A PROFILE OF EARLY 21ST CENTURY TEACHERS OF NORTHWEST OHIO: THE RELATIONSHIP BETWEEN TEACHERS’ TECHNOLOGY INTEGRATION AND LEADERSHIP PRACTICES

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Leadership Practices Inventory (LPI)
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ABSTRACT

Rachel A. Reinhart, Advisor

In 2010, U. S. Secretary of Education, Arne Duncan, encapsulated the national concern and immediate need for educational change in order to prepare our students for the 21st century by stating, “The urgency to improve our children’s schools has never been greater.” Therefore, in order to develop students with the skills and knowledge needed to thrive in college, careers, and/or citizenship in the 21st century, teachers must be prepared—including, but not limited to, their pedagogical methodologies as well as their technological and leadership knowledge, skills, and practices.

The purpose of this correlational study was to examine the relationship between teachers’ leadership practices and their classroom technology integration within the framework of ISTE NETS, Partnership for 21st Century Skills, and TPACK. Teachers (N = 361) from six northwest Ohio suburban school districts participated in the online 21st Century Technology Integration and Teacher Leadership (21-TITL) inventory, made up primarily of the Overall Technology Integration Scale (OTIS) and Teacher Leadership Practices Inventory (T-LPI), a modified version of Kouzes and Posner’s Leadership Practices Inventory (LPI).

Numerous significant results were discovered, including: a correlated sixth T-LPI subscale (Refine the Craft); moderately correlated technology and leadership factors (Reflection and Modified Stage of Technology Adoption); a T-LPI subscale (Challenge the Process) that predicts Overall Technology Integration; a two-factor model that predicts Technology Integration, a six-factor model that predicts Teacher Leadership, and various group differences for both Overall Technology Integration (Technology Efficacy, Professional Development,
Reflection, Modified Stage of Technology Adoption, Computers in the Classroom, Total Computing Hours Per Week, and Total Leadership Positions) and Leadership Practices (Gender-Female, Technology Efficacy, Social Trait-Extrovert, Professional Development, Reflection, Modified Stage of Technology Adoption, Computers in the Classroom, Total Computing Hours Per Week, and Total Leadership Positions).

Implications and recommendations are presented (relating to Classroom Technology Integration and Teacher Leadership Practices) for 21st century teachers, administrators, schools, and government or legislative leadership in order to preserve institutional knowledge and transform teaching and learning through support and funding for embedded, continual, reflective professional development focused on TPACK + Leadership (or CPTaLK).
DEDICATIONS

To two Inspirations, no longer with us,

who innately “challenged the process”

in one way or another…

To Sarah: The first in our family to even consider a quest like this and who remains a constant inspiration for all things good and right in this world; and

To Karma: One of the sweetest and gentlest, yet strongest and toughest creatures I had the honor to take care of (as she did me) for almost 13 years… offering me a little break every time she visited me and bowed her head for a neck rub and laid at my feet to support my times “in the chair” or (in her weaker days) next to me as my sofa-buddy.

Both of you (and Barbara) are truly missed!
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Rossford Schools, the administration, past and present, and especially to Sandy Smith for the support and flexibility during the past couple years. Also, to all the teachers who help me see on a daily basis how important technology integration and leadership practices are to student success in their classrooms;

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Dr. David Meel for the Excel spreadsheet and scatterplot creation, helping me turn a vision into reality; although my research changed a bit since then and is not included here, your time and expertise were appreciated! Maybe next time I’ll come back to that project?;

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And lastly, to everyone who reminded me that this is “just a paper” (albeit a fairly long, wordy one that very few people will read it its entirety)!

To my family: My parents for their unwavering support and belief in me… as a student, athlete, teacher, coach, and now researcher and writer. More specifically, to mom for the usual encouragement to “go for it” and perhaps even three decades of subliminal messages prompting me to give a doctorate any consideration whatsoever and dad for the frequent requests about “the paper” and discussing our experiences with technology and leadership in the worlds of education and business;

Kim for her constant support and our many discussions of leadership examples (and non-examples);

My brothers, Matt and Steve (plus Amelia), who know first hand what it’s like to raise the next generation of learners;
All my nieces and nephews who I do not get to see very often, but their pictures remind me daily how important it is to work to improve teaching and student learning. Plus, Kiana, my “extended family,” who showed me during her early years and ever since how essential technology skills are to transforming teaching and learning for her generation;

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And finally, Steve Jobs, who died the same day that I defended my proposal for this dissertation—October 5, 2011. As the Butterfly Effect phenomenon suggests… just as the flap of butterfly wings in one part of the world can affect the weather in another, so too might Steve Jobs’ Apple IIe computer in my 8th grade math class have inspired or sparked my interest in and passion for educational technologies to improve teaching and learning. Thanks Steve, for your contributions, great and small.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER I. INTRODUCTION</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background of the Problem</td>
<td>1</td>
</tr>
<tr>
<td>20th Versus 21st Century Learning: Industry to Information to Innovation</td>
<td>2</td>
</tr>
<tr>
<td>Teacher and Student Roles in 21st Century Learning</td>
<td>5</td>
</tr>
<tr>
<td>Concerns with “Unschooled” Digital Natives</td>
<td>6</td>
</tr>
<tr>
<td>21st Century Teacher: Content, Technology Integration and Leadership</td>
<td>7</td>
</tr>
<tr>
<td>Rationale</td>
<td>8</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>10</td>
</tr>
<tr>
<td>Research Questions</td>
<td>10</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>11</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>13</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>14</td>
</tr>
<tr>
<td>Delimitations and Limitations of the Study</td>
<td>17</td>
</tr>
<tr>
<td>Organization of the Remaining Chapters</td>
<td>19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER II. LITERATURE REVIEW</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 21st Century Need for Classroom Technology Integration</td>
<td>20</td>
</tr>
<tr>
<td>Recent National Calls for Systemic Change</td>
<td>21</td>
</tr>
<tr>
<td>National educational technology plans</td>
<td>22</td>
</tr>
<tr>
<td>Composite Framework for 21st Century Teaching and Learning</td>
<td>23</td>
</tr>
<tr>
<td>National Educational Technology Standards (NETS)</td>
<td>24</td>
</tr>
<tr>
<td>Partnership for 21st Century Skills (P21)</td>
<td>26</td>
</tr>
</tbody>
</table>
Comparing ISTE NETS•Students and the Partnership for 21st Century Skills (P21) .......................................................... 28

