MANAGING CHANGE: THE MEASUREMENT OF TEACHER SELF-EFFICACY IN TECHNOLOGY-ENHANCED STUDENT-CENTRED LEARNING ENVIRONMENTS

By

LUCY MARY FERREIRA

A thesis submitted in partial fulfilment of the requirements of the degree of

MASTER OF ARTS

in

LEARNING AND TECHNOLOGY

We accept the thesis as conforming to the required standard

******************************************************************************
Jennifer Walinga, PhD, Academic Supervisor

******************************************************************************
G. B. Henderson, M. Ed., External Reader/Examiner

******************************************************************************
Alice MacGillivray, PhD, Committee Chair

ROYAL ROADS UNIVERSITY

August 2013

© Lucy Ferreira, 2013
The aim of this research was to create a reliable and valid measure of teacher self-efficacy in relation to the use of technology for student-centred learning. This study introduces two scales, the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES) and the Student-Centred Use of Technology Teacher Outcome Expectancy Scale (SCUTTOES) for development. This study focused on the initial stages of development which involved the comparison of the two scales with an existing measure of efficacy, the Teachers’ Sense of Efficacy Scale (TSES) as a preliminary test for validity. The surveys were distributed to teachers in the Lower Mainland region of British Columbia, and the responses were analyzed for reliability, validity, and factor structure. The instruments were found to be valid measures, although further testing with larger sample sizes is recommended. Based on the results, a professional development program is suggested to raise teacher efficacy for the use of technology in student-centred learning.
TABLE OF CONTENTS

ABSTRACT ........................................................................................................... 2

LIST OF TABLES ................................................................................................. 5

LIST OF FIGURES ............................................................................................... 6

CHAPTER ONE: BACKGROUND TO THE STUDY ............................................... 7
  Theoretical Framework ....................................................................................... 8
    Social cognitive theory ....................................................................................... 8
    Self-efficacy theory ......................................................................................... 9
  Teacher Efficacy ................................................................................................. 10
  Research Questions ........................................................................................... 11
  Limitations ......................................................................................................... 12
    Factor analysis ................................................................................................. 12
    Online survey .................................................................................................. 13
  Delimitations ....................................................................................................... 14
  Definition of Key Terms ..................................................................................... 14
  Chapter Summary ............................................................................................. 17

CHAPTER TWO: LITERATURE REVIEW ............................................................ 19
  Social Cognitive Theory and Organizational Change ....................................... 19
    The role of teacher self-efficacy in managing change .................................... 21
    Strengthening self-efficacy ............................................................................. 23
  Changes in Technology ..................................................................................... 24
    Constructivist learning theory ....................................................................... 26
    Constructivist pedagogy .................................................................................. 27
    Collective efficacy through supportive school culture .................................. 29
  Changes in teachers’ roles ............................................................................... 30
  Measurement of Teacher Self-Efficacy ............................................................. 31
    Conceptual constraints .................................................................................... 31
    Constructing teacher efficacy scales ............................................................. 33
  Outcome expectancies ....................................................................................... 34
  Chapter Summary ............................................................................................. 35

CHAPTER THREE: METHODS ........................................................................... 37
  Research Design ............................................................................................... 37
  Creating the Self-Efficacy Instrument ............................................................... 39
  Research Participants ....................................................................................... 44
  Data Analysis .................................................................................................... 46
    Reliability ........................................................................................................ 46
    Validity ............................................................................................................ 47
    Descriptive analyses ....................................................................................... 47
    Factor analysis ............................................................................................... 48
  Chapter Summary ............................................................................................. 48
CHAPTER FOUR: RESULTS .................................................................................................................................49
Description of the Sample ............................................................................................................................49
Efficacy Expectations for Technology-Enhanced Student-Centred Learning ......................................................50
Outcome Expectations for Technology-Enhanced Student-Centred Learning .....................................................54
Reliability, Validity, and Factor Structure of the SCUTTES, SCUTTOES, and TSES ...............................56
   Reliability of the SCUTTES, SCUTTOES, and TSES survey instruments ....................................................56
   Validity of the SCUTTES and SCUTTOES instruments .............................................................................57
Factor Analysis of the SCUTTES ....................................................................................................................58
Qualitative Data ...........................................................................................................................................60
   Lack of resources .........................................................................................................................................61
   Training .....................................................................................................................................................61
   Policy .......................................................................................................................................................62
Chapter Summary ......................................................................................................................................62

CHAPTER FIVE: DISCUSSION, RESEARCH IMPLICATIONS AND RECOMMENDATIONS ...........................................65
Discussion of Survey Results ..........................................................................................................................65
   SCUTTES results .......................................................................................................................................66
   SCUTTOES results .....................................................................................................................................67
Limitations of the Research ............................................................................................................................69
Application of Survey Findings .......................................................................................................................72
   Mastery modeling .......................................................................................................................................72
   Suggestions for implementation ..................................................................................................................75
   Perceived challenges to the implementation of change ...............................................................................77
Chapter Summary ......................................................................................................................................78

REFERENCES ...............................................................................................................................................82

APPENDIX A: THE ISTE NETS STANDARDS FOR ADMINISTRATORS .................................................................87

APPENDIX B: THE ISTE NETS STANDARDS FOR STUDENTS ........................................................................89

APPENDIX C: THE ISTE NETS STANDARDS FOR TEACHERS ........................................................................91

APPENDIX D: THE STUDENT-CENTRED USE OF TECHNOLOGY TEACHER EFFICACY SCALE .........................93

APPENDIX E: THE STUDENT-CENTRED USE OF TECHNOLOGY TEACHER OUTCOME EXPECTANCY SCALE (SCUTTOES) ..............................................................98

APPENDIX F: INVITATION LETTER TO SCHOOL DISTRICTS .......................................................................100

APPENDIX G: INFORMED CONSENT DOCUMENT .....................................................................................103
LIST OF TABLES

Table 1  Features of Student-Centred Learning Environments ..................................................28

Table 2  Positive and Negative Outcome Expectancies of Using Technology for Student-Centred Learning .................................................................................................................41

Table 3  Grouping Efficacy Expectancies by Outcome Expectancy ...........................................43

Table 4  Demographic Information of Survey Participants ................................................................50

Table 5  Efficacy Expectations of Teachers as Measured by the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES) ...........................................................................51

Table 6  Efficacy Expectations of Teachers as Measured by the Teachers’ Sense of Efficacy Scale (TSES) ......................................................................................................................53

Table 7  Outcome Expectations of Teachers as Measured by the Student-Centred Use of Technology Outcome Expectancy Scale (SCUTTOES) ..............................................................55

Table 8  Mean, Standard Deviation, and Cronbach’s Alpha for the SCUTTES and its Subscales ...............................................................................................................................60
LIST OF FIGURES

Figure 1. Triadic reciprocal causation. .................................................................20

Figure 2. Representation of the difference between efficacy expectations and outcome expectations. ........................................................................40
CHAPTER ONE: BACKGROUND TO THE STUDY

Student-centred learning facilitated by the adoption of technology in the classroom has been identified as one of the key goals of the British Columbia education plan (Abbott, 2011). Across North America, significant resources have been spent equipping schools with computer hardware and software, and training teachers on the integration of technology in their classrooms (Palak & Walls, 2009). Despite this investment in tools and training, the adoption of new teaching practices to reflect the change from a teacher-centred to a student-centred model of instruction have been slow to materialize (Keengwe, Onchwari, & Wachira, 2008). Although teachers use technology in their practice, it is primarily used for “preparation, administration, and management purposes . . . [and rarely used to facilitate] student-centered pedagogy even among teachers who work in technology-rich schools and are comfortable with technology” (Palak & Walls, 2009, p. 436). Research has suggested that intrinsic factors, such as beliefs, confidence, and commitment, have a greater impact than extrinsic factors, such as access to technology, support, and time, in determining whether a teacher will use technology for student-centred learning (Ertmer, Ottenbreit-Leftwich, & York, 2007).

One such intrinsic factor is efficacy, defined as a teacher’s “judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated” (Tschannen-Moran & Woolfolk Hoy, 2001, p. 783). Teachers with high efficacy tend to experiment with methods of teaching to meet their students’ needs, spend more time planning, persist longer with students who struggle, and promote achievement, efficacy, and motivation in their students (Henson, Kogan, & Vacha-Hasse, 2001). Teacher self-efficacy varies in different contexts as teachers may exhibit different levels of efficacy depending on the subject, student population, or school environment.
(Tschannen-Moran & Woolfolk Hoy, 2001). Chen (2010) found efficacy to be the most important determinant of the extent to which pre-service teachers integrate technology for student-centred learning into their practice. Currently, no valid and reliable instrument for measuring teacher self-efficacy in relation to the use of technology for student-centred learning exists. It was the aim of this research to create a preliminary instrument that could be used to measure teacher self-efficacy regarding the use of technology for student-centred learning and to test this instrument for reliability and validity. The following section outlines the theoretical framework for self-efficacy research.

**Theoretical Framework**

There is increasing “recognition of the need for systemic transformation in education”, which will result in redefinitions of the roles of teachers, students, and schools (Watson & Reigeluth, 2008, p. 43). As education transforms, teachers will need to adjust their teaching methods to reflect the change from an industrial age society to an information age society (Watson & Reigeluth, 2008). The “traditional, rigid, ‘one size fits all’ design of schools . . . [will likely change to] more personalized, student-centred designs to meet the needs of an increasingly diverse student population” (Education Development Center, 2011, p. 9). As schools change so will the role of teachers, and ensuring that teachers are able to make the necessary changes to their teaching behaviour is an important component of educational reform.

**Social cognitive theory**

Social cognitive theory provides a theoretical framework to explain how “changes in behaviour produced by different methods of treatment derive from a common cognitive mechanism” (Bandura & Adams, 1977, p. 288). This common cognitive mechanism serves as a means of “creating and strengthening expectations of personal efficacy” (Bandura, 1977, p. 193).
Social cognitive theory assumes that “people are capable of human agency, or the intentional pursuit of courses of action” (Henson, 2001, p. 3), and that this agency operates through a process called triadic reciprocal causation. The model of reciprocal causation is based on the assumption that human agency results in “future behavior as a function of three interrelated forces: environmental influences, our behavior, and internal personal factors such as cognitive, affective, and biological processes” (Henson, 2001, p. 3). According to social learning theory, people are neither completely autonomous nor influenced entirely by their external environment (Bandura, 1989). Instead, behaviour is governed by the “dynamic interplay between the external, the internal, and our current and past behavior” (Henson, 2001, p. 3). Human agency as defined by social cognitive theory is “mediated by our efficaciousness, . . . [and] self-efficacy beliefs influence our choices, our effort, our persistence when facing adversity, and our emotions” (p. 4).

**Self-efficacy theory**

Self-efficacy can be defined as “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 3). The level of an individual’s perceived self-efficacy affects their “choice of activities and behavioral settings, how much effort they expend, and how long they will persist in the face of obstacles and aversive experiences” (Bandura & Adams, 1977, p. 287). People with high self-efficacy set high goals for themselves and demonstrate more commitment towards achieving these goals (Bandura, 1989). They also persevere longer in the face of obstacles and tend to focus on successful outcomes rather than dwelling on how things may go wrong (Bandura, 1989).

Self-efficacy has been demonstrated to be a strong predictor of both current behaviour and the effect of treatments on behaviour change (Bandura, 1977; Henson, 2001). Expectations
of personal efficacy stem from four major sources of information: (a) performance accomplishments, (b) vicarious observation, (c) verbal persuasion, and (d) states of physiological arousal that indicate anxiety or stress in relation to the task (Bandura & Adams, 1977). Bandura (1977) theorized that there are two components to a person’s efficacy: (a) outcome expectancy and (b) efficacy expectation. An outcome expectancy is “defined as a person’s estimate that a given behaviour will lead to certain outcomes; . . . [whereas an efficacy expectation is] the conviction that one can successfully execute the behaviour required to produce the outcomes” (Bandura, 1977, p. 193). Individuals may believe that a certain course of action will lead to positive outcomes (i.e., outcome expectation), but if they do not think they can consistently perform this action (i.e., efficacy expectation), then they will not initiate the required behaviours (Bandura, 1977). Because a person’s behaviour can be influenced by both efficacy and outcome expectations, this research aimed to address both aspects in relation to technology-enhanced student-centred learning.

**Teacher Efficacy**

Bandura’s (1977) theory of efficacy can be applied to the construct of teacher self-efficacy. Outcome expectancy reflects “the extent to which students can be taught given such factors as family background, IQ, and school conditions” (Gibson & Dembo, 1984, p. 570). Efficacy expectations in teaching correspond to “teachers’ evaluation of their own abilities to bring about positive student change” regardless of environment (p. 570). Studies of teacher self-efficacy have frequently determined that there are two separate dimensions that contribute to efficacy. There is general agreement that the first factor is a measure of the teacher’s efficacy expectations, or personal teaching efficacy (Tschannen-Moran & Woolfolk Hoy, 2001). There is less agreement on the meaning of the second factor, but it is often referred to as general teaching
efficacy and correlates loosely with Bandura’s notion of outcome expectancy (Tschannen-Moran & Woolfolk Hoy, 2001).

Social cognitive theory and self-efficacy theory are the underlying theoretical frameworks on which the study of teacher self-efficacy is based. Since self-efficacy is an accurate predictor of behaviour as well as changes in behaviour following an intervention, a tool that can accurately measure efficacy with regard to the desired behavioural change is necessary. As teachers will need to change their instructional behaviour to move from a teacher-centred to student-centred learning paradigm, the ability to measure teacher self-efficacy in their ability to institute student-centred learning with technology is an important component of educational reform. This research is a preliminary step towards the measurement of teacher efficacy on tasks related to technology-enhanced student-centered learning.

**Research Questions**

This study aimed to answer the following questions:

1. What are the efficacy expectations of teachers in relation to their ability to execute the practices of technology-enhanced student-centred learning? How do these expectations compare with efficacy expectations for traditional teaching tasks?

2. Do teachers primarily associate positive or negative outcomes with technology-enhanced student-centred learning?

3. What is the factor structure of the self-efficacy scale developed in this study?

4. What is the relationship between teachers’ self-efficacy and outcome expectancy beliefs in relation to technology-enhanced student-centred learning environments?
Limitations

For this research, I used a primarily quantitative methodology in which participants were asked to respond to efficacy statements using a 9-point Likert scale. The survey was first examined for content validity by a panel of experts. The revised survey was then distributed to approximately 300 teachers in the Lower Mainland through Survey Monkey, an online survey tool. The same respondents were also asked to complete an online version of the Teacher’s Sense of Efficacy Scale (TSES) as well as a survey measuring their outcome expectancies for technology-enhanced student-centred learning. The survey also included an optional comments section that provided qualitative data. The factor structure of the new survey instrument was then determined in order to make recommendations for professional development priorities. There were several limitations associated with the use of both factor analysis and an online survey.

Factor analysis

Factor analysis is a statistical method that is used to investigate whether a number of observable factors are linearly related to a smaller number of unobservable factors (Tryfos, 1997). Factor analysis has been used in the development of nearly all previous teacher self-efficacy scales; therefore, it was an appropriate methodology for the development of the teacher self-efficacy scale in using technology to promote student-centred learning proposed by this study. However, factor analysis does have some methodological limitations that are important to note. First of all, there are several methods of obtaining factor solutions, and each method may give rise to an entirely different interpretation of the results (Tryfos, 1997). Most studies of teacher self-efficacy have used the eigenvalue rule (i.e., to retain only those factors with eigenvalues greater than one) and the scree test to determine the number of significant factors to retain following initial factor analysis (Henson, 2001). Both rules can lead to mistaken
conclusions about the number of factors present, as the eigenvalue rule tends to overestimate the number of factors, and the scree test is often subjective to the researchers’ own biases towards their findings (Henson, 2001). To help address these issues, both the eigenvalue rule and the scree test were applied to the factor analysis and the conclusions were drawn from a comparison of the results from both techniques.

