A; Tutorial; Exemplars; Reflection; VCoP	Glogster; Reflection	Collaboration; Communication; Resources for teaching and learning
		Group B	Q & A; Tutorial; Exemplars; Reflection	Glogster; Reflection	Collaboration; Communication; Resources for teaching and learning

Appendix E: Information Overview Cover Letter and Consent Form,

Superintendent or Director

From: Donna Baratta, EdD Candidate Instructional Leadership, Western Connecticut State University

Re: Research Study Information

As a doctoral candidate at Western Connecticut State University, I am preparing to launch a dissertation research study. The purpose of the research study is to investigate the effects of online professional development in technology on teachers' attitudes and content integration. Participating teachers will participate in online learning modules for professional development in technology. Each module uses dynamic, high quality, Internet based resources focused on personal productivity, product creation, or communication. The learning modules provide a wonderful opportunity for teachers of all experience levels to develop engaging activities using cutting edge technology. Upon completion of the modules, teachers will have designed products that are ready for seamless integration into their teaching repertoire. It is anticipated that the professional development will take a minimum of 15 hours to complete. All resources and modules are available free of cost. Teachers will complete pre- and post-tests.

At this time, I invite your teachers to participate in this research study. Details of the study are listed below.

Research Timeline:
        Dissertation Proposal Defense September 29, 2010
        Institutional Review Board Approval Received: October 15, 2010
        Consent forms to teachers: October 25, 2010; Forms returned by November 4, 2010
        Module delivery, participation, pre- and post-tests: November 8, 2010 – December 17, 2010
        All content will be delivered online.
        All instruments will be completed online.
        All communication will take place online.

Attached please find a consent letter for the school administrator and consent letters for teachers. Please be so kind as to distribute the letters, as appropriate, via email. Electronic signatures are acceptable. Simply "sign" by typing your name and the information requested on the space provided. All consent forms may be submitted via email to techpdresearch@gmail.com.

I will report research findings upon the conclusion of the research study to participating districts, upon request. It is my hope that findings will assist district personnel in the development of online professional development offerings.

I would be happy to answer any questions you may have via email at techpdresearch@gmail.com.

I thank you in advance for your continued support.

Donna Baratta
Western Connecticut State University
techpdresearch@gmail.com

Dear Administrator,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of the study is to investigate the effects of online professional development in technology on teachers' attitudes and content integration.

Teachers will participate in online learning modules for professional development in technology. Each module uses dynamic, high quality, Internet based resources focused on personal productivity, product creation, or communication. The learning modules provide a wonderful opportunity for teachers of all experience levels to develop engaging activities using cutting edge technology. Upon completion of the modules, teachers will have designed products that are ready for seamless integration into their teaching repertoire. All resources and modules are available free of cost. Two instruments will be used in this study. The Teachers' Attitudes Toward Technology (TAC) and the Levels of Technology Innovation Digital Age Survey. All surveys will be completed online and will take approximately 45 minutes.
This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. Results of this study will enable educators to better understand professional development options online. Participation in this study is completely voluntary. The questionnaires are coded to ensure that all responses will be held strictly confidential.

In preparation for my study, I have contacted administrators throughout Westchester, Rockland and Connecticut, in addition to International Schools to determine interest in participation.

Participation in this study is completely voluntary. **The questionnaires are coded to ensure that all responses will be held strictly confidential. Individual teacher responses will not be made available.**
Thank you for your cooperation and contribution to this research study.
Sincerely,
Donna Baratta

Superintendent Signature _____ Date _____
District _____
Please return this form, via email to techpdresearch@gmail.com

Appendix F: Cover Letter and Consent Form, Principal

Donna Baratta
Western Connecticut State University
techpdresearch@gmail.com

Dear _____,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of the study is to investigate the effects of online professional development in technology on teachers' attitudes and content integration.

Teachers will participate in online learning modules for professional development in technology. Each module uses dynamic, high quality, Internet based resources focused on either personal productivity, product creation, or communication. The learning modules provide a wonderful opportunity for teachers of all experience levels to develop engaging activities using cutting edge technology. Upon completion of the modules, teachers will have designed products that are ready for seamless integration into their teaching repertoire. All resources and modules are available free of cost. Two instruments will be used in this study. The Teachers' Attitudes Toward Technology (TAC) and the Levels of Technology Innovation Digital Age Survey. All surveys will be completed online and will take approximately 45 minutes.

This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. Results of this study will enable educators to better understand professional development options online. Participation in this study is completely voluntary. The questionnaires are coded to ensure that all responses will be held strictly confidential.

In preparation for my study, I have contacted principals throughout Westchester, Rockland and Connecticut, in addition to International Schools to determine interest in participation.

Participation in this study is completely voluntary. **The questionnaires are coded to ensure that all responses will be held strictly confidential. Individual teacher responses will not be made available.**

Thank you for your cooperation and contribution to this research study.

Sincerely,

Donna Baratta

Principal Signature _____ Date _____

Appendix G: Cover Letter and Consent Form, Teacher

Donna Baratta

Western Connecticut State University techpdresearch@gmail.com

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Dear Teacher,

I am currently enrolled in the doctoral program for Instructional Leadership at Western Connecticut State University. This program requires that I design and implement a dissertation research study. The purpose of the study is to investigate the effects of online professional development in technology on teachers' attitudes and content integration.

Participating teachers will participate in online learning modules for professional development in technology. Each module uses dynamic, high quality, Internet based resources focused on either personal productivity, product creation, or communication. The learning modules provide a wonderful opportunity for teachers of all experience levels to develop engaging activities using cutting edge technology. Upon completion of the modules, teachers will have designed products that are ready for seamless integration into their teaching repertoire. All resources and modules are available free of cost. Two instruments will be used in this study. The Teachers' Attitudes Toward Technology (TAC) and the Levels of Technology Innovation Digital Age Survey. All surveys will be completed online and will take approximately 45 minutes.

This research study has been reviewed and approved by Western Connecticut State University's Institutional Review Board. Results of this study will enable educators to better understand professional development options online.

Participation in this study is completely voluntary. **The questionnaires are coded to ensure that all responses will be held strictly confidential. Individual teacher responses will not be made available.**

Thank you for your cooperation and contribution to this research study. Please read the attached consent form, and provide your consent by returning the form to me via email, with your name typed on the participant signature line.

Sincerely,

Donna Baratta

Participant Signature _____ Date _____

School Name: _____Preferred email address: _____