TPACK: 21st Century Teacher Expectations .................................................. 30

Conditions for Successful Technology Integration ........................................ 33

21st Century Classroom: Constructivist, Student-Centered, and H.O.T.S. .... 33

Constructivist methodology ................................................................. 33

21st century skills attainment through student-centered constructivism .......... 35

H.O.T.S.: Higher Order Thinking Skills .................................................... 37

Technology Integration for Teaching and Learning ...................................... 41

Research on Teachers’ Technology Integration .......................................... 42

Apple Classrooms of Tomorrow (ACOT) .................................................. 42

Levels of Teaching Innovation (LoTi) ........................................................ 44

“No Significant Difference” Research Findings .......................................... 45

Factors Impacting Teacher Technology Integration: Teacher Characteristics ................................................................. 48

Dispositions ............................................................................................. 49

Demographics .......................................................................................... 49

Gender ....................................................................................................... 49

Years experience ...................................................................................... 51

Social trait: Level of Extroversion (LoE) .................................................... 51

Environment ........................................................................................... 52

Level of reflection ..................................................................................... 52
Professional development.................................................. 53
Educational level.............................................................. 53
Professional Development and Support........................................... 54
Development Process Takes Time............................................. 55
Continual, Ongoing, Perpetual Learning.................................... 57
Differentiated Professional Development.................................... 57
Ohio’s Professional Development and Support Efforts.................... 58
The Need for Teacher Leadership............................................. 60
Technology Integrating Teacher Leaders as Change Agents ........... 60
Definitions of Teacher Leadership............................................. 62
Skills of Teacher Leaders...................................................... 63
Factors Affecting Teacher Leadership........................................ 64
Teachers as professionals..................................................... 65
National standards for teacher coaches in technology
and leadership...................................................................... 65
The Importance of Teacher Leadership in the 21st Century............ 66
Measuring Teacher Leadership Through Business Leadership Practices...... 67
Teacher Leadership and Business Leadership Principles............... 70
Technology Integration and Leadership: Foundations for 21st Century
Teaching Practice................................................................... 70
Summary of Chapter 2................................................................ 72
Introduction to Chapter 3.......................................................... 74
CHAPTER III. METHODOLOGY ............................................. 75
Research Design ................................................................. 75
Participants ................................................................. 75
Instrumentation ............................................................. 76
  School Environment and Background ................................ 77
  Teacher Leadership Practices ........................................ 78
  Technology Integration .................................................. 80
  Validity and Reliability .................................................. 83
Procedures ................................................................. 84
  HSRB Approval of Online Survey .................................... 84
  Instrument Deployment and Data Collection ...................... 84
Research Questions ...................................................... 85
Data Analysis and Variables ........................................... 85
CHAPTER IV. RESULTS .......................................................... 92
Response Rate ............................................................. 92
Participant Demographics and Background Experiences Factors ........... 92
  Subjects and Grade Levels Taught ................................... 93
  Experience and Age .................................................... 94
  Level of Reflection ..................................................... 95
  Professional Development ............................................ 96
  Teacher Education Level ............................................. 97
  Gender ................................................................. 98
  School Technology Environment and Background ................ 98
Research Question 3: Do Technology Integration and Leadership Practices Differ by Teachers’ Demographic or Background Variables?  

Gender differences ................................................................. 114
Masters degree in educational technology ............................... 114
Technology efficacy ................................................................. 115
Social trait (level of extroversion) ............................................ 116
Professional development ....................................................... 117
Reflection ................................................................................ 117
Modified Stage of Technology Adoption (mSTA) .................... 118
Teaching experience ................................................................. 119
Computers in the classroom ...................................................... 119
Total computing hours ............................................................. 120
Total leadership positions ......................................................... 122
College/university teaching ....................................................... 122

Research Question 4: Which Factors Best Predict Teachers’ Technology Integration (Overall Technology Integration)? ................................................................. 123

Research Question 5: Which Factors Best Predict Teacher Leadership Practices (T-LPI)? ................................................................. 125

Summary of Results ................................................................. 125

CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS .......................... 130

Review of the Study ................................................................. 130
Discussion of Significant Research Findings and Implications ....... 131
Descriptive Results For Demographics, Technology Integration, and Teacher Leaders ................................................................. 131
  Technology use and integration .................................................. 131
  Comparing LoTi to overall technology integration scores .......... 132
  Modified Stage of Technology Adoption (mSTA) Scores
    as an “Integration Leader-Finder” ........................................... 134
    Teacher leadership practices ............................................... 134

Research Finding 1: Relationships Between Teachers’ Technology Integration, Leadership Practices, and Level of Reflection .......... 135

Research Finding 2: Challenge the Process T-LPI Subscale Best Predicts Overall Technology Integration ................................................................. 137

Research Finding 3: Group Differences in Overall Technology Integration and T-LPI Scores ................................................................. 139
  Technology efficacy ............................................................ 140
  Professional development ...................................................... 141
  Professional reflection .......................................................... 142
  Modified Stage of Technology Adoption (mSTA) ....................... 142
  Computers in the classroom .................................................. 143
  Total computers hours ......................................................... 145
  College/university teaching and total leadership positions ......... 146
  Gender ............................................................................ 147
  Social trait (level of extroversion) .......................................... 148
  Master’s in educational technology degree programs ............... 149
Teaching experience .......................................................... 150

Research Finding 4: Predictors for Classroom Technology Integration...... 152

Research Finding 5: Predictors for Teacher Leadership Practices ............ 153

Recommendations........................................................................ 154

21st Century Teacher Knowledge: TPACK + Leadership ....................... 155

Improving “CPTaLK” Through Embedded, Needs-Based Professional Development ........................................................................ 156

Embedded, needs-based professional development............................ 156

Professional development and computer use .................................. 158

Barriers to professional development ........................................... 159

Example of embedded, needs-based professional development ............ 160

21st century skills and CPTaLK–focused professional development .......... 161

Retaining institutional knowledge in the era of teacher retirements ........ 162

Administrative leadership and support is needed, too ......................... 163

Creating the Infrastructure for a 21st Century Enabled Learning Community .................................................................................. 166

Computer and Internet availability: All-around access ....................... 166

Policy changes to improve access.................................................. 168

Unblock “Web 2.0” or collaborative websites....................................... 168