**Online survey**

The distribution of the survey instrument from the online platform of Survey Monkey may have also contributed to error in the results of this study. Not all respondents may have been sufficiently computer literate to complete the survey online, leading to a potential sampling bias (Dillman, as cited in Archer, 2003). This was partially addressed by including only teachers employed in schools that have purchased technological equipment in the past five years. It was assumed that the use of technology in the school environment would have provided the majority of invitees with the skills necessary to complete the Internet-based survey. Technological issues such as loss of Internet connection, mistakes in programming, and user error may have also affected the validity of the survey results. However, the online survey programming had several features designed to assist in reducing error from technological issues. These features included:

- Listing only 10 questions per page and submitting the respondents’ answers at the end of each page. The program also allowed for the respondent to continue the survey at the point where they left off in the case of connection interruption or time-out and allowed the researcher to access partially submitted data.

- The survey was tested several times before inviting participants to complete it to resolve possible glitches in the programming.
• Customized error messages were used to instruct respondents to the exact location of their errors: for example, returning them to a question that they did not fill out.

• Each respondent was assigned a unique ID so that they could not fill out the survey more than once.

Although these methods assisted in limiting the scope of error involved in the use of Internet surveying and factor analysis, some error may still have remained in the results of this study.

**Delimitations**

This study included only K-12 educators employed in schools that have purchased technological equipment (e.g., laptops, SmartBoards, tablets, etc.) for use in the classroom in the last five years. The study was limited to these participants because educators without access to technological equipment might have been uncomfortable with the online survey format and unable to answer survey questions that specifically related to technology use in the classroom. The primary purpose of this study was to develop a valid and reliable preliminary instrument for the measurement of teacher self-efficacy. However, the results have also been used to summarize the current efficacy expectations of teachers towards the use of technology for student-centred learning and suggest recommendations for professional development and teacher training programs. The study focused specifically on teaching tasks that relate to the use of technology for student-centred learning and not teaching tasks in general or technology used for other purposes such as preparation, administration, or management.

**Definition of Key Terms**

*Case-based learning*: students review a specific, realistic, complex event (i.e., case) that requires some type of action on their part (e.g., a recommendation). The teacher facilitates student analysis, discussion, and case resolution through questioning (Fallows & Ahmet, 1999).
**Efficacy expectations**: the conviction that one can successfully execute the behaviour required to produce certain outcomes.

**Eigenvalues**: an index used in factor analysis that represents the extent to which a factor explains variance across the variables. An eigenvalue greater than one indicates that the component accounts for more variance than a single variable and is, therefore, a significant factor.

**General teaching efficacy (GTE)**: the beliefs of a teacher about the power of external forces on student learning. External forces include home environment; social and economic factors of class, race and gender; and the cognitive, emotional, and physiological needs of each child.

**Goal-based scenarios**: learn-by-doing environments, either real or virtual, that enable students to work towards desired goals.

**K-12 educator**: a person employed to teach full-time at a public or private school in the Lower Mainland region of British Columbia, Canada.

**Learning-by-design**: based on the learning theory of constructionism, learners are viewed as designers and creators of an authentic artifact that can be shared both with their peers in the class or with the world as a whole through an online platform.

**Media**: a means of communication that requires an information source, a means of information transmission, and a receiver of the information (Bates & Poole, 2003). Examples of media include speech, writing, drama, radio and television programming, computer programming, and Web-based courses (Bates & Poole, 2003).

**Outcome expectations**: a person’s estimate that a given behaviour will lead to certain outcomes.
Personal teaching efficacy (PTE): a teacher’s assessment of his or her own abilities, regardless of learning environment, to increase student learning.

Problem based learning: an instructional method in which students learn through a process of facilitated problem solving (Hmelo-Silver, 2004).

Project-based learning: a model of learning that organizes learning around projects. Projects can be defined as “complex tasks, based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations” (Thomas, 2000, p. 1).

Scree test: a test for determining the number of factors to retain in a factor analysis. In a scree test, the eigenvalues are plotted in descending order of their magnitude against their factor numbers. This will often create a graph that decreases sharply at first and then levels off. The break between the steep slope and the leveling off indicates the number of meaningful factors.

Self-efficacy: beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments (Bandura, 1997, p. 3). People with high self-efficacy tend to persist longer and set higher expectations for themselves than those with low self-efficacy.

Social cognitive theory: an approach to understanding human cognition, action, motivation, and emotion that assumes that people actively shape their environments rather than passively react to them (Bandura, as cited in Maddux, 2000).

Student-centred learning: for the purposes of this study, student-centred learning environments are defined as having the following features:

- They are based on a constructivist philosophy whereby students are viewed as constructing knowledge based on their own experiences.
• They are based on a constructivist pedagogy whereby students participate in active and experiential learning opportunities such as case-based learning, goal-based scenarios, learning by design, project-based learning, and/or problem-based learning.
• Technology is used in authentic ways that imitate how professionals in the workplace use digital tools.
• Students are active users and manipulators of digital tools and use technology to create digital products
• Appropriate technological tools—mobile devices (e.g., iPhones, iPads, laptop computers), presentation devices (e.g., LCD projectors, SmartBoards), and wireless connectivity—are accessible at the school in order to support student-centred learning.

Teaching efficacy: a teacher’s judgment of his or her capabilities to bring about desired levels of student engagement and learning.

Technology: Technologies can be defined as physical things that do not, by themselves, communicate (Bates & Poole, 2003). Examples of technologies include “classrooms, books, theaters, cinemas, radio sets and transmitters, cable, satellites, television monitors, computers, computer software, and computer networks” (p. 48)

Chapter Summary

In this chapter, the purpose, theoretical framework, limitations, and delimitations of the study were introduced. Digital technologies have fundamentally changed the skills required for teachers and learners, and the measurement of teachers’ perceived ability to perform these new tasks is necessary if schools are to move from an industrial age to an information age model. This research represented the preliminary phase of instrument development to measure the self-
efficacy of teachers in relation to tasks associated with technology-enhanced student-centred learning. The study was based on the theoretical framework of social cognitive theory, which states that behaviour is influenced by the environment, personal factors, and past and current behaviour in a process called triadic reciprocal causation. Self-efficacy mediates the interactions between these forces and has been demonstrated to be an accurate predictor of both current behaviour and behavioural change following an intervention. Teacher efficacy was introduced as the application of self-efficacy theory to teachers’ beliefs about their ability to achieve positive student change. The study was limited by the use of factor analysis and an online survey tool, as well as by the exploratory nature of the research.

I begin the next chapter with a review of the literature regarding the effect of digital technologies on teaching and learning. This is followed by a discussion of the role of self-efficacy in teacher behaviour and a summary of past teacher self-efficacy research.
CHAPTER TWO: LITERATURE REVIEW

I have organized this literature review around the theme of change. The relationship between social cognitive theory, self-efficacy, and organizational change is discussed in the first section. This will be followed by a discussion of the changes in technology, learning theories, pedagogy, school culture, and the role of educators as schools shift from an industrial age paradigm to an information age paradigm (Watson & Reigeluth, 2008). I conclude the literature review with a discussion of themes in efficacy research and how past measurement instruments for teacher self-efficacy must be updated to reflect the changed roles of educators and schools in the information age.

Social Cognitive Theory and Organizational Change

The beginning of the 21st century has been characterized by “accelerated social and technological change as well as growing global interdependence” (Bandura, 1995, p. ix). The transition from the industrial to information era has profoundly affected education systems, as today’s students “require cognitive and self-regulatory competencies to fulfill complex occupational roles” that place a “premium on capability for self-directed learning” (Bandura, 1995, p. 17). In order to remain successful, both individuals and organizations, including teachers and schools, must be fast learners and rapid changers in order to keep pace with developments in the external environment (Bandura, 1997). Social cognitive theory, mediated by the personal and collective efficacy of teachers and schools, provides a framework in which to measure teacher self-efficacy in relation to their ability to perform new skills and anticipate positive outcomes for student-centred learning enhanced by technology use.

Social cognitive theory views human agency as operating within a system of triadic reciprocal causation, wherein behaviour, personal factors, and the external environment interact...
The Measurement of Teacher Self-Efficacy 20

to determine the intentional courses of action a person chooses to pursue (Bandura, 1997). A typical depiction of the triadic reciprocal causation is presented in Figure 1, which emphasizes the bidirectional nature of the interactions between the three elements.

![Triadic reciprocal causation diagram](image)

*Figure 1. Triadic reciprocal causation.*

Note: Based on information from Bandura (1997, p. 6).

Triadic reciprocal causation illustrates that human adaptation and change are rooted in social systems and represent an “integrated causal perspective in which social influences operate through self-processes that produce the actions” (Bandura, 1997, p. 6) of an individual. The embedded nature of human agency within a social system stresses the importance of both individual skills and beliefs, but also the influence of the social environment in a person’s ability to express and influence the outcomes experienced through their behaviours. Both internal and external influences moderate a person’s feeling of self-efficacy, or belief in their ability to exercise human agency (Bandura, 1997). The reciprocal interaction between a person’s environment and behaviour means that changes in the environment will produce changes in behaviour and vice versa. The incorporation of computer technology for student-centred learning represents a change in the working environment of the teacher. Through triadic reciprocal causation, the change in environment produces a corresponding change in behaviour as the individual responds to the new tools and teaching techniques associated with technology-enhanced student-centred learning. Whether the new environment results in behaviour change
depends on organizational and personal factors that derive from the common cognitive
mechanism of self-efficacy (Bandura, 1977). Therefore, increasing teachers’ self-efficacy in
relation to student-centred learning plays an important role in transitioning schools from an
industrial age model to an information age model.

The role of teacher self-efficacy in managing change

Teacher self-efficacy can be defined as the “teacher’s belief in his or her capability to
organize and execute courses of action required to successfully accomplish a specific teacher
previously noted, teachers with high efficacy tend to experiment with methods of teaching to
meet their students’ needs, spend more time planning, persist longer with students who struggle,
and promote achievement, efficacy, and motivation in their students (Henson et al., 2001).
Teacher self-efficacy varies in different contexts, as teachers may exhibit different levels of self-
efficacy depending on the subject, student population, or school environment (Tschanne-Moran
& Woolfolk Hoy, 2001), and teachers with high self-efficacy tend to employ more humanistic
and student-centred learning practices in their classrooms (Goddard, Hoy, & Woolfolk Hoy,
2004; Wheatley, 2005). Perceived efficacy is also predictive of the level of behaviour change an
individual is capable of pursuing (Bandura, Adams, Hardy, & Howells, 1980, p. 40), as higher
efficacy is correlated with an increased ability to “tenaciously overcome obstacles and persist in
the face of failure” (Goddard et al., 2004, p. 4). The transition from a teacher-centred to a
student-centred model of instruction requires that teachers learn a variety of new skills and
instructional techniques, and this process may be challenging. Since teachers with high efficacy
tend to persist longer in the face of challenges, such as those presented by the transition to
technology-enhanced student-centred learning, building efficacy should be a key component of educational reform efforts.

In discussing social cognitive theory, it has been stated that individual actions both affect and are affected by their social context; therefore, a discussion of school culture and collective efficacy are also important to understanding the ability of education systems to adapt to the information age. Teacher self-efficacy research has traditionally focused on the individual efficacy of each teacher; however, environmental factors such as “excessive role demands, poor morale, inadequate salaries, low status and lack of recognition” (Tschannen-Moran et al., 1998, p. 221) can weaken teacher self-efficacy. The environment of a school leads to the creation of collective efficacy—or “the judgment of teachers in a school that the faculty as a whole can organize and execute the courses of action required to have a positive effect on students” (Goddard et al., 2004, p. 4). Some teachers may find themselves employed in schools with low morale and a depressed sense of collective efficacy, whereas others will work in schools where “mutuality, shared responsibility, and confidence in the conjoint capability of the faculty” are the norm (Goddard et al., 2004, p. 8). Successful schools breed successful teachers through the process of perceived efficacy, as the high morale of the teaching staff encourages each teacher to persist longer in the face of obstacles (Goddard et al., 2004, p. 8). As collective efficacy influences individual teacher self-efficacy, any new measurement of teacher self-efficacy must also include items that target collective efficacy. The scale developed in this study has attempted to target both individual and collective efficacy by including items that relate to both classroom instruction (i.e., individual) and tasks related to collaboration with other teachers or stakeholders (i.e., collective).
Strengthening self-efficacy

According to social cognitive theory, self-efficacy can be strengthened through four mechanisms: (a) personal performance accomplishments, (b) vicarious experiences, (c) verbal persuasion, and (d) physiological states (Bandura, 1977, p. 195). Of these, personal performance accomplishments are the strongest way of building efficacy, as actually performing the task creates the confidence that the task can be done again (Goddard et al., 2004). However, trying new tasks can initially have a negative effect on a teacher’s sense of efficacy (Tschannen-Moran et al., 1998). Rising standards and a change in the definition of what constitutes good teaching can be disorienting for educators, as they must develop new strategies to cope with these changes and disregard practices in which they may feel efficacious (Tschannen-Moran et al., 1998; Wheatley, 2005). The shift to a more equal power differential between students and teachers may also decrease teacher self-efficacy, as the teacher retains less control over the learning process, and may actually know less than their students in some areas (e.g., use of technology) (Prensky, 2007; Wheatley, 2005).

Previous teacher self-efficacy research has focused primarily on teachers’ efficacy in the present and immediate future in relation to tasks that they regularly encounter in their teaching environment (Wheatley, 2005). However, rapid changes in technology and the explosion of new knowledge mean that we do not know what knowledge or skills students and teachers will need 10 years from now or what teaching tasks will be commonplace in the future. Wheatley (2005) argued for a conceptual change in the measurement of teacher self-efficacy from a focus on current skills and performance to measurement of “teachers’ efficacy beliefs in learning to teach better” (p. 750). Rapid change will be a consistent feature of learning environments in the foreseeable future, and the measurement of individual and collective teacher self-efficacy in
relation to the *ability to adapt* to these changes will provide important information for teacher educators looking to train teachers for education systems of the future. The best practices for future education systems are “typically defined as those that promote student-centered learning”, which “emphasizes authentic experiences, encourages active learning, and results in the creation of new products” (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010, p. 1321). This study has aimed to address teachers’ self-efficacy and outcome expectancies in relation to anticipated tasks that are features of technology-enhanced student-centred learning environments. Measurement of these efficacy and outcome expectancies may illuminate possible reasons why teachers and education systems have been slow to respond to the changes in society brought on by the information age. Some of the most relevant changes of the information age to education policy and practice are highlighted in the next sections.

**Changes in Technology**

The digital revolution has resulted in vast changes for teachers’ use of technology and media. Technologies prevalent in schools only 20 years ago, such as chalkboards, encyclopaedias, card catalogues, VCRs, and film cameras, have been quickly replaced by their digital successors. This trend will continue, as the capacity of our digital equipment will roughly double each year for the foreseeable future due to a combination of “Moore’s Law for processors, increases in transmission speeds, storage capacity, and other developments” (Prensky, 2007, p. 41). As the information storage and computing power of technology increases, so too does the ability of technology users to create and manipulate an increasing diversity of media. Today’s computer users can use Web-based tools to create videos, podcasts, Wikipedia entries, cartoons, interactive timelines, games, and other media to express their ideas to not only peers in their classroom, but also to peers around the world (Prensky, 2007). If it is accepted that
a “major goal of education should be to equip students with the intellectual tools, efficacy beliefs, and intrinsic interests to educate themselves” (Bandura, 1995, p. 17), then the use of technology and media for a diverse range of knowledge acquisition and communication strategies to meet the needs of individual learners is integral to preparing students for occupational roles in the information age.