Update COPPA laws........................................................................ 169
Curricular focus on 21st century skills and authentic ways of knowing .......................................................... 169
Policy of Funding Excellence ............................................................... 170
Recommendations for Future Study .................................................. 172
Recommendations for the 21-TITL online survey............................... 174
Conclusions ...................................................................................... 175
Technology Integration & Teacher Leadership .................................. 176
Model for teacher leadership through technology integration .......... 177
Leading in leadership and closing the technology gender gap ........ 178
Embedded, Needs-Based Professional Development ....................... 178
A Long Road Ahead to Realizing 21st Century Outcomes ............... 182
REFERENCES ................................................................................... 185
APPENDIX A. PARTNERSHIP FOR 21ST CENTURY SKILLS .................... 209
APPENDIX B. ISTE NETS (STUDENTS, TEACHERS, ADMINISTRATORS,
AND COACHES) ............................................................................. 210
APPENDIX C. 21ST CENTURY TECHNOLOGY INTEGRATION AND
TEACHER LEADERSHIP (21-TITL) SURVEY INSTRUMENT .............. 215
APPENDIX D. QUESTIONS INCLUDED AND EXCLUDED ON THE
TEACHER LEADERSHIP PRACTICES INVENTORY (T-LPI) .......... 235
APPENDIX E. HSRB APPROVAL .......................................................... 237
APPENDIX F. SURVEY INVITATION EMAIL ......................................... 240
APPENDIX G. MODIFIED STAGES OF TECHNOLOGY ADOPTION (mSTA) .... 242
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>59</td>
</tr>
<tr>
<td>7</td>
<td>64</td>
</tr>
<tr>
<td>8</td>
<td>69</td>
</tr>
<tr>
<td>9</td>
<td>71</td>
</tr>
<tr>
<td>10</td>
<td>71</td>
</tr>
<tr>
<td>11</td>
<td>72</td>
</tr>
<tr>
<td>12</td>
<td>76</td>
</tr>
<tr>
<td>13</td>
<td>77</td>
</tr>
</tbody>
</table>

1. **19th-20th vs. 21st Century Learning**

2. **Similarities Between the NETS•Students and the Partnership for 21st Century Skills Framework**

3. **Contrasting Views of Instruction and Construction**

4. **LoTi (Levels of Teaching Innovation) Levels and Descriptions**

5. **Research on Demographic Variables in Technology Integration and Leadership Practices**

6. **Report findings from the Ohio State Legislative Office of Education Oversight**

7. **Structural and Cultural Factors Enabling or Inhibiting Teacher Leadership**


10. **Detailed: Theoretical Frameworks (TPACK, 21st Century Skills, and NETS)**

11. **Theoretical Framework Components Compared to Teacher and Student Aspects of Teaching and Learning**

12. **Participant’s School District Data (from 2010-11 District Report Cards)**

13. **Summary of the 21st Century Technology Integration and Teacher Leadership (21-TITL) Sections**
14 Five Levels of Teacher and Student Technology Use (Integration) on the Overall Technology Integration Scale (OTIS) Survey ........................................ 82
15 21st Century Technology Integration and Teacher Leadership (21-TITL) Survey Subscales Paired With Survey Item Number and Value Ranges .................. 86
16 Research Questions, Variables, and Data Analysis Procedures ........................................ 90
17 School District Survey Participation.................................................................................. 93
18 Subject(s) Taught ........................................................................................................ 94
19 Grade Level Currently Teach.......................................................................................... 94
20 Teaching Experience in Years ...................................................................................... 95
21 Age Range.................................................................................................................. 95
22 Reflection Level About Teaching Practice .................................................................... 96
23 Voluntary Professional Development (PD) Attended (Past 3 Years) ......................... 97
24 Highest Education Level Completed ............................................................................ 97
25 School Technology Environment and Background..................................................... 99
26 Computer(s) Availability ............................................................................................ 99
27 Digital Tool Integration Use in Classroom ................................................................. 101
28 Digital Tool Frequency of Integration......................................................................... 103
29 Computer Use for Professional Tasks (Hours Per Week) ........................................... 104
30 Percent of Professional Tasks Completed at Home/Non-School ............................... 104
31 Computers in the Classroom........................................................................................ 105
32 Modified Stage of Technology Adoption (mSTA) From 1-7....................................... 106
33 Modified Stage of Technology Adoption (mSTA) Levels (1-7) Frequencies for Current Self, Self 3 Years Ago, and Colleagues Today................................. 107
<table>
<thead>
<tr>
<th>Page</th>
<th>Summary of Technology Related Factors Used in Inferential Analyses</th>
<th>108</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Leadership Positions</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>College/University Teaching Experience and Groups</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Teachers Leadership Practices (T-LPI) Factors</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Research Question #1: Correlation Matrix of Overall Technology Integration, Leadership Practices, and Other Technology-Related Variables</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>Regression Coefficients of Challenge the Process T-LPI Subscale Predicting Overall Technology Integration</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>Independent Samples t-Test Results for Gender Differences in Overall Technology Integration and Leadership Practices (T-LPI)</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Masters Degree in Educational Technology Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Technology Efficacy Group Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>Social Trait Group Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>Professional Development Group Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>Teacher Reflection Group Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>Modified Stage of Technology Adoption (mSTA) Group Differences in Overall Technology Integration and Total Leadership Practices</td>
<td>119</td>
</tr>
</tbody>
</table>
47 Teaching Experience Group Differences in Overall Technology Integration and Total Leadership Practices ................................................................. 119
48 Computers in the Classroom Group Differences in Overall Technology Integration and Leadership Practices ......................................................... 120
49 Total Computing Hours Per Week Group Differences in Overall Technology Integration and Total Leadership Practices ........................................ 121
50 Teachers’ Total Leadership Positions Group Differences in Overall Technology Integration and Total Leadership Practices ...................... 122
51 College/University Teaching Group Differences in Overall Technology Integration and Total Leadership Practices ...................................... 123
52 Factors Predicting Teacher’s Overall Technology Integration (Modified Stage of Technology Adoption and Total T-LPI) ........................................ 124
53 Factors Predicting Teacher’s Overall Technology Integration (Modified Stage of Technology Adoption and T-LPI Subscales) ........................... 124
54 Factors Predicting Teacher Leadership Practices (T-LPI) ................................................................. 125
55 Summary of Inferential Results by Research Question ......................................................... 128
56 Significant Group Differences on Background and Experience Factors in Overall Technology Integration and Teacher Leadership Practices .......... 140
57 Gender Differences (Significant and Non-Significant) ................................................................. 147
58 Summary of Factor-based Future Research Suggestions for Group Differences in Overall Technology Integration and Teacher Leadership Practices Inventory (T-LPI) ................................................................. 173
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The balanced 3-legged framework of 21st century teaching</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>The three frameworks needed to support and define 21st century teaching practice</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>National Educational Technology Standards (NETS) for Students, Teachers, and Administrators</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>TPACK Model</td>
<td>31</td>
</tr>
<tr>
<td>6</td>
<td>Bloom’s (1956) Taxonomy of Cognitive Learning and Anderson and Krathwohl’s (2001) Revised Bloom’s Taxonomy</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>Edgar Dale’s Cone of Experience (1969)</td>
<td>39</td>
</tr>
<tr>
<td>8</td>
<td>Overall Technology Integration Scale (OTIS)</td>
<td>82</td>
</tr>
<tr>
<td>9</td>
<td>Significant group differences in overall technology integration scores by the number of classroom computers</td>
<td>144</td>
</tr>
<tr>
<td>10</td>
<td>Significant group differences in Total T-LPI Scores by the number of classroom computers</td>
<td>145</td>
</tr>
<tr>
<td>11</td>
<td>Non-significant differences in overall technology integration scores by years of teaching experience</td>
<td>151</td>
</tr>
<tr>
<td>12</td>
<td>Non-significant group differences in total T-LPI Scores by years of teaching experience</td>
<td>152</td>
</tr>
<tr>
<td>13</td>
<td>Model for teacher change</td>
<td>164</td>
</tr>
<tr>
<td>Page</td>
<td>Section</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Modified model for teacher change through learning</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>21-TITL survey items to modify: Overall Technology Integration Scale responses</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>ISTE’s 2011 National Educational Technology Standards for Coaches</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Initial process for 21st century teacher professional development</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Outcome: Bi-directional processes for 21st century teacher professional development</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Formula for effective 21st century teachers</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER I. INTRODUCTION

Background of the Problem

“We are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer” (Seymour Papert, 1980, p. 36-7).

The whirlwind of change inside the education field (Bonk, 2009; Cuban, 2004) has finally gained enough momentum to reach a tipping point—or so it appears. As we enter the second decade of the 21st century, the educational transformation movement has emerged from seeds of thought during the late 1900s and early 2000s (Dale, 1972; Dwyer, 1994; Fullan & Smith, 1999; Healy, 1990; Katz, 1972; 1985; Kline, 2002; Papert, 1980; Toffler, 1970) and is once again beginning to germinate into a full-blown national movement toward educational transformation (Duncan, 2010; Obama, 2010; US DOE, 2010). Increasingly, long-standing teaching practices and student outcomes are vigorously being questioned, debated, examined, assessed, and transformed in order to meet the needs of 21st century students to prepare them for what is essentially an unknown future (Brooks-Young, 2006, 2010; Darling-Hammond, 2008; Warlick, 2004).

Over the last decade, this call for change has been popularized through a mainstream media articles (Wallis, 2006) a Hollywood movie (Waiting for Superman), as well as federal government initiatives such as the 2001 No Child Left Behind Act and the 2010 Race to the Top funding. In 2010, U. S. Secretary of Education, Arne Duncan, encapsulated the national concern and immediate need for educational change in order to prepare our students for the 21st century by stating, “The urgency to improve our children’s schools has never been greater” (Duncan, 2010a, ¶ 2). In another instance, Secretary Duncan (2010b) even went so far as to claim that
problems within the United States educational system such as low graduation rate are “morally unacceptable and economically unsustainable” (¶ 35).

In addition to the Secretary of Education’s call for educational improvement, the 2010 National Educational Technology Plan (U.S. Department of Education) echoes a similar call to action:

“We are… at an inflection point for a much bolder transformation of education powered by technology. This revolutionary opportunity for change is driven by the continuing push of emerging technology and the pull of the critical national need to radically improve our education system.” (p. xiii)

Therefore, in order to develop students with the skills and knowledge needed to thrive in the 21st century, teachers must be prepared—including, but not limited to, their pedagogical methodologies as well as their technological and leadership knowledge, skills, and practices (Becker, 2000a; Becker & Ravitz, 1999; Fullan & Smith, 1999; Riel & Becker, 2000).

20th Versus 21st Century Learning: Industry to Information to Innovation

The end of the 20th century brought the world into the digital age—a technologically driven era requiring new definitions for work, communication, privacy, and learning. It is this world of connections that allows learning to extend beyond cultures and countries (Bonk, 2009; Friedman, 2005; Kouzes & Posner, 2002; Pink, 2005; Rifkin, 2004). This new world, by consequence, requires new teaching methods, strategies, and practices in order to fully prepare students to succeed or even survive in a world that has shifted focused from industry to information and innovation (Brooks-Young, 2010; Chen, 2010; Churches, Cornish, 1996; Crockett & Jukes, 2010; Cross, 2006; Friedman, 2005; Negroponte, 1995; November, 2010b; Papert, 1980; Pink, 2005; Prensky, 2001, 2010; Richardson, 2006; Trilling & Fadel, 2009; Warlick, 2004). Table 1 encapsulates how 20th and 21st century teaching and learning needs have changed due to these global and societal changes (Thoman & Jolls, 2005), which Trilling and
Fadel (2009) suggest the need to shift the “learning balance” toward 21st century skills, or those on the right, in order to prepare students.

Table 1

19th–20th vs. 21st Century Learning (excerpts from Thoman & Jollis, 2005, p. 8)