In order to impart feelings of efficacy for technology use in a diversity of situations, teachers must also feel efficacious in its use and associate technology with positive outcomes, such as enhanced career opportunities, for their students. However, it is difficult for teachers to keep pace with their students when it comes to using new technologies (Prensky, 2007). Today’s students often know more than their teachers about technology and how to manipulate it for learning (Prensky, 2007). Students can quickly access information using Internet-enabled applications and do not need to rely on the teacher as the source of all knowledge. This means that teachers must let go of “whatever control comes from being ‘the only one in the room who knows’” (Prensky, 2007, p. 42), resulting in a change in social environment of the classroom (Prensky, 2007). The change in social environment, through reciprocal causation, then alters the role of the teacher in the classroom. Instead of deciding on learning objectives and dictating how these objectives will be met, teachers may need to change their behaviour with students to a more collaborative approach that focuses on individualized learning objectives and support for students to meet unique learning goals. The instruments developed by this study, therefore, aimed to address teacher efficacy in skills linked to technology use for student-centred objectives such as collaboration and individualized instruction as well as attitudes towards the outcomes of using technology for student-centred learning.
The Measurement of Teacher Self-Efficacy

Constructivist learning theory

The following excerpt from Tynjälä (1999) succinctly summarized the challenges faced by education systems in the face of sweeping societal changes associated with the information age:

Increasing internationalization, the growing proportion of symbolic-analytic or knowledge-intensive work, increasing use of information technology, and a new organization of work based on networks and teams have extended the range of abilities needed in professional work. What employers expect of their employees is not only a good command of relevant knowledge but diversified social, communication and cooperation skills, ability to work in different contexts with experts from other fields, and ability to critically select, acquire, and use knowledge. Peculiar to today’s society and working life is rapid change; experts continuously must construct and reconstruct their expertise in a process of lifelong learning. In combination, these requirements pose considerable challenges to educational systems, which are expected to produce experts for working life of the future. (p. 357)

Of particular note is the need for education systems to instill self-directed knowledge acquisition, lifelong learning, and collaborative skills. These contrast with the needs of the industrial age paradigm of education, which was designed to sort students into laborers and managers and move the youth population through the mandatory process of schooling in the most efficient manner possible (Watson & Reigeluth, 2008). Industrial age school systems accomplished this efficiency by grouping students by age and expecting them all to learn the same amount of material in the same way and at the same time (Watson & Reigeluth, 2008, p. 42). The new paradigm in education to replace the industrial age model is often termed the “information age model . . . [in which] students set their own goals for learning, and determine resources and activities that will help them meet those goals” (Pederson & Liu, 2003, p. 57). Constructivism is the primary learning theory and pedagogy associated with the information age paradigm of instruction.
According to the constructivist viewpoint, “knowledge is both individually constructed and socially co-constructed from interactions and experiences with the world” (Jonassen, Cernusca, & Ionas, 2007, p. 4). Learners construct meaning “from practice (or activity) and from discussion and reflection on that practice” (p. 4). The constructivist perspective represents a shift in values from “attempts to communicate to students in efficient ways, to attempts to create learning situations that promote the engagement of learners in practice fields . . . and fields of practice” (p. 4). Learning is derived from experience and is acquired through communication between the learner, the teacher, and the wider school community (Bates & Poole, 2003). Advances in technology allow teachers to focus on individual learning outcomes rather than objectives that are common to large groups of students. The increased opportunities for self-direction and collaboration afforded by technological change support a shift from a one-size-fits-all design of schools to a design based on constructivism, where teachers assist students to “set their own goals for learning, and determine resources and activities that will help them meet those goals” (Pederson & Liu, 2003, p. 57). The use of constructivism clearly aligns with the identified goals of information age education systems and reinforces the use of a student-centred pedagogy, the features of which will be described in the next section.

**Constructivist pedagogy**

Pedagogy influences the “activities, methods, and structures of the learning environment . . . [and provides] the basis for the methods and strategies employed and the ways in which to-be-learned content is organized” (Hannafin & Land, 1997, p. 174). A summary of the pedagogical techniques associated with constructivist, student-centred learning environments is provided in Table 1, which was adapted from information provided by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012, p. 427).
Student-centred learning environments support the acquisition of skills needed for collaboration and self-directed learning, both essential for success in the modern interconnected and rapidly evolving workplace. Because information age education is best founded upon constructivist learning principles, this study specifically addressed teacher self-efficacy in relation to the use of technology for student-centred learning, as this approach will become increasingly important to learners in the digital age.

Table 1

Features of Student-Centred Learning Environments

<table>
<thead>
<tr>
<th>Categories of Classroom Practice</th>
<th>Student-Centred Pedagogy</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>• Student-directed</td>
</tr>
<tr>
<td></td>
<td>• Primarily interactive</td>
</tr>
<tr>
<td>Teacher role</td>
<td>• Guide discovery</td>
</tr>
<tr>
<td></td>
<td>• Model active learning</td>
</tr>
<tr>
<td></td>
<td>• Collaborator (sometimes learner)</td>
</tr>
<tr>
<td>Student role</td>
<td>• Create knowledge</td>
</tr>
<tr>
<td></td>
<td>• Collaborator (sometimes expert)</td>
</tr>
<tr>
<td>Curricular characteristics</td>
<td>• Depth – focused on student interaction</td>
</tr>
<tr>
<td></td>
<td>• Focus on understanding of complex ideas</td>
</tr>
<tr>
<td></td>
<td>• Application of knowledge to authentic tasks</td>
</tr>
<tr>
<td></td>
<td>• Integrated multidisciplinary themes</td>
</tr>
<tr>
<td>Classroom social organization</td>
<td>• Collaborative learning</td>
</tr>
<tr>
<td></td>
<td>• Social distribution of thinking</td>
</tr>
<tr>
<td>Assessment practices</td>
<td>• Applied knowledge</td>
</tr>
<tr>
<td></td>
<td>• Process oriented</td>
</tr>
<tr>
<td></td>
<td>• Alternative measures</td>
</tr>
<tr>
<td></td>
<td>• Criterion referenced</td>
</tr>
<tr>
<td></td>
<td>• Self-assessment and reflection</td>
</tr>
<tr>
<td>Technology role</td>
<td>• Exploration and knowledge construction</td>
</tr>
<tr>
<td></td>
<td>• Communication (collaboration, information expression)</td>
</tr>
<tr>
<td></td>
<td>• Tool for writing, data analysis, problem solving</td>
</tr>
<tr>
<td>Technology content</td>
<td>• Emphasis on thinking skills</td>
</tr>
<tr>
<td></td>
<td>• Skills taught and learned in context and application</td>
</tr>
</tbody>
</table>
Collective efficacy through supportive school culture

Social cognitive theory “asserts that teachers’ perceptions of both self and organization influence their actions” (Tschannen-Moran & Barr, 2004, p. 190). Perceived collective efficacy is affected by the school culture, which can be defined as “the shared values and belief systems in an organization that shape its formal and informal practices” (Bandura, 1997, p. 474). The values of an organization are reflected in the norms and priorities it promotes, the types of behaviour that are rewarded and penalized, and the attitudes and behaviours that are modeled by members of the organization (Bandura, 1997). A school culture that promotes adoption of new teaching practices, a positive attitude toward technology use, and a shared pedagogical vision for technology use jointly created by all stakeholders in the education system is essential to successful technology integration (Education Development Center, 2011).

One of the most prevalent barriers to using technology for student-centred learning has been organizational support (Chen, 2010; Education Development Center, 2011). Schools may need to significantly restructure their staffing roles and expectations and articulate coherent policies regarding the use of technologies such as cell phones and the Internet (Education Development Center, 2011). School leaders must also encourage a culture of collaboration in which “teachers work together to explore more effective uses of technology” and search for opportunities for cross-curricular collaboration (Education Development Center, 2011, p. 13). This may mean changes in traditional subject-oriented scheduling to allow time for collaboration and cross-curricular planning (Hew & Brush, 2007). Assessment systems such as high stakes testing can also slow the pace of pedagogical change, as teachers may not risk new methods of teaching if they are being evaluated on student test scores (Hew & Brush, 2007). Schools and school districts may need to alter assessment practices from product-oriented (e.g., tests and...
assignments) to process-oriented (e.g., self-assessments, skills assessments) practices (Education Development Center, 2011). These represent sweeping and fundamental changes to the current model of education, and if effective changes are to be made, education systems must create “optimal conditions for learning the new ways, provide the resources and positive incentives for adopting them, and build supports into the social system to sustain them” (Bandura, 1997, p. 514). Practices that build collective efficacy, such as teacher ownership in school decisions, teacher collaboration, high expectations for students, and supportive school leadership, must be a part of technology integration and should also be assessed by the new self-efficacy instrument (Adams & Forsyth, 2006; Goddard et al., 2004). Items relating to teachers’ perceived ability to collaborate with others and influence organizational decision-making have been included on the new self-efficacy measure.

**Changes in teachers’ roles**

While it is still not fully known exactly how the roles of teachers will change in the information age, in 2009, the International Society for Technology in Education (ISTE) created a good approximation by generating a list of competencies for administrators (ISTE, 2009a), students (ISTE, 2009b), and teachers (ISTE, 2009a) in the use of technology for student-centred learning. The ISTE standards for administrators, students, and teachers can be found in Appendices A, B, and C respectively. These competencies address many of the changes noted in the previous sections regarding technology, learning theory, pedagogy, and organizational structure. The ISTE standards are an excellent source to describe the required skills of educators, administrators, and students in 21st century education systems. Therefore, they were used as a basis to generate task items to measure teacher self-efficacy for the use of technology for student-centred learning. Since teachers do not perform their jobs in isolation, unencumbered by
factors such as school culture and individual differences in student learning, all three competency lists: teacher, administrator, and student, are important to assess the preparedness of teachers for technology-enhanced student-centred learning. An explanation of how the ISTE standards for administrators, students, and teachers are translated into a scale for measuring self-efficacy will be detailed in the next chapter.

**Measurement of Teacher Self-Efficacy**

A wealth of research on the definition and measurement of teacher self-efficacy has been conducted over the past 30 years. While many measurement instruments have been constructed, “teacher efficacy remains a conceptually elusive construct, . . . [which is] difficult to assess with certainty” (Hebert, Lee, & Williamson, as cited in Wheatley, 2005, p. 749). A summary of some of the key issues in teacher self-efficacy research, including conceptual constraints, the distinction between efficacy and outcome expectations, and the appropriate wording and format of teacher self-efficacy scales, is presented in this section.

**Conceptual constraints**

The study of teacher self-efficacy began with the RAND assessment (Tschannen-Moran et al., 1998), which asked teachers to indicate their level of agreement with two statements based on Rotter’s (1966) locus-of-control theory. The RAND researchers viewed teacher efficacy as “the extent to which teachers believed that they could control the reinforcement of their actions” and “whether control of reinforcement lay within themselves or in the environment” (Tschannen-Moran et al., 1998, p. 202). Other researchers then built within this conceptual strand of efficacy research, creating such measures as the Responsibility for Student Achievement Scale (Guskey, as cited in Tschannen-Moran & Woolfolk Hoy, 2001) and the Teacher Locus of Control Scale (Rose & Medway, as cited in Tschannen-Moran & Woolfolk Hoy, 2001).
The conceptual underpinnings of efficacy research experienced a transition in the early 1980s with the creation of the Teacher Efficacy Scale (Gibson & Dembo, 1984), which used Bandura’s (1977) social cognitive theory as a theoretical base. Gibson and Dembo (1984) created 30 items addressing teacher self-efficacy, and they asked teachers to rate their responses on a five-point Likert scale from “Strongly Agree” to “Strongly Disagree”. When the responses from the efficacy instrument were submitted to factor analysis, the researchers found that a two-factor structure existed within the 30 efficacy items. Gibson and Dembo labelled the first item “personal teaching efficacy” (p. 573) and defined it as a teacher’s estimation that they can successfully perform a given behaviour. The second factor was termed “outcome expectancy” (p. 574), or a teacher’s estimate that performing a certain action would lead to certain results in the context of external environmental influences (e.g., home environment, family background etc.).

Gibson and Dembo’s (1984) Teacher Efficacy Scale (TES) is the “predominate instrument in the study of teacher efficacy” (Henson et al., 2001, p. 405), and numerous other instruments including the Science Teachers Efficacy Beliefs Instrument (STEBI) (Riggs & Enoch, 1990), a classroom management efficacy beliefs scale, and a special education efficacy beliefs scale (Tschannen-Moran & Woolfolk Hoy, 2001) are based on the TES. However, several concerns have been raised about the construct validity of the TES including a possible conflict resulting from the mixing of the two theoretical traditions of Rotter’s (1966) locus-of-control theory and Bandura’s (1977) social cognitive theory (Tschannen-Moran & Woolfolk Hoy, 2001). The conclusion that the second factor represents outcome expectancies has also been called into question. In the following two sections, I address these criticisms of the TES and examine other, more recent instruments that may be more valid measures of teacher efficacy.
Constructing teacher efficacy scales

Measuring self-efficacy requires “more than simply asking about one’s generalized perceptions of competence in the given domain” (Bong, 2006, p. 290). Asking whether someone has certain abilities or is good at certain tasks is different from “asking whether one can execute, with those recognized capabilities, the requisite course of action to meet a variety of situational demands for achieving successful performance” (p. 290). For this reason, researchers are encouraged to phrase self-efficacy items with “I can” rather than “I will” to emphasize forward-looking capability (Klassen, Tze, Betts, & Gordon, 2011). Researchers have also recommended using a 10-point Likert scale in the measurement of self-efficacy to allow for a greater differentiation of responses (Bandura, 2006). Because self-efficacy is concerned with a person’s perceived capabilities and not with their beliefs about whether they can perform the task at a higher or lower level than someone else, items that ask the respondent to compare their abilities with those of teachers in general are not reflective of self-efficacy (Bong, 2006).

The TES scale and its derivatives do not meet these requirements for wording and structure. The items are not phrased using “I can”, and use a five-point Likert scale. Additionally, many of the items focus on whether student learning is influenced more by the teacher or by the student’s home environment, which is more consistent with Rotter’s (1966) locus-of-control theory than Bandura’s (1977) social cognitive theory. Scales such as the STEBI that are derived from the TES also contain this conceptual confusion and contain generalized statements that are not specific to a certain task and, therefore, should not be considered a measure of self-efficacy.

Bandura (1997) and Tschannen-Moran and Woolfolk Hoy (2001) have both created scales that address the issues inherent in the TES and its derivatives. Both scales use “I can”
phrasing, rate items on a 9-point Likert scale, and focus on specific teaching tasks. The Teachers’ Sense of Efficacy Scale (TSES) developed by Tschannen-Moran and Woolfolk Hoy (2001) has been demonstrated to be both reliable and valid in the measurement of teacher self-efficacy (Tschannen-Moran & Woolfolk Hoy, 2001) and is more widely used than Bandura’s scale. Based on the recommendations in the literature for the effective construction of self-efficacy scales, the scale developed in this study used “I can” phrasing, rated items on a 9-point Likert scale, and tested for construct validity through correlation with the TSES.

**Outcome expectancies**

There has been considerable debate about whether the second factor found in studies of teacher efficacy, labeled general teaching efficacy (GTE) by Gibson and Dembo (1984), is truly a measure of a teacher’s outcome expectancy: that is, their belief that a certain action will produce a given result (Tschannen-Moran et al., 1998). The TES and its derivatives measure GTE with questions that probe teachers’ beliefs about what is possible for teachers in general to accomplish. However, Bandura (as cited in Tschannen-Moran et al., 1998) noted that an outcome a teacher expects from an action stems from an assessment of his or her own capabilities and expected level of performance, not from what would be possible for others to accomplish under similar circumstances. Therefore, questions probing for outcome expectancy should refer to “outcomes the individual teacher could expect, given certain actions or means he or she felt capable of delivering” (Tschannen-Moran et al., 1998, p. 223). Wheatley (2005) recommended assessing teacher efficacy through probing outcome expectancy beliefs of teachers about “the likely outcomes that would result from skillful use of new curricula or methods *with which they have little or no skill* [author’s italics]” (p. 750). When faced with new teaching methods or curricula, such as those used in technology-enhanced student-centred learning, teachers have
multiple expected outcomes, including “student learning, behavior, noise, colleagues’ and parents’ reactions, and the personal consequences of using that teaching method” (p. 751). These outcome expectancies may be pivotal for teacher motivation and efficacy, so it is important that they be addressed in efficacy scales. For this reason, a second scale was developed to specifically address outcome expectancies of teachers in relation to the use of technology for student-centred learning.

**Chapter Summary**

The rapid growth and proliferation of technology has already had a transformational effect on the way we communicate, conduct business, and learn. Education systems will likely convert from the current one-size-fits-all industrial model to an information age model in which student learning becomes more personalized and self-directed. Education is in a time of transition, and teachers must be able to adapt to an ever-changing educational landscape as knowledge and technology continue to grow exponentially into the foreseeable future.