<table>
<thead>
<tr>
<th>19th – 20th Century Learning</th>
<th>21st Century Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited access to knowledge and information (i.e. ‘content’) primarily through print</td>
<td>Infinite access to knowledge and information (‘content’) increasingly through the Internet</td>
</tr>
<tr>
<td>Emphasis on learning content knowledge that may or may not be used in life</td>
<td>Emphasis on process skills for lifelong learning</td>
</tr>
<tr>
<td>Goal is to master content knowledge (literature, history, science, etc)</td>
<td>Goal is to learn skills (access, analyze, evaluate, create) to solve problems</td>
</tr>
<tr>
<td>Facts and information are “spoon-fed” by teachers to students</td>
<td>Teachers use discovery, inquiry-based approach</td>
</tr>
<tr>
<td>Print-based information analysis</td>
<td>Multi-media information analysis</td>
</tr>
<tr>
<td>Pencil / pen and paper or word processing for expression</td>
<td>Powerful multi-media technology tools for expression</td>
</tr>
<tr>
<td>Classroom-limited learning and dissemination</td>
<td>World-wide learning and dissemination</td>
</tr>
<tr>
<td>“Lock-step” age-based exposure to content knowledge</td>
<td>Flexible individualized exposure to content knowledge</td>
</tr>
<tr>
<td>Mastery demonstrated through papers and tests</td>
<td>Mastery demonstrated through multi-media</td>
</tr>
<tr>
<td>Teacher selecting and lecturing</td>
<td>Teacher framing and guiding</td>
</tr>
</tbody>
</table>
Because the world has changed, so have students' educational needs. The reality of the 21st century is that a connected globalized society has brought forth the need for students to acquire and master new skills and literacies, not just memorize and recite content or factual knowledge in preparation for today’s tests or gain basic skills for tomorrow’s blue or white-collar jobs (Friedman, 2005; Pink, 2005). Skills required in this century focus less on memorization or ‘one-time learning’ and more on perpetual, higher order learning, including critical thinking, problem solving, information and media literacy (ChanLin, Hong, Horng, Chang, & Chu, 2006; Darling-Hammond, 2008; ISTE 2007; Partnership for 21st Century Skills, 2009; Pink, 2005; Trilling & Fadel, 2009).

Furthermore, teachers are no longer preparing students for factory assembly lines or cubicle-centric office jobs that they will have for the rest of their life. Instead, teachers are asked to prepare students for an ever-changing world (Friedman, 2005; Levy & Murnane, 2004; Pink, 2001; Rifkin, 2004). Moreover, the work itself has changed. Skills, such as creativity, innovation, and problem solving, as opposed to brute physical labor or repetitive and/or reproducible analytical tasks, are essential in the 21st century workplace (Friedman, 2005; Levy & Murnane, 2004; Pink, 2001; Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009). These outdated 20th century skills are increasingly being replaced by computers and robotics or outsourced to cheaper labor outside our borders and overseas. Therefore, teachers at all levels of education need to teach students technology-related skills while reinforcing the 21st century higher order thinking skills in order to prepare them for the new, unknown world of work and living in the 21st century (ChanLin, et al., 2006; Henscheid, 2008; Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009; Warlick, 2004).
Teacher and Student Roles in 21st Century Learning

In addition to teachers playing the obvious key role in 21st century education, students play a critical role as well. Rather than being merely the recipients of reform efforts to improve learning, students now are also the drivers. According to the United States Department of Education’s National Educational Technology Plan (2004), “Today’s technology-literate middle and high school students will also be drivers of reform, creating a new student-teacher partnership” (p. 46). The 2010 Educational Technology Plan (U.S. Department of Education) further clarifies the disparity between the technology tools (digital tools) students use outside versus inside schools, reminding us that it’s important that they learn to use these devices both “formally and informally” to create “their own engaging learning experiences” (p. 4).

Essentially, teachers prepare students for “college, careers, and/or citizenship” (Schmoker, 2011). Therefore, another concern for educators and society today is that in addition to preparing students for higher education or work after high school, there is a longer-term need—preparing future citizens for daily life in the 21st century (Brooks-Young, 2010; Fullan & Smith, 1999) in addition to focusing on their quality of life (Trilling & Fadel, 2009). The growing complexity of a technologically advancing world requires of its democratized citizens the following: higher levels of thinking, communicating, and action than ever before in history—from being an educated voter on local issues, deciphering and sorting through mass media advertisements and politician promises, to buying healthy foods for your family, balancing a household budget, and raising healthy, well-adjusted children. All of these requirements of life in the rapidly-paced 21st century will call for higher levels of dynamic, ongoing learning, beginning with K-12 schooling (Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009).
In order to prepare an educated and effective citizenry, new skills will be required of today’s students in addition to basic content or foundational knowledge that dominated 20th century education (Fullan & Smith, 1999; Papert, 1980; Pink, 2005; Tagg, 2003). Students will need to learn and master a wide array of technological skills and knowledge in order to be prepared for their future world that will be dominated by digital devices and practices (Beglau, Craig-Hare, Foltos, Gann, James, Jobe, Knight, & Smith, 2011; Bonk, 2009; Brooks-Young, 2010; Kurzweil 1999; Warlick, 2004). For today’s students, commonly called “digital natives” due to their lifelong association with technology and internet-based culture (Prensky, 2001), foundational knowledge will always be important, especially for certain tasks. But memorized knowledge or facts become less important when living in an anytime-anywhere connected society—one full of hobbyists, professionals, and scholars whose ideas (or their real, live selves)—are only a few mouse clicks or screen taps away.

Concerns with “Unschooled” Digital Natives

Despite what popular media or even students (a.k.a. digital natives) themselves say, when it comes to technology, they often do not know as much as they think they do—or as much as we think they do. Although millennials have grown up surrounded by technology tools that have supported their entertainment whims and productivity or communication necessities, they are not necessarily efficient, productive, or safe users of these technologies (Bennett, Maton, & Kervin, 2008; Kennedy, Judd, Churchward, Gray, & Krause, 2008). Although digital natives may know how to use many digital tools socially or for entertainment purposes, they often lack the skills required for other daily-life basics such as finding accurate or reliable online information or how to communicate effectively and appropriately in a professional, courteous manner. In other words, their excessive use of technologies in one context does not mean they are experts in all
digital contexts or scenarios (Kennedy, et al., 2008). Just as a teenager who has seen thousands of cars growing up, rode in them countless times, and even played driving (racing) video games for a decade is still not automatically granted a license to drive, the same applies for their use of digital tools in other contexts outside purposes of entertainment and peer socialization. Specific, targeted instruction and practice are still needed in order to be effective, successful, and safe—whether for learning how to drive or how to use the Internet for research or professional, courteous communications.

Unfortunately, until recently, most students were left on their own to figure out these technologies, rather than taught appropriate and safe uses by teachers or parents (Papert, 1996). Today, these skills are now essential for students. In regards to teaching, learning, and preparing for our future, this changes everything. Essentially, the triad of teaching, learning, and technology are now inseparable from and indispensable within a 21st century classroom. And in order for this transformation to occur, teachers will need to take on more leadership roles in order to plan, create and maintain the needed change to include these new technology-based skills and practices (Crowther, et al., 2002; Fullan & Smith, 1999; Riel & Becker, 2008).