Self-efficacy has been correlated with increased perseverance and a willingness to experiment with new methods, making the measurement and enhancement of teachers’ efficacy in relation to technology-enhanced student-centred learning a crucial component of educational reform. Current measures of teacher self-efficacy have focused on traditional teaching tasks, and there is a need for a new instrument to measure efficacy in relation to teaching methods employed in technology-enhanced student-centred learning. Collective efficacy and efficacy in relation to the ability to learn new teaching techniques, largely ignored in previous efficacy instruments, have been included in this new efficacy measure. Outcome expectancies regarding student-centred technology use were also measured. The measurement scales created in this thesis are a first step towards evaluating the efficacy of educators in relation to 21st century
teaching tasks and may shed light on the reasons why changes in educational policy and
procedure have been slow to develop.

The methods used to develop the efficacy and outcome expectancy scales used in this
study are outlined in the next chapter. The statistical methods used to determine validity and
reliability of the two scales will also be discussed.
CHAPTER THREE: METHODS

The purpose of this study was to conduct a preliminary investigation of the efficacy of teachers regarding the use of technology for student-centred learning. In order to measure efficacy in the domain of technology-enhanced student-centred learning, two instruments were developed: (a) the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES) and (b) the Student-Centred Use of Technology Teacher Outcome Expectancy Scale (SCUTTOES). The reliability, validity, and factor structure of these research instruments as well as the relationship between efficacy and outcome expectancies were explored in this study. The methods used to develop and test the instruments for reliability and validity are outlined in this chapter. The process of participant selection and ethical considerations of the research are also discussed.

Research Design

Bandura (2006) recommends several steps in the development of self-efficacy scales. The first requirement is that the scale accurately represent the construct being measured (i.e., self-efficacy) by using “can do” rather than “will do” phrasing (p. 308). Self-efficacy is a judgment of perceived capability and using the verb “can” in questionnaire items differentiates responses from other self-referent judgments such as self-esteem (Bandura, 2006). Scales should also be specifically related to the domain of functioning (Bandura, 2006; Bong, 2006; Tschannen-Moran & Woolfolk Hoy, 1998), and there has been much debate about the appropriate level of specificity in efficacy scales. In this study, the behaviour of interest is the application of skills that teachers need to successfully instruct in technology-enhanced student-centred learning environments. The literature review revealed that ISTE has published a set of standards for administrators (ISTE, 2009a), students (ISTE, 2009b), and teachers (ISTE, 2009c) that can be
used to define the behaviours required of educators in 21st century learning environments. The ISTE National Educational Technology Standards (NETS) for administrators, students, and teachers can be found in Appendices A, B, and C respectively, and they reflect the competencies and skills required of educators, students, and the school community for student-centred learning and effective teaching through the use of technology. Surveying teachers about their perceived ability to perform the competencies listed in the ISTE NETS standards can, therefore, be used to measure efficacy expectations in the specific domain of teaching with technology for student-centered learning.

Bandura (2006) next recommended that the questionnaire be pretested, and items that are ambiguous should be rewritten or eliminated (p. 315). The face validity of the self-efficacy instrument was submitted to a panel of experts at the research division of the ISTE for revision. These experts were chosen based on their knowledge and experience in questionnaire design and familiarity with the NETS standards. They were asked to recommend changes to formatting and to omit redundant or poorly phrased questionnaire items. The panel of experts was also asked to assess the validity of the instrument by answering the following four questions originally suggested by Radhakrishna (2007, Step 4, para. 2-5):

1. Is the questionnaire measuring what it is intended to measure (self-efficacy)?

2. Does it accurately represent the skills needed by educators to teach effectively in technology-enhanced student-centred learning environments?

3. Is it appropriately worded and laid out for the sample population?

4. Is the questionnaire comprehensive enough to collect all the information needed to address the purpose and goals of the study?
Bandura (2006) recommended that the scale be tested for reliability using Cronbach’s alpha, as similar domains of efficacy should have a high correlation. Validity can also be measured using convergent, discriminate, or predictive validity tests. In this study, the validity of the new self-efficacy instrument was determined by comparing it with an existing measure of teacher efficacy, the TSES. This is an example of convergent validity, and further studies should build upon the findings of this research to determine whether the instrument developed also has discriminate and predictive ability in its measure of self-efficacy. How these steps were used to develop the self-efficacy and outcome expectancy scales used in this study are succinctly outlined in the following sections.

Creating the Self-Efficacy Instrument

Self-efficacy is typically measured using a quantitative methodology in which research participants are presented with a series of items portraying different types and levels of task demands (Bandura, 2006). Participants are then asked to rate the strength of their belief in their ability to perform each task item on a Likert scale. Two separate scales were created for this study to represent the separate efficacy belief constructs of efficacy expectations and outcome expectations. In this section, I outline how the items for the two surveys were generated.

As defined in social cognitive theory, efficacy beliefs are “future-oriented judgments about capabilities to organize and execute the courses of action required to produce given attainments in specific situations or contexts” (Goddard et al., 2004, p. 3). This definition distinguished between the courses of action taken by an individual, or group in the case of collective efficacy, and the attainments expected from these actions. In self-efficacy theory, these two different components are labeled efficacy expectations and outcome expectations (Gibson & Dembo, 1984). An outcome expectation has been “defined as a person’s estimate that a given
behaviour will lead to certain outcomes, . . . [whereas an efficacy expectation is] the conviction that one can successfully execute the behavior required to produce the outcomes” (Bandura, 1977, p. 193). Individuals may believe that a certain course of action will lead to positive outcomes (i.e., outcome expectation), but if they do not think they can consistently perform this action (i.e., efficacy expectation), then they will not initiate the required behaviours (Bandura, 1977). The relationship between efficacy and outcome expectancies in regard to behaviour is represented in Figure 2.

![Figure 2: Representation of the difference between efficacy expectations and outcome expectations](image)

*Figure 2.* Representation of the difference between efficacy expectations and outcome expectations.

The expected outcomes of a behaviour are also a key component of efficacy, and teachers often have many “anticipated outcomes regarding teaching methods, including student learning, behaviour, noise, colleagues’ and parents’ reactions, and the personal consequences of using that teaching method” (Wheatley, 2005, p. 751). Outcomes of using technology for student-centred learning may be both positive and negative. Positive outcomes are revealed in articles referring to the benefits of technology-enhanced student-centred learning practices, while negative outcomes are revealed in literature discussing the barriers to technology implementation. Ten possible outcome expectancies (five positive and five negative) were chosen based on their frequency of appearance in the literature reviewed and were used to generate items measuring
teacher outcome expectancy in the use of technology for student-centred learning. Some common positive and negative outcomes that teachers may anticipate towards using technology for student-centred learning are summarized in Table 2.

### Table 2

**Positive and Negative Outcome Expectancies of Using Technology for Student-Centred Learning**

<table>
<thead>
<tr>
<th>Outcome Expectancies</th>
<th>Description</th>
</tr>
</thead>
</table>
| Positive outcomes of technology-enhanced student-centred learning | • Increased student motivation and participation  
• Increased student achievement on standardized tests  
• Better preparation of students for 21st century work environments  
• Improved critical thinking and problem solving abilities  
• Development of collaborative skills through project based learning |
| Negative outcomes of technology-enhanced student-centred learning | • Time required for lesson preparation (loading materials online, finding support websites, etc.).  
• Technical support needed in case of a technological error  
• Student-centred learning means a loss in adherence to instructional objectives  
• Student-centred and project based learning requires more time than direct instruction, and teachers may not finish the curriculum  
• Teachers may need time-consuming or expensive training to learn the skills required for teaching effectively with technology |

Outcome expectancy items were created based on the positive and negative outcomes listed in Table 2. Efficacy expectancy items were written based on the competencies listed in the ISTE NETS for administrators (ISTE, 2009a), students (ISTE, 2009b), and teachers (ISTE, 2009c). The phrasing of the efficacy expectation items was modeled after the wording of items on the Teachers’ Sense of Efficacy Scale (TSES), which used questions beginning with “to what extent can you . . .” or “how well can you . . .” in relation to teaching tasks (Tschannen-Moran & Woolfolk Hoy, 2001). Initially, 49 items reflecting different competencies required by teachers
to effectively use technology for student-centred learning were created. These competencies were then grouped according to the outcome expectancy they helped to support. A demonstration of how efficacy expectations (i.e., a teachers’ belief in their ability to perform a behaviour listed on the ISTE Standards) were matched with both positive and negative outcomes that logically follow from those behaviours is provided in Table 3.

Outcome expectancies often stem from perceived self-efficacy in relation to performing the tasks required to achieve positive outcomes (Tschannen-Moran et al., 1998). Therefore, high perceived efficacy on performance tasks should be positively correlated with positive outcome expectancies and negatively correlated with pessimistic outcome expectancies. The grouping of self-efficacy items in relation to perceived outcome expectancies can be used to determine whether high self-efficacy on the teaching tasks required for technology-enhanced student-centred learning correlate positively with positive outcomes and inversely for negative outcomes.

The final versions of the self-efficacy and outcome expectancy surveys can be found in Appendices D and E respectively. Following grouping of the items by outcome expectancy, 15 of the original 49 items were judged to be too similar to other items and were removed. The resulting first draft was separated into two separate surveys, with the first measuring efficacy expectations and the second measuring outcome expectancies. These two documents were respectively titled the “Student-Centred Use of Technology Teacher Efficacy Scale” (SCUTTES) and the “Student-Centred Use of Technology Teacher Outcome Expectancy Scale” (SCUTTOES). A 9-point Likert scale was used in order to compare the results of the instrument with the TSES, which also uses a 9-point scale. Following the revisions made by the panel of experts, the final efficacy scale was uploaded to an online survey platform available through Survey Monkey (http://www.surveymonkey.com/) and pre-tested by a group of volunteers to
determine if there were any glitches in the survey software and delivery. The data gathered in the pre-test were not used in the final analysis; they were simply gathered to ensure that the program software functioned correctly.

Table 3

*Grouping Efficacy Expectancies by Outcome Expectancy*

<table>
<thead>
<tr>
<th>Outcome Expectancy</th>
<th>Efficacy Expectancy</th>
</tr>
</thead>
</table>
| Technology allows students to develop interpersonal skills through collaborating on online projects with their peers and teachers. | • To what extent can you encourage students to reflect on their learning using digital collaborative tools (e.g. blogs, wikis)?
| | • To what extent can you collaborate with students, peers, parents, and community members using digital tools and resources?
| | • How well can you promote and model digital etiquette and responsible social interactions in online communities to your students?
| | • To what extent can you create learning tasks for your students that require them to collaborate with students in other countries?
| | • To what extent can you discuss the use of technology with teachers in your school?
| | • To what extent can you use online communities to learn more about the use of technology in the classroom?
| Technology use for Student-centred learning leads students to lose focus on the learning objectives. | • To what extent can you manage a class in which each student is pursuing their own personalized learning activities?
| | • How well can you assist students to plan strategies that will guide their own inquiry?
| | • How well can you assist students to plan and manage their activities to complete a project?
Research Participants

The target population for the final survey was K-12 teachers working in Lower Mainland schools or school districts that have purchased technological equipment for use in the classroom in the last five years. Teachers without reliable access to technological equipment are unable to use it to promote student-centred learning, and therefore, only teachers with access to technological equipment were included in this study. The sample was drawn from two school districts in the Lower Mainland region of British Columbia, and approximately 300 teachers were asked to complete the survey.

To ensure the standards of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada [Tri-Council], 2010) were met, the research design was submitted to an Ethics Review Board at Royal Roads University. Following ethics approval from Royal Roads University, two school districts (Vancouver and Surrey) in British Columbia, Canada, were contacted, and each district conducted a second ethical review. Specific schools were requested as research participants based on their use of technology. Schools were initially identified by searching for schools where technology use was mentioned in news briefs on the district website. After the first round of schools was contacted, a second round of contact schools in the Vancouver District was recommended for participation by the district technology co-ordinator. Once permission was granted by the district, the principals of the targeted schools were contacted by both email and phone to determine their interest in participating in the study. Once approval to contact teachers was given by the school principal, teachers were sent an email describing the study and including a link to the online survey. Upon activating the link, teachers were asked to read a description of
the research study and provide their informed consent for participation before being allowed to access the questionnaire. A copy of the letter of introduction to the school district and the informed consent document for survey participation can be found in Appendices F and G respectively.

The survey did not ask for any personally identifiable information, although to differentiate results from different schools, some participants received a unique link that identified their response by email address. This was done only when permission from the school to do so was granted. In the case that permission was not granted, teachers were given a generic link and asked to complete the survey within a given time frame in order to differentiate their results from other schools. School responses were differentiated because summaries of results were offered to participant schools as an incentive to complete the survey. Two schools took advantage of this incentive and received reports summarizing responses and providing professional development suggestions. Participant data were stored in a password-protected file on my personal computer, and all information will be deleted five years following completion of the thesis project. As I am not employed by the public school system in the province of British Columbia, there was no conflict of interest or power differential between the research participants and myself. An Internet survey was chosen as the method of delivery because it was an efficient means of contacting people in numerous geographic locations around the Lower Mainland. Because only schools that have demonstrated technology use in the classroom were included in this sample, it was assumed that teachers in these schools would have the technological skills necessary to complete an online survey.
Data Analysis

This study aimed to create a preliminary measure of teacher self-efficacy for the use of technology for student-centred learning that was both valid and reliable. Therefore, analysis of the results of the efficacy instrument focused on establishing the reliability and validity of the questionnaire.

Reliability

Reliability is a measure of the accuracy or precision of a measurement instrument (Radhakrishna, 2007). In essence, reliability refers to whether an instrument consistently produces similar results. There are several ways to measure reliability, including test-retest, split half, alternate form, and internal consistency tests. It was not within the scope of this study to administer the final survey more than once, so reliability was measured using Cronbach’s alpha, a measure of internal consistency (Tavakol & Dennick, 2011).

Alpha was developed by Lee Cronbach in 1951, and provides a measure of the internal consistency of a questionnaire on a scale of zero to one (Tavakol & Dennick, 2011). The alpha value “describes the extent to which all the items in a test measure the same concept or construct” (p. 53) and can assist in determining the amount of measurement error in a research instrument. A high alpha measurement indicates a high degree of internal consistency between items on a test and helps the researcher to assess if the questions are all addressing the same construct. If the self-efficacy instrument was reliable, it was anticipated that the SCUTTES scale should have high internal consistency (greater than 0.7). The alpha value of the data were calculated using the statistics program SPSS.
Validity

Validity is “concerned with the extent to which an instrument measures what it is intended to measure” (Tavakol & Dennick, 2011, p. 53). An instrument can yield consistent, reliable results, but might be measuring the wrong construct, making it invalid. The panel of experts assessed content validity prior to the survey being distributed to the target population. Construct validity of the SCUTTES was also determined by correlating the results with teacher responses on an established measure of teacher efficacy, the TSES. It was anticipated that a positive correlation between the SCUTTES and TSES would indicate that they are measuring a similar construct. This study focussed solely on testing the convergent validity of the SCUTTES survey, but did not assess the discriminate and predictive validity of the instrument.

Descriptive analyses

The mean and standard deviation of each item on the SCUTTES and SCUTTOES were calculated. This analysis was used to identify areas in which British Columbian teachers feel low efficacy or outcome expectations, in addition to identifying general areas of strength in efficacy and outcome beliefs. Standard deviation was calculated to determine the variability in answer responses, as Bandura (2006) had noted that low variability may mean that the item is confusing or the level of task demand is inappropriate for the group surveyed. Outcome expectancy items were divided into two groups, with one reflecting positive outcome expectations and the other reflecting negative outcome expectations. The mean and standard deviation of the items in each group were then calculated and compared to determine whether teachers primarily associate positive or negative outcomes with technology-enhanced student-centred learning. Mean efficacy expectation scores were correlated with the scores for positive and negative outcomes expectations to determine if there was a relationship between efficacy and outcome expectations.
Factor analysis

An exploratory factor analysis was performed using principal components analysis in order to determine the factor structure of the SCUTTES scale. Any factors that had an eigenvalue greater than one were retained in addition to any further factors deemed to be statistically significant upon application of the scree test. Two tests are used to determine significant factors in order to maximize the reliability of the analysis. The number of factors extracted from the data provided information on the latent variables that influence teacher self-efficacy towards performing tasks related to technology-enhanced student-centred learning.

Chapter Summary

The methods employed to collect and analyze data on teacher self-efficacy and outcome expectations in using technology for student-centred learning were presented in this chapter. I also detailed the study design, instrumentation used, and statistical analysis procedures, as well as the process for choosing research participants and the ethical considerations of the project. The study is intended to be a preliminary step in the creation of a new measure of self-efficacy, involving the creation of the questionnaires and a pre-test with a sample population to determine reliability and validity. In the following chapter, I describe the sample population and provide an analysis of the data gathered from the distribution of the SCUTTES and SCUTTOES surveys.
CHAPTER FOUR: RESULTS

The purpose of this study is to develop a preliminary instrument that can be used to measure teacher self-efficacy regarding the use of technology for student-centred learning, and to test this instrument for reliability and validity. Three surveys were used in this study: the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES), the Student-Centred Use of Technology Teacher Outcome Expectancy Scale (SCUTTOES), and the Teacher Sense of Efficacy Scale (TSES). I begin this chapter with a description of the sample population, followed by a quantitative analysis of the results from the three survey instruments. Qualitative data collected through an optional comments section at the end of each online survey page were also analyzed and provided possible reasons for the efficacy and outcome expectations of teachers who participated in the survey.

Description of the Sample

The target audience for the surveys was comprised of K-12 teachers working in the school districts of Surrey or Vancouver in British Columbia, Canada. Sixteen schools in these districts were identified as having purchased technological equipment for the classroom in the last five years and were invited to participate in the study. Of the sixteen schools contacted, five agreed to distribute the survey to their staff. The survey was distributed to four secondary schools and one primary school, comprising a total of 294 teachers who received the link to the online survey. Of the 294 teachers who were emailed the survey link, 68 responses were received for a response rate of 23%. The majority of respondents came from two secondary schools in the Vancouver district that wished to use the results from the survey to guide their own professional development programs. The demographics of the teachers who completed the survey are outlined in Table 4. This section of the survey was optional, and the number of total respondents for each variable is indicated in the first
column of Table 4. There was considerable diversity in the age, experience, and subject taught among the survey respondents.

Table 4

*Demographic Information of Survey Participants*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Answer Option</th>
<th>Percent (N = 68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>41.2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>45.6</td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>13.2</td>
</tr>
<tr>
<td>Age (n = 68)</td>
<td>20 years and under</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>21-30 years</td>
<td>16.2</td>
</tr>
<tr>
<td></td>
<td>31-40 years</td>
<td>30.9</td>
</tr>
<tr>
<td></td>
<td>41-50 years</td>
<td>19.1</td>
</tr>
<tr>
<td></td>
<td>51-60 years</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td>over 60 years</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>11.8</td>
</tr>
<tr>
<td>Years of Experience (n = 68)</td>
<td>Less than 5 years</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>6-10 years</td>
<td>20.6</td>
</tr>
<tr>
<td></td>
<td>11-15 years</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>16-20 years</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>over 20 years</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>11.8</td>
</tr>
<tr>
<td>Subject Taught (n = 68)</td>
<td>Art</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>Music</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Language Arts</td>
<td>19.1</td>
</tr>
<tr>
<td></td>
<td>Social Studies</td>
<td>19.1</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>Physical Education</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>35.3</td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>14.8</td>
</tr>
</tbody>
</table>

**Efficacy Expectations for Technology-Enhanced Student-Centred Learning**

The first research question posed by this study was to determine the efficacy expectations of teachers in relation to technology-enhanced student-centred learning and to compare these
expectations with teachers’ efficacy in regard to traditional teaching tasks. The mean and standard deviation for each item within the SCUTTES scale are outlined in Table 5. The items have been ordered from lowest average efficacy to highest average efficacy. Descriptive statistics from the TSES are outlined in Table 6, also ordered from lowest to highest average efficacy. Both scales asked teachers to indicate the strength of their efficacy on a scale of 1-9, where 1 is “Not at all” efficacious, and 9 is “A Great Deal”.

Table 5

_Efficacy Expectations of Teachers as Measured by the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES)_

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Item Mean</th>
<th>Item Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent can you create learning tasks for your students that require them to collaborate with students in other schools?</td>
<td>4.59</td>
<td>2.16</td>
</tr>
<tr>
<td>How well can you troubleshoot technological systems and applications?</td>
<td>4.98</td>
<td>2.33</td>
</tr>
<tr>
<td>To what extent can you use digital tools to grade formative and summative assessments?</td>
<td>5.09</td>
<td>2.36</td>
</tr>
<tr>
<td>To what extent can you assume a leadership role in demonstrating a vision of technology integration?</td>
<td>5.18</td>
<td>2.57</td>
</tr>
<tr>
<td>To what extent can you manage a class in which each student is pursuing their own personalized learning activities?</td>
<td>5.26</td>
<td>2.23</td>
</tr>
<tr>
<td>How well can you use technology to analyze assessment data?</td>
<td>5.26</td>
<td>2.37</td>
</tr>
<tr>
<td>To what extent can you stay abreast with emerging trends regarding the effective use of technology?</td>
<td>5.36</td>
<td>2.19</td>
</tr>
<tr>
<td>To what extent can you encourage students to reflect on their learning using digital collaborative tools (e.g. blogs, wikis)?</td>
<td>5.38</td>
<td>2.10</td>
</tr>
<tr>
<td>How well can you model responsible social interactions in online communities to your students?</td>
<td>5.41</td>
<td>2.60</td>
</tr>
</tbody>
</table>

_Table 5 continued on following page_
<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Item Mean</th>
<th>Item Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent can you access technology systems to support teaching and learning?</td>
<td>5.45</td>
<td>2.14</td>
</tr>
<tr>
<td>To what extent can you access professional development opportunities focusing on continuous improvement of digital-age teaching skills?</td>
<td>5.45</td>
<td>2.11</td>
</tr>
<tr>
<td>To what extent can you access role models for the effective use of technology?</td>
<td>5.53</td>
<td>2.27</td>
</tr>
<tr>
<td>How well can you assist students to plan strategies that will guide their own inquiry?</td>
<td>5.55</td>
<td>2.09</td>
</tr>
<tr>
<td>To what extent can you advocate for school policies to support implementation of a technology-infused curriculum?</td>
<td>5.58</td>
<td>1.87</td>
</tr>
<tr>
<td>How well can you instruct students in the use of computers?</td>
<td>5.65</td>
<td>2.32</td>
</tr>
<tr>
<td>How well can you engage students in exploring real-world issues using digital tools and resources?</td>
<td>5.98</td>
<td>2.11</td>
</tr>
<tr>
<td>To what extent can you evaluate student work that is provided in a variety of media/formats?</td>
<td>6.23</td>
<td>2.05</td>
</tr>
<tr>
<td>How much can you do to develop personal responsibility for lifelong learning in your students?</td>
<td>6.33</td>
<td>1.93</td>
</tr>
<tr>
<td>To what extent can you model innovative thinking to your students?</td>
<td>6.45</td>
<td>2.00</td>
</tr>
<tr>
<td>To what extent can you adapt your lesson plans to incorporate digital tools and resources?</td>
<td>6.45</td>
<td>2.16</td>
</tr>
<tr>
<td>To what extent can you discuss the use of technology with teachers in your school?</td>
<td>6.65</td>
<td>1.84</td>
</tr>
</tbody>
</table>
Table 6

*Efficacy Expectations of Teachers as Measured by the Teachers’ Sense of Efficacy Scale (TSES)*

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Item Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much can you assist families in helping their children do well in school?</td>
<td>5.34</td>
<td>1.87</td>
</tr>
<tr>
<td>How much can you do to motivate students who show low interest in school work?</td>
<td>5.79</td>
<td>1.80</td>
</tr>
<tr>
<td>How much can you do to help your students value learning?</td>
<td>6.40</td>
<td>1.68</td>
</tr>
<tr>
<td>How well can you implement alternative strategies in the classroom?</td>
<td>6.77</td>
<td>1.75</td>
</tr>
<tr>
<td>How much can you do to get students to believe they can do well in school work?</td>
<td>6.79</td>
<td>1.73</td>
</tr>
<tr>
<td>To what extent can you craft good questions for your students?</td>
<td>7.03</td>
<td>1.64</td>
</tr>
<tr>
<td>How well can you use a variety of assessment strategies?</td>
<td>7.18</td>
<td>1.54</td>
</tr>
<tr>
<td>How much can you do to calm a student who is disruptive or noisy?</td>
<td>7.21</td>
<td>1.59</td>
</tr>
<tr>
<td>How much can you do to control disruptive behaviour in the classroom?</td>
<td>7.32</td>
<td>1.59</td>
</tr>
<tr>
<td>To what extent can you provide an alternative explanation or example when students are confused?</td>
<td>7.47</td>
<td>1.62</td>
</tr>
</tbody>
</table>

A cursory examination of the statistics from the two measures of teacher efficacy revealed two observations. First, the average efficacy scores appeared to be higher on the TSES than they were on the SCUTTES, indicating that teachers feel, on average, more efficacious on traditional teaching tasks than tasks associated with student-centred use of technology. Secondly, the variation in teacher responses, as indicated by the standard deviation, was higher in the SCUTTES than the TSES. This indicated a greater range of efficacy on each item, perhaps indicating that there is a wide range of comfort levels in the use of technology for student-
centred learning. The standard deviation on the SCUTTES also indicated there was a reasonable spread of responses per item, which has suggested that the level of task demand was appropriate to the domain of functioning.

In order to determine if there was a statistically significant difference between the scores on the TSES and the SCUTTES, a Wilcoxon signed rank test was performed. This test is used to determine if the median values of two sets of ordinal data from the same sample group are statistically different. Of the 62 respondents who completed both tests, 52 scored higher on the TSES than the SCUTTES. Of the remaining 10 respondents, nine scored higher on the SCUTTES than the TSES, and one respondent tied for both surveys. This represented a significant \( p < 0.01 \) difference between scores on the two measures of teacher efficacy and indicated that teachers feel more efficacious when performing traditional teaching tasks than when performing tasks related to student-centred technology use. The implications of this finding will be discussed in the next chapter.

**Outcome Expectations for Technology-Enhanced Student-Centred Learning**

The SCUTTOES was developed to determine if teachers primarily associated positive or negative outcomes with technology use. The scale consists of ten items, five of which represent positive outcomes and five representing negative outcomes. Teachers were asked to respond to each item using a scale of 1-9, where 1 is “Strongly Disagree” and 9 is “Strongly Agree”. The mean and standard deviation for each item are represented in Table 7. The items have been separated into positive and negative outcomes and ranked from lowest to highest score in each category.
Table 7

*Outcome Expectations of Teachers as Measured by the Student-Centred Use of Technology Outcome Expectancy Scale (SCUTTOES)*

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Item Mean</th>
<th>Item Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive Outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology allows students to develop interpersonal skills.</td>
<td>4.05</td>
<td>2.12</td>
</tr>
<tr>
<td>Technology use improves overall student achievement on standardized tests.</td>
<td>4.62</td>
<td>1.46</td>
</tr>
<tr>
<td>Technology improves the critical thinking abilities of students.</td>
<td>4.90</td>
<td>2.01</td>
</tr>
<tr>
<td>Technology use encourages student participation in achieving learning goals.</td>
<td>5.87</td>
<td>1.87</td>
</tr>
<tr>
<td>The use of technology in the classroom helps prepare students for the 21st century workplace.</td>
<td>7.08</td>
<td>1.58</td>
</tr>
<tr>
<td><strong>Negative Outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology use for student-centred learning makes it difficult to focus on the learning objectives of the curriculum.</td>
<td>4.21</td>
<td>2.11</td>
</tr>
<tr>
<td>Technology is unreliable.</td>
<td>5.46</td>
<td>2.60</td>
</tr>
<tr>
<td>Technology use for project-based learning requires more class time than direct instruction.</td>
<td>6.18</td>
<td>1.95</td>
</tr>
<tr>
<td>Technology use requires large amounts of preparation time.</td>
<td>6.28</td>
<td>2.17</td>
</tr>
<tr>
<td>Teachers must continue to update their technological skills in order to gain and keep employment.</td>
<td>6.54</td>
<td>2.24</td>
</tr>
</tbody>
</table>

A Wilcoxon signed rank test was performed to determine if there was a significant difference between the responses to positive and negative outcome statements. The test determined that there was no significant difference ($p = 0.129$) between the positive outcome statements and negative outcome statements. Thirty-four teachers agreed more strongly with negative outcomes, 23 teachers agreed more strongly with positive outcomes, and four teachers received the same median score on both sets of questions. From these data, it can be determined that while there was no significant difference in teachers’ positive and negative outcome
expectancies, there did seem to be a slight preference for negative outcomes in relation to positive outcomes. This will be further discussed in the following chapter.

The data can also be used to answer the third question posed by this study to determine if there is a correlation between a teacher’s efficacy score on the SCUTTES and their outcome expectancies as measured by the SCUTTOES. Spearman’s rho test was carried out to compare the efficacy scores on the SCUTTES, first with positive outcome expectancies and then with regard to negative outcome expectancies. A significant positive correlation between efficacy scores and positive outcome expectancies \((r_s = 0.425, p = 0.001)\) and a negative correlation \((r_s = -0.243, p = 0.059)\) between efficacy scores and negative outcome expectancies was found, although this score was only just non-significant at the \(p < 0.05\) level. This analysis indicated that there was a correlation between efficacy expectations and outcome expectations on tasks related to technology-enhanced student-centred learning. The higher the efficacy expectations of a teacher, the more likely they were to relate positive outcomes to technology use. This relationship will be discussed further in the next chapter.

**Reliability, Validity, and Factor Structure of the SCUTTES, SCUTTOES, and TSES**

The final question posed by this study was to determine the reliability and validity of the new measurement instruments, the SCUTTES and SCUTTOES. Additionally, the factor structure of the SCUTTES was analyzed to determine the underlying influences on teacher self-efficacy in the use of technology for student-centred learning. The next section contains details of these analyses.

**Reliability of the SCUTTES, SCUTTOES, and TSES survey instruments**

Reliability of the scales used in this study was determined using Cronbach’s alpha (Santos, 1999; Tavakol & Dennick, 2011), a measure of internal consistency. An alpha value
above 0.70 indicates an acceptable degree of internal consistency within a survey instrument (Santos, 1999). The calculated alpha value for the SCUTTES was 0.954, and the TSES had an alpha value of 0.930, indicating that both instruments had a high degree of internal consistency. The SCUTTOES measured both positive and negative outcome expectancies towards the use of technology for student-centred learning and, as such, was measuring two different constructs. It should, therefore, have a low degree of internal consistency when all items are included, but should have a greater degree of consistency within the subsets of positive and negative outcome expectancies. This was supported by the alpha value calculations, as the internal consistency of the entire SCUTTOES survey was found to have an alpha value of 0.258, but the internal consistency within positively phrased outcomes was 0.708 and between negative outcomes was 0.585. The high alpha values of the SCUTTES and TSES surveys indicated that the results from these instruments were reliable, while the SCUTTOES survey demonstrated less correlation between items and may have been measuring more than one construct, particularly in regard to negative outcome expectancies.