21st Century Teacher: Content, Technology Integration and Leadership

Technology use in the classroom can be both a means and an end in itself to learning higher-level concepts such as critical thinking. The integration of digital tools allows students to learn and develop skill sets for new communication and connecting practices that have quickly become essential in our personal and professional lives within an inevitable ubiquitously-connected world and the not-so-far-away future (Cross, 2006; Selber, 2004; U.S. Department of Education, 2010). In order for students to be knowledgeable and skilled in these areas, teachers need to be knowledgeable and skilled as well so they can plan, direct, and facilitate student
learning toward 21st century outcomes and expectations, individually as well as collaboratively (Beglau, et al., 2011). Therefore, in preparing students for the world ahead, teachers need to develop skill sets in effective teaching strategies for 21st century learning, which includes technology integration (Beglau, et al., 2011; Mishra & Koehler, 2006). Moreover, teachers also need to engage in teacher leadership practices so they can lead themselves, their students, and even their colleagues toward the dynamic future of teaching and learning (Crowther, et al., 2002; Riel & Becker, 2008; Sandholtz, Ringstaff, & Dwyer, 1997).

**Rationale**

Within the last few years, three major national initiatives have highlighted the need for a transformation in teaching and learning that includes technology-enhanced educational opportunities at all levels of instruction. These initiatives include: 1) the nationally focused, individually state adopted 21st Century Skills framework from the Partnership for 21st Century Skills; 2) the updated or ‘refreshed’ National Educational Technology Standards for students, teachers, and administrators (NETS, 2007-2009) from the International Society for Technology in Education (ISTE); and last, but certainly not least, 3) the introduction of a national technology assessment in the forthcoming 2014 National Assessment of Educational Progress (NAEP) test. (Note that the NAEP test for Technology was originally scheduled for 2012.)

These three initiatives coincide with the recent 2010 National Educational Technology Plan, or NETP (U.S. Department of Education, 2010), which provides a direction and course of action for the next five years. The NETP boldly states the imperative to begin transformations of our educational system immediately, “(W)e do not have the luxury of time. We must act now” (p. 3) and, “As we enter the second decade of the 21st century, there has never been a more pressing need to transform American education or a better time to act.” (p. xv). This includes
action at all levels of instruction, from pre-kindergarten through higher and even adult or professional education. Essentially, the 2010 NETP can be considered a call to action for transformative change in all public education.

In response to these national, as well as state and local initiatives, education transformation will likely occur primarily through the action of teachers—for without teacher action, change most certainly will not occur in schools (Crowther, et al., 2002; Fullan, 1993a, 1994). Similar to transitions in the business world, leadership at various levels is needed and requires certain skills or practices in order to be successful (Kouzes & Posner, 1987; 2002). Therefore, in addition to school and district leadership, teachers take on formal and informal leadership roles as change agents working in collaboration and cooperation with administrators, parents, or students to improve educational practice and student learning (Fullan, 1993a; Papert, 1996; Riel & Becker, 2000, 2008). Furthermore, teachers’ will increasingly need to effectively integrate technology into their classrooms in order to prepare students for the 21st century.

As both of these teacher practices become essential for effective teaching and learning, school districts, colleges of education, and the general public all have a vested interest to make certain that all teachers are prepared and proficient in both leadership practices and technology integration for student success. Very little research has focused specifically on the relationship between teacher leadership practices and their technology integration practices. Teacher leadership practices and technology integration focus are key factors affecting the future of teaching and learning in this connected, ever-changing, technologically-centric world where students’ need for lifelong continual learning (often on their own) will dominate cultures of work and play the further we progress into the 21st century (Bonk, 2009; Chen, 2010; Cross, 2006; Warlick, 2004).
Identifying the relationship between teachers’ leadership practices and technology integration focus, as well as their significant demographic traits, may assist practicing or pre-service teachers, teacher educators, and educational leaders in developing an array of skills, practices, and experiences needed to become more effective in preparing students for the 21st century, since the same skills will be required of them as well. In other words, if a strong correlation between teacher leadership practices and technology integration focus exists, further research into the causal nature of these factors, as well as the professional development of these practices, should follow so that more teachers are prepared to lead their students and schools through imminent 21st century educational transformations.

**Purpose of the Study**

The purpose of this correlational study was to examine the relationship between teachers’ leadership practices and their classroom technology integration. In addition, typical demographic traits as well as background information—gender, years teaching, computer use, subject and grade level taught, social type, technology efficacy, modified Stage of Technology Adoption (Christensen & Knezek, 1999; Russell, 1995), etc.—were examined in comparison to two key practices of 21st century teachers, leadership practices and technology integration focus. To accomplish this, 1,655 teachers from six northwest Ohio suburban school districts were invited to take an online survey using SurveyGizmo. Additional specifics about the survey and the variables are discussed in more detail in Chapter 3: Methodology.

**Research Questions**

1. Do technology integration factors significantly relate to Leadership Practices and Level of Reflection?
2. Which of the six (6) leadership practices (T-LPI) subscales best *predicts* a teacher’s overall technology integration?

3. Does technology integration or leadership practices *differ* by demographic or background variables?

4. Which factors best *predict* a teacher’s technology integration (Overall Technology Integration)?

5. Which factors best *predict* a teacher’s leadership practices (T-LPI)?

**Significance of the Study**

Although many studies have examined at least one of these teacher practices (leadership or technology integration), in relation to other variables, to date, little research has been found that directly examines both leadership practices and technology integration of teachers (MacDonald, 2006). Identifying a particular practice or combination of practices among teachers may assist educational leaders and teacher educators in developing the skills needed to become more effective teachers of 21st century students, whether during their pre-service education or in-service professional development. Additionally, this study adds to a fairly new, yet rapidly developing, body of educational technology research that examines multiple traits as correlational variables to predict technology use in the classroom—an essential component of preparing students for 21st century living, learning, and thriving.

At the local level, answers to these research questions also provide a snapshot or profile of teachers from selected suburban school districts in northwest Ohio based on their leadership practices and technology integration focus. School district decision makers, including, but not limited to, professional developers, curriculum directors, principals, superintendents, and school
board members, can then analyze the overall profile to determine areas of strength as well as potential areas of improvement exist in regard to preparing their students for the 21st century.

In addition to the benefits to PK-12 institutions and their constituent communities, the findings of this research also aid colleges of education as they prepare future teachers to become successful, effective 21st century educators. The earlier that pre-service educators are made aware of and become comfortable with new tools and strategies for learning, as well as become aware of their own leadership practices, the better prepared they will be for educating students within a system that is transforming to meet the needs of a future world of connected, ubiquitous technologies and opportunities—which consequently (and ironically) also require ongoing learning, facilitation, and leadership (Beglau, et al., 2011; Cross, 2006; Fullan & Smith, 1999; Hopson, Simms, & Knezek, 2002; ISTE 2007, 2008). In other words, strong teacher leadership and technology practices benefit teachers, their administrators, students, and community members in the ongoing change cycles that have become commonplace in 21st century schools.

In all, as researchers learn more about certain teacher behaviors, traits, experiences, or circumstances that can be improved, with a focus on and redirection toward best practice, the closer the educational community comes to fulfilling the promise of effective teaching and learning and preparing student for their futures. With the large numbers of retiring teachers over the next several years, school district leadership must carefully consider the practices, traits, and experiences of their teachers or potential hires in order to direct future professional development opportunities or the selection of new teachers to further improve the overall effectiveness of their staff in facilitating student learning and community development. In addition, these research findings can aid participating teachers in uncovering areas of needed improvements for their own development as a professional 21st century educator.
Conceptual Framework

Although the term “21st Century Learning” is most often associated with the integration of technology, another factor that is essential for student success in this century of educational transformation is teacher leadership (Crowther, et al., 2002; Fullan, 1993a, 1994; ISTE, 2008; Riel & Becker, 2000, 2008). Therefore, for this study, teachers’ leadership practices and their technology integration focus for learning were examined within the theoretical framework for this study based primarily on three recent developments related to 21st century teaching for successful learning—one teacher preparation framework and two national PK-12 initiatives for improving student learning and success: (a) TPACK – Technological Pedagogical and Content Knowledge (Koehler & Mishra, 2009; Mishra & Koehler, 2006, 2010); (b) NETS – National Educational Technology Standards for Students and Teachers (ISTE, 2007, 2008); and (c) 21st Century Skills (Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009).

Each of these three framework components (TPACK, NETS, and 21st Century Skills) are discussed further in Chapter 2 in relation to teacher leadership practices, technology integration, and other demographic factors examined in this study. In regards to an early 21st century teacher, each of these three component pieces is crucial to the whole, like the three legs of a stool, where if one were taken away, the sturdy foundation no longer exists. Figure 1 and Figure 2 show this analogy of the importance of these three components to the overall well-being and balance of an effective 21st century teacher.
Figure 1. The balanced 3-legged framework of 21st century teaching.

Figure 2. The 3-frameworks needed to support and define 21st century teaching practice.

**Definition of Terms**

21st Century Skills: “The content knowledge and applied skills that today’s students need to master to thrive in a continually evolving workplace and society” (Brooks-Young, 2010, p. 6); also refers to the Partnership for 21st Century Skills and their list of student outcomes (see Appendix A).
Digital Immigrant: Prensky (2001) is first credited with using this term to describe the older population of the 21st century, “Those of us who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology (p. 1-2).

Digital Native: Prensky (2001) is first credited with using this term to describe students of the 21st century, those who “are all ‘native speakers’ of the digital language of computers, video games and the Internet” (p. 1).

Ed-Tech: shortened version of educational technology.

HOTS (higher order thinking skills): referring to Bloom’s taxonomy of cognitive functioning in learning, where low levels are Knowledge and Comprehension, middle levels are Application and Analysis, and high levels are Synthesis and Evaluation; a “revised” Blooms taxonomy for digital-learning (Anderson & Krathwohl, 2001) includes the use of Create (rather than synthesis), which is placed at the highest level.

ISTE: International Society for Technology in Education.

LoTi: levels of teaching innovation (formerly called Levels of Technology Implementation) developed by Moersch (1995, 2010).

Millenials: students born in the mid to late 1980s and therefore have lived with various technologies in their everyday lives (e.g., cable television, cell phones, computers); often synonymous with “digital natives”.

Modified Stage of Technology Adoption (mSTA): Based primarily on Christensen and Knezek’s (1999) and Russell (1995) Stages of Adoption of Technology in Education and generally refers to a teacher’s level of technology experience, abilities, and comfort. A seventh
stage of “Assisting Others” was added, primarily to signify extending the integration focus to a leadership role beyond one’s classroom and students. (See Appendix G)


**Overall Technology Integration Scale (OTIS):** The technology integration portion of the 21-TITL Survey that assesses teachers’ use of ten technology tools in their class along a continuum of teacher to student-centered uses. Frequency of that use is also assessed.

**Professional Development (PD):** structured learning opportunities for teachers to improve their professional practice, often based on school district and individual goals to ultimately improve student learning.

**Social Style:** an aspect of an individual’s personality, focusing solely on their level of interaction with others (Extroversion - Introversion).

**Student-centered Learning:** a learning environment or activity where the student is actively focused on the learning outcome by creating, evaluating, discussing, analyzing, questioning, writing, etc., which requires higher levels of cognition; most often the teacher acts as a facilitator or “guide on the side” in order to support student learning.

**Teacher-centered Learning:** a learning environment or activity where the teacher is active or talking, demonstrating, sharing information (written, verbal, gestures) while the students are more passive, most often listening and/or writing what was said, demonstrated, or written by the teacher; does not require higher levels of cognition, but most often involves memorization and comprehension only.

Technology Self-efficacy: a person’s belief in her or his technology abilities and level of competence.

Technology Integration: utilization of a technological device (hardware), program/application (software), or networks (Internet, WAN, LAN) for teaching and/or learning practices.

Web 2.0: a term coined by Tim O’Reilly in 2004 to describe the second generation of the Internet that allows for more user participation and connectivity rather than merely information gathering or viewing; with Web 2.0 websites/tools, literally anyone with an Internet connection can create websites, upload images, or share information on social networking sites (e.g., Facebook), unlike with Web 1.0 where only a relatively few technology-savvy individuals or corporations had the knowledge and skills to create and maintain websites or add text, images, audio, or video.