Validity of the SCUTTES and SCUTTOES instruments

The questions on the SCUTTES were adapted from the ISTE standards for administrators (ISTE, 2009a), students (ISTE, 2009b), and educators (ISTE, 2009c). For this reason, the content validity of the instrument was assessed by the research team at ISTE. As experts in both research methods and the use of technology in education, the team at ISTE provided valuable feedback that led to the rewording of several questions on both the SCUTTES (see Appendix E) and the SCUTTOES (see Appendix F) and the removal of three questions that were deemed to be redundant.
The criterion validity of the SCUTTES can also be assessed by determining if the results are correlated with those of the TSES survey. The TSES is a widely known and used scale for the measurement of teacher efficacy and can be used as a standard against which the new SCUTTES survey can be measured. Spearman’s rho can be used to determine if there is a linear relationship between the results on the SCUTTES and TSES, indicating that there is a correlation between the scores on the two surveys. The presence of a strong correlation would indicate that the two surveys are measuring the same construct: in this case, teacher self-efficacy. As the data were ordinal in nature, Spearman’s rho was used to determine correlation instead of Pearson’s correlation coefficient. A significant \( r_s = 0.521, p < 0.01 \) relationship was found between the scores on the SCUTTES and the TSES. This would suggest that the SCUTTES instrument is a valid measure of teacher self-efficacy. The TSES included only efficacy statements, not outcome expectations, so it could not be used as a standard for the criterion validity of the SCUTTOES scale.

**Factor Analysis of the SCUTTES**

The SCUTTES (see Appendix E) was submitted to principal components analysis in order to determine the underlying factor structure. Factor analysis has been used to determine the strength of the correlation between variables on a test and provides information about factors that explain variance in the data. The following section is a description of the results from the factor analysis of the SCUTTES.

Before submitting data to a factor analysis, it is important to first ensure that the data are appropriate for this type of statistical test (Pett, Lackey, & Sullivan, 2003). The appropriateness of a data matrix for factor analysis can be determined through the use of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett’s Test of Sphericity. In the case of the SCUTTES
instrument, both the Kaiser-Meyer-Olkin Measure (0.899) and Bartlett’s test (chi-square = 1017.298, \( df = 210, p < 0.05 \)) indicated that the matrix is appropriate for factor analysis.

Principal components analysis of the SCUTTES responses extracted three factors with eigenvalues greater than one, which accounted for 65% of the variance in the data. The solution was then rotated using varimax rotation, which confirmed the existence of three factors. All factor loadings less than 0.40 were removed from the rotated component matrix in order to make significant loadings on the factors clear. A scree test was also performed and confirmed the three-factor solution. Eleven of the 21 items on the SCUTTES loaded significantly on only one factor. Of the remaining ten items, one loaded on all three factors, so was removed from further analysis, and nine loaded on two factors. To determine the placement of the items that loaded on more than one factor, a reliability analysis was done on each factor solution. The effect of the removal of a cross-loading item on the factor solution was calculated, and items were placed with the factor in which their exclusion would have the greatest negative impact on reliability. For example, the question “How well can you engage students in exploring real-world issues using digital tools and resources?” loaded significantly on both Factor 1 (0.517) and Factor 2 (0.652) following varimax rotation. When placed with Factor 1, the reliability, as measured by Cronbach’s alpha, of the scale would decrease by 0.009 if this question were removed. When placed with Factor 2, however, the reliability decreases by 0.025 when the item was removed. Although the effect was small in both cases, the item had a greater effect on the reliability of Factor 2 than Factor 1; therefore, it was placed in this category. This analysis was performed with all items that loaded significantly on more than one item.

After sorting the items into categories based on their factor loadings, the three factors were named based on common features of the questions in each group. These factors were
labeled “efficacy for technology use in student-centred activities” (9 items), “efficacy for collaboration with others” (5 items), and “efficacy for accessing resources and professional development” (6 items). In order to determine whether the factors truly represented measurement of a similar construct, alpha values for each subscale were obtained. Additionally, the average efficacy and standard deviation of the responses were calculated in order to determine if efficacy was similar across all categories. This information is displayed in Table 8.

Table 8

<table>
<thead>
<tr>
<th>Scale/Subscale Analyzed</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full SCUTTES Survey</td>
<td>5.64</td>
<td>2.18</td>
<td>0.949</td>
</tr>
<tr>
<td>Technology use in student-centred activities</td>
<td>5.82</td>
<td>2.20</td>
<td>0.922</td>
</tr>
<tr>
<td>Collaboration with others</td>
<td>5.39</td>
<td>2.19</td>
<td>0.857</td>
</tr>
<tr>
<td>Accessing professional development/resources</td>
<td>5.57</td>
<td>2.15</td>
<td>0.862</td>
</tr>
</tbody>
</table>

The alpha values for each subscale indicated that they are reliably measuring the same construct. Additionally, there was little difference between the means and standard deviations of the three subscales, indicating that teacher self-efficacy is affected equally by all the factors. The possible interpretation of these three factors on teacher self-efficacy will be further discussed in the concluding chapter.

**Qualitative Data**

The online survey contained an optional space for teachers to leave comments at the end of each page. The responses provide insight into the reasons for the low average efficacy on tasks related to the use of technology for student-centred learning as measured on the SCUTTES
scale. Several teachers began their responses by stating that the survey questions were misleading; as one teacher stated, “I could do many of these things; I don’t, but I could.” Many of the comments identified barriers that may prevent teachers from carrying out technology-enhanced student-centred learning despite having the desire or skill to do so. These barriers were divided into three main categories: resources (including time), training, and school policy. This section will briefly summarize the comments of teachers in relation to each category.

**Lack of resources**

Lack of resources, in particular functioning computers, was the most commonly mentioned barrier in the comments section. Many teachers noted that there are an inadequate number of computer labs for the number of students in their school. Lack of technology access in the homes of lower-income families was also a frequently stated problem, as some students cannot afford a smart phone or Internet-enabled computing device. As one teacher stated, “The issue is not the desire to use technology; it is the lack of funding that leads to a dearth of technology.” This sentiment was echoed in several other comments, and many teachers felt that they could use technology in student-centred ways, such as using class blogs or collaborating with Google documents, but were limited by a lack of funding for technological resources and equipment.

**Training**

Many comments also focused on a desire for greater access to training and professional development. As one teacher noted, “There is no such program that is not possible to handle; you just need to receive time and training to learn it.” Another teacher noted that professional development was available, but was paid for by the teacher with possible reimbursement. Several teachers also commented on wishing to receive training for specific hardware or software,
including BCESIS (British Columbia Enterprise Student Information System) and iPads. One teacher commented that “a lot of these questions depend on the teacher’s ability to engage and use technology to the benefit of the student in learning,” something that could be improved through greater professional development and training.

**Policy**

School and district policy were also mentioned frequently as barriers to implementing technology use for student-centred learning. Several teachers commented that they have been advised to be cautious in “engaging in social interaction in online communities in any forum which may be seen by students.” Although it makes sense for teachers to be prudent in their choice of online social communities, a key feature of 21st century learning environments is online digital collaboration. Therefore, district and school policies that discourage social media or mobile learning on cellular phones constitute a barrier to this kind of collaboration. One teacher also noted that although avenues exist to advocate for changes to school policy, there is “no perceivable effect” after the issue has been communicated.

**Chapter Summary**

The results from the survey instruments were summarized in relation to the questions posed by the study. The SCUTTES was determined to be a reliable and valid measure of teacher self-efficacy through the calculation of its internal consistency and a strong correlation with an established measure of teacher self-efficacy, the TSES. Statistical analysis showed that on average, teachers feel less efficacious on tasks relating to technology-enhanced student-centred learning, as measured by the SCUTTES, than on traditional teaching tasks, as measured by the TSES. Content analysis of the comments left by some respondents indicated that some possible
reasons for low efficacy on teaching with technology include access to resources, access to training opportunities, and restrictive school and district policies.

The SCUTTOES was found to have a low alpha value, indicating a low degree of correlation between items. When the scale was divided into positive and negative outcome statements, the reliability increased to an acceptable standard for the positive outcome statements, but was still low for the negative outcomes. A correlation between the SCUTTES (see Appendix E) and SCUTTOES (see Appendix F) was determined, as teachers with high efficacy for the use of technology for student-centred learning also demonstrate more positive outcome expectations from technology use. Likewise, a negative correlation existed between positive efficacy expectations and negative outcome expectations. There was no significant difference between the responses for the positive and negative outcome expectancy items, indicating that teachers, regardless of efficacy, hold both positive and negative outcome expectancies for technology use.

The factor structure of the SCUTTES scale was determined, and three factors were identified. They were named efficacy for technology use in Student-centred activities (9 items), efficacy for collaboration with others (5 items), and efficacy for accessing resources and professional development (6 items). The internal consistency of each subscale was calculated, and each subscale was shown to have high alpha values. The average and standard deviation for each subscale were not statistically different from each other, indicating that all factors are equally influential on a teacher’s efficacy expectations.

In the next chapter, I will discuss the implications of these findings in relation to professional development and support for teachers in the integration of technology-enhanced
student-centred learning environments. Recommendations for schools and district policy as well as ideas for further research will also be discussed.
CHAPTER FIVE: DISCUSSION, RESEARCH IMPLICATIONS AND RECOMMENDATIONS

The key themes, reliability, and application of the information gathered in this research are the key focus of this chapter. I will first discuss the findings of the study followed by a description of the limitations of the research and suggestions for future investigation. This will be followed by a discussion of the implication of the findings for Lower Mainland schools and suggestions for professional development and policy to increase teacher self-efficacy in relation to technology-enhanced student-centred learning.

Discussion of Survey Results

Earlier in this paper, two components of efficacy were identified and defined. Outcome expectations were defined as “a person’s estimate that a given behavior will lead to certain outcomes; . . . [whereas an efficacy expectation was defined as] the conviction that one can successfully execute the behavior required to produce the outcomes” (Bandura, 1977, p. 193). In this study, efficacy expectations were measured using the SCUTTES scale, and outcome expectations were measured using the SCUTTOES scale, both of which were developed within this study as preliminary tools for the study of teacher efficacy in relation to technology-enhanced student-centred learning. Overall, it was found that teachers had low efficacy on tasks related to technology-enhanced student-centred learning when compared to their efficacy expectations for traditional teaching tasks. Perceived self-efficacy was also positively correlated with outcome expectations, as teachers who scored higher on the SCUTTES also identified more with the positive outcomes associated with the use of technology for student-centred learning. The results on the SCUTTES scale are further outlined in this section, followed by a discussion of the SCUTTOES results.
The Measurement of Teacher Self-Efficacy

**SCUTTES results**

Comparison of results from the SCUTTES and TSES surveys indicated that in general, teachers feel more efficacious on tasks related to traditional teacher-centred instruction than tasks associated with technology-enhanced student-centred learning. Self-efficacy is not an omnibus measure and is most predictive of behaviour when applied to specific contexts and tasks (Bong, 2006). It logically follows that efficacy and behavioural choices are self-reinforcing. A higher feeling of efficacy tends to produce a greater effort in the individual to persist with tasks in which they feel efficacious, and a low feeling of efficacy will cause a person to avoid the tasks that evoke this feeling (Tschannen-Moran et al., 1998). This has implications for teaching behaviour, as implementation of change initially “has a negative impact on teachers’ personal efficacy” (p. 237), and overcoming this barrier is difficult. When given the choice between different behaviours, people generally choose the behaviour with which they feel efficacious and “shun what they feel inefficacious to perform” (Bandura, 1997, p. 464). The feeling of higher efficacy on traditional teaching tasks may cause teachers to continue to choose teacher-centred over student-centred pedagogies, as they feel more efficacious with these methods.

This may explain why technological equipment is primarily used to support teacher-centred instruction, such as using a PowerPoint to deliver a lecture (Education Development Center, 2011; Ottenbreit-Leftwich et al., 2010; Palak & Walls, 2009). This tendency makes sense in the context of the efficacy expectations of teachers as measured by the SCUTTES and TSES. Because teachers feel more efficacious in teacher-directed activities, as measured by the TSES, it follows that technology would initially be used to fit in with teaching pedagogies that are familiar and have been successful in the past. In addition, high self-efficacy tends to be cyclical in nature, as “greater efficacy leads to greater effort and persistence, which leads to better
performance, which in turn leads to greater efficacy” (Tschannen-Moran et al., 1998, p. 234).

This means that a person tends to repeat and reinforce behaviours in which they feel efficacious and avoid those that give them a feeling of low efficacy. Since teachers in general feel more efficacious on the tasks related to teacher-directed, traditional instruction, these behaviours are reinforced, while behaviours related to technology-enhanced student-centred learning are likely avoided due to the feeling of low efficacy they inspire. Bandura (1997) noted that changing a person’s efficacy beliefs requires “compelling feedback that forcefully disputes the pre-existing disbelief in one’s capabilities” (p. 82). Therefore, the challenge presented to professional development programs seeking to improve the integration of technology for student-centred learning is to persuade teachers to change from a method of behaviour in which they feel efficacious to one in which they may feel low efficacy. Possible strategies for managing this transition will be discussed following the summary of the SCUTTOES survey, as addressing outcome expectancies is also important to instituting behaviour change.

**SCUTTOES results**

Teacher responses to the SCUTTOES indicated that there was no statistically significant difference between the expectation of positive outcomes or of negative outcomes. Despite a lack of significant difference, however, some of the items on the outcome expectancy scale bear mentioning, as they represent some interesting insights into teachers’ beliefs regarding the outcomes of technology use. While there was general agreement that technology use in the classroom was needed to prepare students for the 21st century workplace, with 83% of respondents selecting a 6 or higher on the 9-point scale, there was far less agreement that teachers needed technological skills in order to remain employed, with only 70% of teachers agreeing to this statement with a score of 6 or higher. People take action when they hold efficacy
The Measurement of Teacher Self-Efficacy

and outcome expectations that make the effort of learning new skills worthwhile (Bandura, 1997). If 30% of teachers do not believe that technological skills are needed to gain and keep employment in teaching, this can represent a significant impediment to their incentive to learn these new skills. Therefore, training to increase the use of technology for student-centred learning should begin with the notion that “effective teaching requires effective technology use” (Ertmer & Ottenbreit-Leftwich, 2010, p. 256). Linking technological effectiveness with teaching effectiveness is an essential first step because it provides the forceful disruption of existing beliefs that can lead to behaviour change. Teachers must be aware that although they may feel efficacious in using traditional teacher-centred strategies, these techniques are no longer the best practice for instruction in the digital age (Ertmer & Ottenbreit-Leftwich, 2010).

The results of the SCUTTES and SCUTTOES also showed a correlation between outcome expectancies and efficacy. The higher the efficacy expectations of a teacher with regard to technology-enhanced student-centred learning, the more positive outcomes (and fewer negative outcomes) they anticipated from the use of technology. This was supported by Bandura’s (1997) assertion that when “people see outcomes as contingent on the adequacy of their performance, and care about these outcomes, that they rely on efficacy beliefs in deciding which course of action to pursue and how long to pursue it” (p. 24). The types of outcomes that people envision depend on how well they believe they can perform on the tasks that produce these outcomes (Bandura, 1997). Therefore, as efficacy for tasks related to technology-enhanced student-centred learning increases, it logically follows that teachers will experience an increase in positive outcome expectancies, as they now feel more capable of achieving these results. Because efficacy expectations and outcome expectations are positively correlated, professional development can focus primarily on improving the efficacy of teachers on tasks as measured by
the SCUTTES, as an improvement in efficacy should produce a corresponding increase in outcome expectations. The limitations of this study and suggestions for further research are outlined in the next section.

**Limitations of the Research**

While it appeared that the SCUTTES is a valid and reliable measure of teacher efficacy, the low response rate to the survey (23%) and small sample size (68) placed limitations on the ability to fully evaluate the scale’s reliability and validity. The small sample size may also have impacted the findings of the factor analysis, as a larger sample might have generated different results.

There was little consensus on the appropriate sample size needed to carry out a factor analysis (Pett et al., 2003). Some researchers, such as Nunnally (as cited in Pett et al., 2003), have suggested that at least 10 subjects per variable are required, which on the 21 items of the SCUTTES would suggest a minimum of 210 respondents. Others have developed general guidelines for sample sizes, such as Comrey and Lee (as cited in Pett et al., 2003), who defined sample sizes between 50-100 as “poor” and samples over 1,000 as “excellent”, with a series of descriptors for intermediate values of the scale.

In general, the literature concerning factor analysis indicated that larger sample sizes are preferable to smaller sample sizes, but there was little agreement on what constitutes a minimally acceptable sample (MacCallum, Widaman, Zhang, & Hong, 1999). A Monte Carlo study conducted by MacCallum et al. (1999) aimed to determine whether a general minimum population exists for factor analysis, or if the minimum required number of participants varies according to the characteristics of the survey and sample. The findings indicate that small sample sizes (i.e., less than 100) can provide good approximations of population characteristics when
two features are present: high commonalities on variables, between 0.4 and 0.7, and several
variables loading on each factor, at a minimum ratio of 4 to 1 (Costello & Osborne, 2005;
MacCallum et al., 1999). Both of these conditions were met by the data collected by the
SCUTTES instrument, as each of the three factors extracted had more than four variables loading
on it with minimal cross-loading, and high commonalities (i.e., greater than 0.4) were recorded
for all variables. While these characteristics did not guarantee that the sample was representative
of the population, the commonality and high variable to factor ratio of the matrix lent credibility
to the findings of the study.

In order to confirm the scale’s reliability and factor structure, the SCUTTES instrument
should be used in future studies with larger sample sizes. Response rates could be improved by
the distribution of a paper version of the survey to school staff, using the results to guide
professional development programs. The survey was distributed to schools between the months
of January to April 2013, and many of the schools contacted expressed concerns that their staff
would not have the time to complete the survey because they were already busy with exams and
other research projects. Distribution of the survey earlier in the school year, perhaps in October,
may have increased response rates, as that time frame is well before exams and after the initial
transition period of September. Taking the survey early in the school year could also allow
schools to use the SCUTTES as a measure of the success of professional development, as it
could be distributed both before and after the school year to determine if efficacy has improved
as a result of training programs. The SCUTTES and SCUTTOES are a preliminary attempt to
measure teacher efficacy beliefs for technology-enhanced student-centered learning, and further
use of the instruments to confirm the findings of this study is recommended. Tests of
discriminate and predictive validity are also recommended to confirm the use of the instruments for professional development and training programs.

Although 11 of the 21 questions asked in the SCUTTES loaded significantly on only one factor, nine cross-loaded on two factors, and one question loaded strongly on all three factors. This question, “To what extent can you use digital tools to grade formative and summative assessments?” was removed from the final analysis. A larger sample size could assist in clarifying the correct placement of cross-loaded items; therefore, repeated use of the SCUTTES instrument would provide a more consistent picture of its reliability and validity in the measure of teacher self-efficacy in relation to technology-enhanced student-centred learning. The reliability and validity would also be enhanced by a more diverse sample population, perhaps selecting from rural and city school districts or with more elementary school teachers represented in the sample.

In order to condense the survey into a manageable number of questions and concepts, items on the ISTE NETS for administrators (ISTE, 2009a), students (ISTE, 2009b), and teachers (ISTE, 2009c) were grouped into related concepts, and only some competencies from each group were made into questions. Perhaps future studies could use a longer version of the survey to determine if there are other concepts not tested in the SCUTTES that may influence the factor structure and findings of this study in relation to the efficacy of teachers in relation to the tasks of technology-enhanced student-centred learning. These limitations open up opportunities for further research using the SCUTTES as a measure of teacher efficacy in technology-enhanced student-centred learning environments.
Application of Survey Findings

The factor structure of the SCUTTES indicated that there were three components to teacher self-efficacy for the use of technology for student-centred learning, which could be interpreted as follows. Efficacy for accessing resources and professional development may represent the impact of the physical school environment on efficacy. Facilitating access to physical resources such as computers and to training opportunities may increase efficacy in this area. Efficacy for collaboration with others may indicate collective efficacy, and promoting opportunities for teachers to interact and collaborate can positively impact efficacy on this factor. Efficacy for technology use for student-centred learning may represent personal teaching efficacy, which could be increased through training programs that allow for successful modeling and practice of student-centred learning techniques. Personal and collective efficacy stems from four main sources: (a) personal performance accomplishments, (b) vicarious experiences, (c) verbal persuasion, and (d) physiological state (Bandura, 1977). Any professional development program that seeks to build efficacy must, therefore, include components of each source of self-efficacy and address all three factors from the SCUTTES scale. Mastery modeling is a technique used in organizational change that is grounded in social cognitive theory and, thus, contains elements of each component in its approach to behaviour change. In the following section, I will outline the components of mastery modeling and how they might be applied to produce behaviour change from teacher-centred to student-centred learning environments in educational systems.

Mastery modeling

Mastery modeling includes three major components (Bandura, 1997, p. 440):

1. The desired occupational skills are modeled to convey the basic rules and strategies.
2. The learners receive guided practice with these rules and strategies under low-risk, simulated conditions.

3. Learners are assisted in the application of these skills to their work situations in ways that will ensure success.

**Phase 1: Instructive modeling**

In order for teachers to make the necessary changes in personal practice to adopt information age teaching techniques, they must both “learn to use technology and they must fundamentally change how they teach” (Levin & Wadmany, 2008, p. 235). Vicarious experiences, through the use of technology role models, can provide teachers with ideas for how technology use for student-centred learning appears in practice (Ertmer & Ottenbreit-Leftwich, 2010). Technology role models can be either selected teachers at the school in question, or they could be role models from similar schools who have been filmed using techniques associated with technology-enhanced student-centred learning. Technology role models demonstrate to teachers how they implement student-centred learning with technology in their classroom and also verbalize their thought processes as they go through the task. This might mean explaining their choice of arrangement of computers in the classroom for classroom management purposes, explaining the benefits and expected outcomes of their learning activity or explaining how the learning task fits with the curriculum, which encourages information age digital literacy skills.

It is recommended that the role model also talk through challenges they face when implementing student-centred learning activities and verbalize their strategies for coping with impediments, recovering from mistakes, and staying motivated (Bandura, 1997). It is suggested that tasks modeled reflect items on the SCUTTES, such as the use of digital collaboration tools, assessment of student work and analysis of assessment data, managing a class where each
student is pursuing their own goals, and troubleshooting technological systems and applications that teachers are likely to use in the class. There are obviously a great number of new skills to be learned, so it is important that models do not present too many at once, as this may lead to cognitive overload and an aversion to trying the new techniques. Phase 1 of the program addresses the first factor in the SCUTTES—efficacy for technology-use in student-centred learning—by providing vicarious examples of classroom practices that promote digital age instruction.

**Phase 2: Guided skill perfection**

Following the modeling of the procedure, it is suggested that teachers be given the opportunity to practice their skills in simulated situations where they do not need to worry about making mistakes or appearing inadequate. This could be accomplished by placing teachers into groups and asking each group to prepare a lesson that uses the technique modeled by the technology role models. Groups would then present their lessons to each other and give constructive feedback that reflects both the strengths of their delivery and suggestions for improvement. The leaders of the professional development can also discuss potential problems teachers will encounter when applying these skills in a classroom context and provide some strategies for overcoming these difficulties. Phase 2 addresses both individual and collective efficacy, corresponding to two of the factors on the SCUTTES scale: (a) efficacy for technology use in student-centred learning and (b) efficacy for collaboration with others. Personal and collective efficacies are enhanced by allowing teachers to practice new skills (i.e., personal efficacy) and give and receive feedback from other teachers (i.e., collective efficacy).
Phase 3: Transfer of skills to the workplace

When transferring skills back to the workplace, it is recommended that teachers be given opportunities to try and reflect on their new skills. Training programs can accomplish this by requiring teachers to incorporate their newly learned skill within a few weeks of the training and then meeting again to discuss their successes or challenges. Professional development activities could be ongoing and situated within the real classroom experience (Hew & Brush, 2007), with opportunities for reflection and discussion with other teachers provided as an integral component of the change process. As teachers gain experience in using technology for student-centred activities, they will likely begin to see positive results, which induces the cyclical nature of efficacy building and results in continued improvement in both efficacy and outcome expectations. The continued discussion surrounding the implementation of student-centred activities in the classroom will build efficacy for collaboration with others and contribute to the collective efficacy of the school.

Suggestions for implementation

Teachers have traditionally performed much of their work in isolation, and the most commonly used model for professional development is “one of long periods, during which teachers work alone, interspersed with an organizational one-day training workshop or expert presentation on a pre-packaged program or resource” (Borg, 2012, p. 301). These models are no longer adequate to keep up with the pace of technological change and to implement the sweeping changes in pedagogy associated with technology-enhanced student-centred learning (Cole, Simkins, & Penuel, 2002). Instead, professional development needs to be sustained, collaborative, and situated in authentic classroom experiences in order to be effective (Cole et al, 2002). It is suggested that schools and districts ensure collaboration between teachers is
encouraged and expected as part of their professional development programs. Collaboration is often constrained by “a lack of time to meet and plan, implement and evaluate [school] practices” (Borg, 2012, p. 309). This lack of time can be addressed by creating flexible timetables, maintaining appropriate levels of staffing, and providing teachers with release time for collaborative planning (Borg, 2012). Providing teachers with the time necessary for collaboration will involve changing the current structure of many school timetables, which still reflect the traditional schooling system whereby a teacher spends most of their time instructing alone in front of the classroom. By cultivating a shared vision for collaborative cultures and providing time through flexible scheduling and appropriate staffing, schools can facilitate greater knowledge sharing and collective efficacy within their professional communities.

Perhaps the best way to implement a new kind of professional development program based on mastery modeling is for the district to begin with a small group of pilot schools. Because effective reform involves the cooperation of the whole school community, it is important that pilot schools indicate they have the support of the staff in implementing the professional development program, and they could be offered incentives such as increased funding for technology systems as part of program participation. These incentives are designed to address the third component of efficacy, access to training and resources, as the pilot program will provide both. The pilot schools could then implement a professional development program based on mastery modeling, in which behaviours are modeled, practiced, and then introduced into the classroom setting. The whole process could be documented and filmed, as the experiences of the pilot schools can be used as models for future schools that adopt the program. It is suggested that the pilot program be monitored, perhaps through action research, and changes in teacher efficacy and outcome expectations measured using the SCUTTES and SCUTTOES
scales throughout the change process. The documentation, continued collaboration, and research on progress toward program objectives would allow the professional development program to respond to the needs of the teaching staff as they progress through the change process. The program can then be disseminated from the pilot schools to other schools in the district, as “there is nothing more persuasive than seeing effective practices in use” (Bandura, 1997, p. 514). Since self-efficacy attributes are grounded in social cognitive theory, a professional development program that is designed to raise efficacy should also be based on this approach. It is for this reason that a mastery modeling approach to teacher training is recommended for professional development.

**Perceived challenges to the implementation of change**

Despite providing educators in British Columbia with an overall vision of change to a more technology-driven and student-centred education system, in response to *BC’s Education Plan* (Abbott, 2011), the BC Ministry of Education (2011) has acknowledged that they are “faced with serious fiscal challenges . . . [with] no easy solutions” when attempting to implement the ideals of the plan (para. 5). Funding is needed to upgrade computers and network systems and to provide the needed training and collaboration opportunities for staff. Perhaps by starting the program with pilot schools, the costs of upgrading school computer infrastructure can be spread out over many years, with schools receiving new technology as part of the incentive for joining the professional development program. This leads to some ethical considerations about the choice of schools for the pilot program, so it would be important that participant schools go through an application process that is transparent and rests on criteria determined by the district. Continued participation in the project would also be guided by adherence to the training, as teachers and schools must be working on implementing the new practices and recording them for
the use of other schools that join the project at a later date. To assist with its dissemination, teachers and administrators at participant schools would need to also be willing to take on mentorship roles at other area schools upon completion of the project. Funding is a complex issue that will continue to greatly affect the ability of British Columbian schools to implement the ideals of the *BC’s Education Plan*. Further research into ways of increasing school funding or stretching school budgets to accommodate more staff and training could be an important focus in future research.

**Chapter Summary**

As society transitions from an industrial age to an information age, learning practices that promote student-centred, self-directed study and collaboration are essential to prepare students for the modern workplace (Watson & Reigeluth, 2008). Despite investments in technology and training, education systems have been slow to adopt technology-based student-centred learning (Palak & Walls, 2009). Efficacy and outcome expectations towards the tasks associated with technology-enhanced student-centred learning may illustrate reasons for why education systems have been slow to transition to a more student-centred model of learning. This study aimed to develop a valid and reliable instrument for the measurement of teacher efficacy and outcome expectations in relation to their ability to perform tasks associated with technology-enhanced student-centred learning.

The two scales developed in the study were termed the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES) and the Student-Centred Use of Technology Teacher Outcome Expectancy Scale (SCUTTOES). The SCUTTES demonstrated high reliability and both content and construct validity through assessment by a panel of experts and correlation with an existing measure of teacher efficacy, the Teachers’ Sense of Efficacy Scale (TSES). The
factor structure of the SCUTTES was analyzed, and three factors were extracted. The factors were tested for internal consistency and termed efficacy for technology use in student-centred activities, efficacy for collaboration with others, and efficacy for accessing resources and professional development. Repeated use of the SCUTTES with larger sample sizes is recommended in order to confirm the factor structure, reliability, and validity of the measure for assessing teacher efficacy in relation to technology-enhanced student-centred learning.

The SCUTTOES scale was separated into positive outcome expectancies and negative outcome expectancies. The responses demonstrated that teachers expect both positive and negative outcomes from technology use. Efficacies were positively correlated with positive outcome expectancies and negatively correlated with negative outcome expectancies, reinforcing the theoretical relationship between the two components as outlined by social cognitive theory (Bandura, 1997). A statistically significant difference was found between teachers’ efficacy for student-centred learning, as measured by the SCUTTES, and efficacy for traditional teaching tasks, as measured by the TSES. In general, teachers were more efficacious on traditional teaching tasks than those associated with technology-enhanced student-centred learning.

The findings of this study have indicated several possible reasons for the slow pace of change in educational systems to address the needs of the information society. First, because self-efficacy tends to predict courses of action an individual will choose, higher efficacy on traditional teacher-centred tasks means that teachers will continue to choose this method of instruction over student-centred instruction. This partially explains why technology integration has been primarily teacher-centred and suggests that educational reform must begin with acknowledging that this method of instruction is no longer the best practice for teaching in the digital age (Ertmer & Ottenbreit-Leftwich, 2010). Positive outcome expectancies were positively
correlated with increases in efficacy, indicating that as teachers’ efficacy on technology-enhanced student-centred learning tasks improves, they are more likely to associate positive outcomes with technology use. A mastery modeling approach to professional development was recommended due to the effectiveness of mastery modeling in improving efficacy.

There were several limitations in this study that can be addressed through future research. The small sample size of 68 respondents, drawn primarily from two secondary schools in the Vancouver district, makes it difficult to generalize the results of this study to all British Columbian educators. Further studies should be conducted with the SCUTTES and SCUTTOES with larger sample sizes, perhaps by distributing a paper version of the survey, providing teachers with the survey at a different time of year, and/or encouraging schools to use the survey directly as part of their professional development programming. With repeated use and larger samples, the validity and reliability of the two scales can be refined and their application to implementing education reform determined. Future studies involving tests of predictive and discriminate validity are also recommended. The qualitative data collected indicated that the primary barrier to improving technology use in education was funding, thus further research into ways to improve school budgets to allow for the transition of schools into information age learning environments is recommended. The qualitative data could also be used to generate new items for the SCUTTES and SCUTTOES surveys, as teachers have identified challenges that affect their ability to perform tasks related to technology-enhanced student-centered learning.

The research accomplished its aim of creating a preliminary measure of teacher efficacy in relation to the use of technology for student-centred learning that is valid and reliable. According to social cognitive theory, changes in behaviour derive from the common cognitive mechanism of self-efficacy (Bandura, 1977). Increasing teacher efficacy in relation to tasks for
technology-enhanced student-centred learning can assist teachers and educational organizations to persist in the face of challenges presented by the transformation from an industrial age to information age schooling paradigm. The instruments created in this study could be an important tool in measuring the success of reform efforts aimed at improving teacher and collective efficacy, as changes in efficacy could be measured and used to determine the effectiveness of professional development programs.
REFERENCES


Bong, M. (2006). Asking the right question: How confident are you that you could successfully perform these tasks? In T. Urdan & F. Pajares (Eds.), *Self-efficacy beliefs of adolescents* (pp. 287-305). Greenwich, CT: Information Age.


APPENDIX A: THE ISTE NETS STANDARDS FOR ADMINISTRATORS

1. **Visionary Leadership** – *Educational Administrators inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization.*
   
a. Inspire and facilitate among all stakeholders a shared vision of purposeful change that maximizes use of digital-age resources to meet and exceed learning goals, support effective instructional practice, and maximize performance of district and school leaders
   
b. Engage in an ongoing process to develop, implement, and communicate technology-infused strategic plans aligned with a shared vision
   
c. Advocate on local, state, and national levels for policies, programs, and funding to support implementation of a technology-infused vision and strategic plan

2. **Digital Age Learning Culture** – *Educational Administrators create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students.*
   
a. Ensure instructional innovation focused on continuous improvement of digital-age learning
   
b. Model and promote the frequent and effective use of technology for learning
   
c. Provide learner-centered environments equipped with technology and learning resources to meet the individual, diverse needs of all learners
   
d. Ensure effective practice in the study of technology and its infusion across the curriculum
   
e. Promote and participate in local, national, and global learning communities that stimulate innovation, creativity, and digital age collaboration

3. **Excellence in Professional Practice** – *Educational Administrators promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources.*
   
a. Allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration
   
b. Facilitate and participate in learning communities that stimulate, nurture and support administrators, faculty, and staff in the study and use of technology

c. Promote and model effective communication and collaboration among stakeholders using digital age tools

d. Stay abreast of educational research and emerging trends regarding effective use of technology and encourage evaluation of new technologies for their potential to improve student learning

4. **Systemic Improvement** – *Educational Administrators provide digital age leadership and management to continuously improve the organization through the effective use of information and technology resources.*

   a. Lead purposeful change to maximize the achievement of learning goals through the appropriate use of technology and media-rich resources  

   b. Collaborate to establish metrics, collect and analyze data, interpret results, and share findings to improve staff performance and student learning  

   c. Recruit and retain highly competent personnel who use technology creatively and proficiently to advance academic and operational goals  

   d. Establish and leverage strategic partnerships to support systemic improvement  

   e. Establish and maintain a robust infrastructure for technology including integrated, interoperable technology systems to support management, operations, teaching, and learning

5. **Digital Citizenship** – *Educational Administrators model and facilitate understanding of social, ethical and legal issues and responsibilities related to an evolving digital culture.*

   a. Ensure equitable access to appropriate digital tools and resources to meet the needs of all learners  

   b. Promote, model and establish policies for safe, legal, and ethical use of digital information and technology  

   c. Promote and model responsible social interactions related to the use of technology and information

   d. Model and facilitate the development of a shared cultural understanding and involvement in global issues through the use of contemporary communication and collaboration tools.
APPENDIX B: THE ISTE NETS STANDARDS FOR STUDENTS

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
   
a. Apply existing knowledge to generate new ideas, products, or processes
b. Create original works as a means of personal or group expression
c. Use models and simulations to explore complex systems and issues
d. Identify trends and forecast possibilities

2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
   
a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
c. Develop cultural understanding and global awareness by engaging with learners of other cultures
d. Contribute to project teams to produce original works or solve problems

3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
   
a. Plan strategies to guide inquiry
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
d. Process data and report results

4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
   
a. Identify and define authentic problems and significant questions for investigation

---

5. **Digital Citizenship** – *Students understand human, cultural, and societal issues related to technology and practice legal and ethical behaviour.*
   
   a. Advocate and practice safe, legal, and responsible use of information and technology
   
   b. Exhibit a positive attitude toward using technology that supports collaboration, learning and productivity
   
   c. Demonstrate personal responsibility for lifelong learning
   
   d. Exhibit leadership for digital citizenship

6. **Technology Operations and Concepts** – *Students demonstrate a sound understanding of technology concepts, systems, and operations.*
   
   a. Understand and use technology systems
   
   b. Select and use applications effectively and productively
   
   c. Troubleshoot systems and applications
   
   d. Transfer current knowledge to learning
APPENDIX C: THE ISTE NETS STANDARDS FOR TEACHERS

1. Facilitate and Inspire Student Learning and Creativity – Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.
   
a. Promote, support, and model creative and innovative thinking and inventiveness
   
b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources
   
c. Promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes
   
d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

2. Design and Develop Digital Age Learning Experiences and Assessments – Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS-S:
   
a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
   
b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress
   
c. Customize and personalize learning activities to address students’ diverse learning styles, working strategies, and abilities using digital tools and resources
   
d. Provide students with multiple and varied formative and summative assessment aligned with content and technology standards and use resulting data to inform learning and teaching.

3. Model Digital Age Work and Learning – Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.
   
a. Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations

---

b. Collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation

c. Communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital age media and formats

d. Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning

4. **Promote and Model Digital Citizenship and Responsibility** – *Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behaviour in their professional practices.*

   a. Advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources

   b. Address the diverse needs of all learners by using learner-centered strategies providing equitable access to appropriate digital tools and resources

   c. Promote and model digital etiquette and responsible social interactions related to the use of technology and information

   d. Develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital age communication and collaboration tools.

5. **Engage and Professional Growth and Leadership** – *Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.*

   a. Participate in local and global learning communities to explore creative applications of technology to improve student learning

   b. Exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others

   c. Evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning

   d. Contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community
APPENDIX D: THE STUDENT-CENTRED USE OF TECHNOLOGY TEACHER EFFICACY SCALE

This questionnaire is designed to gain a better understanding of the kinds of things that create difficulties for teachers in using technology for student-centred learning. Please indicate your opinions about each of the statements below by circling the appropriate number. Your answers will be kept strictly confidential and will not be identified by name. The survey consists of 20 questions and should take approximately 5 minutes to complete. Your participation in this research is voluntary. You may choose not to participate or withdraw at any time during the study.

1. To what extent can you model innovative thinking to your students?
1 2 3 4 5 6 7 8 9
None  Very Little  Some Influence  Quite a bit  A Great Deal

2. How much can you do to develop personal responsibility for lifelong learning in your students?
1 2 3 4 5 6 7 8 9
None  Very Little  Some Influence  Quite a bit  A Great Deal

3. To what extent can you evaluate student work that is provided in a variety of media/formats?
1 2 3 4 5 6 7 8 9
None  Very Little  Some Influence  Quite a bit  A Great Deal

4. To what extent can you advocate for school policies to support implementation of a technology-infused curriculum?
1 2 3 4 5 6 7 8 9
None  Very Little  Some Influence  Quite a bit  A Great Deal
5. How well can you engage students in exploring real-world issues using digital tools and resources?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal

6. To what extent can you encourage students to reflect on their learning using digital collaborative tools (e.g. blogs, wikis)?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal

7. How well can you model responsible social interactions in online communities to your students?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal

8. To what extent can you create learning tasks for your students that require them to collaborate with students in other schools?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal

9. To what extent can you discuss the use of technology with teachers in your school?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal

10. To what extent can you adapt your lesson plans to incorporate digital tools and resources?

1  2  3  4  5  6  7  8  9
None  Very Little  Some Influence  Quite a bit  A Great Deal
11. To what extent can you assume a leadership role in demonstrating a vision of technology integration?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

12. To what extent can you access technology systems to support teaching and learning?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

13. To what extent can you manage a class in which each student is pursuing their own personalized learning activities?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

14. How well can you assist students to plan strategies that will guide their own inquiry?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

15. How well can you use technology to analyze assessment data?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

16. To what extent can you access professional development opportunities focusing on continuous improvement of digital-age teaching skills?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal

17. To what extent can you access role models for the effective use of technology?

1  2  3  4  5  6  7  8  9
None Very Little Some Influence Quite a bit A Great Deal
18. To what extent can you stay abreast with emerging trends regarding the effective use of technology?
1 2 3 4 5 6 7 8 9
None Very Little Some Influence Quite a bit A Great Deal

19. How well can you instruct students in the use of computers?
1 2 3 4 5 6 7 8 9
None Very Little Some Influence Quite a bit A Great Deal

20. How well can you troubleshoot technological systems and applications?
1 2 3 4 5 6 7 8 9
None Very Little Some Influence Quite a bit A Great Deal

Please provide us with a little more information about yourself. This information will be used for research purposes only and will be kept confidential.

1. Gender □ Male □ Female

2. Age
□ 20 years and under □ 21 – 30 years □ 31 – 40 years
□ 41 – 50 years □ 51 – 60 years □ over 60 years

3. Years of Teaching Experience
□ less than 5 years □ 6 – 10 years □ 11 – 15 years
□ 16 – 20 years □ over 20 years
4. What grade level do you currently teach? Please check all that apply.

☐ Nursery/Kindergarten  ☐ Grade 1  ☐ Grade 2  ☐ Grade 3  ☐ Grade 4
☐ Grade 5  ☐ Grade 6  ☐ Grade 7  ☐ Grade 8  ☐ Grade 9
☐ Grade 10  ☐ Grade 11  ☐ Grade 12

5. What subject(s) do you currently instruct? Please check all that apply.

☐ Art  ☐ Science
☐ Music  ☐ Drama
☐ Language Arts  ☐ Mathematics
☐ Social Studies  ☐ Physical Education
☐ Other (please specify): ________________________________
APPENDIX E: THE STUDENT-CENTRED USE OF TECHNOLOGY TEACHER OUTCOME EXPECTANCY SCALE (SCUTTOES)

This questionnaire is designed to gain a better understanding of the kinds of outcomes that teachers expect when using technology for Student-centred learning. Please indicate the extent to which you agree with each of the statements below by selecting the appropriate choice on the rating scale. Your answers will be kept strictly confidential and will not be identified by name. This section of the survey consists of 10 questions and should take approximately 5 minutes to complete. Your participation in this research is voluntary. You may choose not to participate or withdraw at any time during the study.

1. Technology allows students to develop interpersonal skills.


2. Technology use for project-based learning requires more class time than direct instruction.


3. Teachers must continue to update their technological skills in order to gain and keep employment.


4. Technology use improves overall student achievement on standardized tests.


5. Technology use encourages student participation in achieving learning goals.

6. Technology use requires large amounts of preparation time.


7. Technology is unreliable.


8. Technology use improves the critical thinking abilities of students.


9. The use of technology in the classroom helps prepare students for the 21st century workplace.


10. Technology use for student-centred learning makes it difficult to focus on the learning objectives of the curriculum.

Dear Sir or Madam,

We would like to invite the Vancouver School District (No. 039) to participate in a research study that measures teachers’ beliefs about their ability to use technology for student-centred learning in the classroom. This research is being conducted by Lucy Ferreira and Jennifer Walinga as part of a Master’s thesis in Learning and Technology from Royal Roads University. Funding for this research is provided by the Social Sciences and Humanities Research Council (SSHRC).

**Project Details**

The Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES) consists of 44 questions about tasks related to teaching with technology to support student-centred learning. Teachers in your school district will be asked to indicate the extent to which they are able to accomplish each task in the survey on a scale of 1–9. Teachers will also be asked to respond to 10 questions on the student-centred Use of Technology Teacher Outcome Expectancy Scale (SCUTTOES). On this scale, they will be asked to indicate the extent to which they agree with common outcomes related to technology use. To ensure instrument validity, the teachers will also be asked to complete a validated teacher efficacy survey, the Teacher’s Sense of Efficacy Scale (TSES) that consists of 10 questions.

The schools selected to participate in this study will be provided with a feedback report outlining efficacy beliefs regarding the use of technology for student-centred learning in the classroom. If you choose to participate, selected schools within the Vancouver School District (No. 039) will be part of a representative sample of approximately 500 teachers across the Lower Mainland that are participating in this project.

**Sampled Schools**

We are seeking your permission to approach the following schools in the Vancouver School District. These schools have been selected because they have all purchased educational technology equipment for use in the classroom in the last five years.

- [school list]
In the event that any of the above schools are unable to participate, we would also like to contact the following substitute schools.

- [school list]

**Project Rationale**

Student-centred learning facilitated by the adoption of technology in the classroom has been identified as one of the key goals of educational reform (Palak & Walls, 2009). Significant resources have been spent on equipping schools with computer hardware and software, and training teachers on the integration of technology in their classrooms (Palak & Walls, 2009). Efficacy beliefs are beliefs about one’s ability to perform a given task, and they are a powerful predictor of behaviour. As the drive to integrate technology into schools for student-centred learning increases, there is a need for teacher educators and professional development organizations to 1) ensure that teachers feel efficacious in their use of technology for student-centred learning, and 2) associate positive outcomes with the use of technology for student-centred learning. The purpose of this study is to examine the efficacy beliefs and outcome expectations of teachers regarding the use of technology for student-centred learning.

**Project Package**

The following documents are enclosed:

1) A letter of permission addressed to the principal of selected schools
2) A copy of the informed consent document for teachers participating in the study
3) A copy of the Student-Centred Use of Technology Teacher Efficacy Scale (SCUTTES).
4) A copy of the Student-Centred Use of Technology Teacher Outcome Expectancy Scale (SCUOTTOES)
5) A copy of the short form Teachers’ Sense of Efficacy Scale (TSES)
6) A letter of approval from the Royal Roads Ethics Committee
7) A two-page summary of the project methods and objectives

**Ethics details**

This research has been reviewed and ethics clearance has been granted from the Royal Roads University Research Ethics Board. If you have any comments or concerns resulting from
your board’s participation in this project, please contact Dr. Gilbert Vanburen Wilkes IV, Research Ethics Board representative for the School of Communication and Culture at Royal Roads University at [email address]

We would like an opportunity to speak with you to discuss our project and will contact you within two weeks to determine your interest. We look forward to collaborating with you on this exciting project.

Sincerely,

Lucy Ferreira and Jennifer Walinga
APPENDIX G: INFORMED CONSENT DOCUMENT

You are being invited to participate in a research study that measures teachers’ beliefs about their ability to use technology for Student-centred projects in the classroom. This study is being conducted by Lucy Ferreira and Jennifer Walinga from the Division of Education Studies at Royal Roads University. This study is part of a Master’s thesis project and is funded by the Social Sciences and Humanities Research Council (SSHRC).

You were selected as a possible participant in this study because you are a British Columbia public school educator working in a school that has purchased technological equipment for use in the classroom in the past five years. The researchers of this project are not employees of the British Columbia public school system, and your participation in this survey will have no effect on your current or future employment. Your participation in this research study is voluntary. You may choose not to participate or withdraw at any time during the study. If you decide not to participate in this study or if you withdraw from participation, you will not be penalized.

The procedure involves filling in an online survey that will take approximately 10 to 15 minutes to complete. The survey consists of three parts: the first contains 21 questions about tasks related to teaching with technology to support Student-centred learning. You will be asked to indicate the extent to which you are able to accomplish each task on a scale of 1 – 9. The second part of the questionnaire is a measure of teacher efficacy on traditional teaching tasks. It contains 9 questions concerning tasks that teachers encounter in traditional school settings and you will be asked to indicate the extent to which you are able to accomplish each task on a scale of 1-9. The final component of the survey contains 10 statements about outcomes of technology use in the classroom. You will be asked to indicate the extent to which you agree with each
statement on a scale of 1-9. If you received an email directly from this website, you have been given a unique link that will be used to track your response. This is done in order to send reminders to participants who did not access the survey on the initial invite, group responses by school type, or generate a personalized report for each school to show the results of their teaching staff on the efficacy scale. If the link was forwarded to you by administrator at your school, it will not track you by any personally identifiable information. At no time will you be identified by name, email address or other personally identifiable attribute in the published data. Please be aware that your data may be subject to the Patriot Act.

We will do our best to keep your information confidential. All data will be stored in a password protected electronic format. To assist in maintaining your confidentiality, the surveys will not ask you for information that can personally identify you. The results of this study will be used for research purposes only and may be shared with Royal Roads University and SSHRC representatives. The results of the research will be published at research.royalroads.ca when the thesis has been completed.

Your school may choose to use the information gathered in this survey to guide future professional development decisions, and the results may be used to make recommendations for teacher training and professional development programs in the future. If you have any questions about the research study, please contact Lucy Ferreira at [email address]. This research has been approved by the Royal Roads University Research Ethics Board for research involving human subjects.

ELECTRONIC CONSENT: Selecting the “Next” button below indicates that you have read the above information and voluntarily agree to participate in this study.