Delimitations and Limitations of the Study

The primary delimitation is that the sample includes only K-12 teachers in several northwest Ohio’s suburban districts, and does not include higher education faculty and K-12 educators in other areas of the state, country, or world, including online-only educators. As explained in Chapter 5, these groups would be natural next steps for future research, depending on the findings reported. Northwest Ohio has two large state universities and several two-year community colleges and smaller private colleges or universities where faculty could be surveyed.
But since there is little focus across the board (locally or nationally) for technology integration at higher education institutions, surveying them seemed premature at this time—although EDUCAUSE is working extensively in this area to increase awareness and needs (EDUCAUSE, 2004). But with a possible shift toward PK-20 education or lifelong learning on the horizon (Bonk, 2009; Cross, 2006; ODE, 2009), studying the higher and further education teacher populations would be critical to an overall perspective of 21st century teachers.

Several limitations of this study may affect the findings or the interpretation of those findings. The first is that the data collected was from an online self-report survey. Therefore, respondents who may have difficulty interpreting a question could respond incorrectly or their responses may not be as objective, as if collected through researcher observation. Another limitation is that since the survey is longer than suggested to obtain a high response rate (this survey takes approximately 12-20 minutes), participants may either answer more quickly without careful consideration, not be as truthful, especially toward the end due to item fatigue (Nulty, 2008), or they may simply stop and not complete the survey.

Similarly, all kinds of researchers (formal, informal, internal and external evaluators) distribute online surveys more often today, which can lead to participant “survey fatigue” (Porter, Whitcomb, & Weitzer, 2004). Furthermore, the length of the survey may reduce the total number of responses or response rate for specific groups or trait types, which may limit the strength of the findings due to smaller samples. If low participant numbers (less than 30 or so) are obtained for any particular group (e.g. “exceptionally high leadership practices”), statistical analysis and methodologies would be compromised, leading to a lack confidence for conclusion generalizability. Therefore, additional responses would need to be collected so that stronger conclusions could be developed.
Because the survey relates to technology use, is voluntary, and was distributed in an online format, the actual respondents may be more skewed toward higher end computer-using teachers rather than a normal distribution consisting of a range from technophobes and neophytes to computer savvy teachers and technophiles. Another limitation is that the participant teachers are from suburban northwest Ohio districts, so generalization to different or more ethnically diverse populations should be cautioned due to the fairly homogenous population.

**Organization of the Remaining Chapters**

This dissertation is composed of five chapters. The remaining chapters include: Chapter 2, a review of the literature, and Chapter 3, the methodology and procedures used for the study, Chapter 4, results, and Chapter 5, conclusions and recommendations.
CHAPTER II. LITERATURE REVIEW

Teachers have been using technologies to aid teaching and learning since the invention of writing, beginning with using paper and pencil or slates and charcoal, chalkboards. Later came more visual technologies such as film, television, and overhead projectors. But since the 1980s, with the advent of the personal computer, digital technologies entered the classroom and have evolved from Basic programming and word processing to today’s wireless Internet access and Web 2.0 applications. Today, information and communication technologies (ICT) or digital technologies have evolved and now allow for live video chats that can occur with anyone, anywhere, anytime or computers that can perform billions of calculations of in a fraction of a second. This chapter presents a synthesis of research literature related to K-12 teachers’ integration of technology in their classrooms and their leadership practices. For the purposes of this research, the focus of the wide scope of ICT affects in education is with ICT or digital technologies and how they have affected and changed teaching and learning in the K-12 classroom.

The 21st Century Need for Classroom Technology Integration

Over a decade ago, the National Research Council report, *How People Learn* (2000), stated that “(e)merging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago” (p. 4). Although *How People Learn* was a broad sweeping research-intensive referendum on what is required for effective, meaningful, long-term learning, an entire chapter was dedicated to the growing importance and need for technology to be integrated into student learning experiences. In the chapter called “Technology to Support Learning,” they discuss how technology should be used to: display and feature student expertise, give students feedback on their learning, allow students
to revise their work, prompt teachers to think about learning in different ways, allow teachers to model processes and learning for students, create active learning environments where students find and solve problems, and connect with the community to broaden learning opportunities.

Ultimately, learning in the early 21st century is tied to technologies as an important, if not essential, partner (Beglau, et al., 2011). The 2000 NRC report asserts that “(c)omputer-based technologies hold great promise both for increasing access to knowledge and as a means of promoting learning” (p. 217). But that “great promise” can go astray if not utilized effectively (Cuban, 2001; Oppenheimer, 2003; Papert, 1996) in that technology does not necessarily lead to improved student learning. In fact, learning can be hindered with the inappropriate or ineffective uses of technologies in the classroom, even from well-intentioned teachers (Mishra & Kohler, 2006; National Research Council, 2000). Unfortunately, many of the National Research Council’s (2000) findings regarding the effective use of technology in particular, have not yet been fully implemented in most schools. Some of these examples are discussed later in this chapter.

**Recent National Calls for Systemic Change**

Due to globalization, our networked technology-filled world has forced the U.S. worker’s purpose to shift from a concentration on industry and manufacturing to one focused on information, innovation, and creation (Friedman, 2005; Pink, 2001, 2005; Prensky, 2001; Tapscott, 1998). According to the 2020 Forecast, Creating the Future of Learning, from Ohio’s KnowledgeWorks Foundation and Institute for the Future (2009) “we are shifting toward a culture of creation in which each of us has the opportunity—and the responsibility—to make our collective future.” Therefore, a “creation society” demands a creation-filled education where the need for higher levels of learning occurs with or without technology. But since that future almost
certainly will be inundated with technologies, the effective and safe use of these digital technology tools would also almost certainly need to be priorities in preparing students for their future, both in their work and personal lives. In order for this change to occur, teachers must take responsibility for and ownership of this future, which requires them to take a leadership role in the design and implementation of curriculum, including the technologies that can be utilized to improve learning for all students in the 21st century. As Chen (2010) points out, “From national defense to environmental defense, from national security to economic security, every major issue of our day depends on our capacity to educate our citizenry to a much higher level than generations past” (p. 2), which is no small task for teachers today.

Over the past decade, several national initiatives have advocated, researched, and developed standards to implement such a change in direction. First, the 2004 National Educational Technology Plan (NETP), followed by the 2010 version, both set the course for the type of education needed in a globalized, connected world. Following the same general principles outlined in both NETPs, ISTE’s NETS and the Partnership for 21st Century Skills established standards and a framework for both teachers and students.

National Educational Technology Plans

Since at least 2004, the U. S. Department of Education has been addressing the need to change education through educational technologies, referring to the emergence of various technologies as both a cause and cure for what ails public education. According to the Department of Education’s 2004 National Educational Technology Plan, the dawn of the 21st century begins a “new golden age in American Education” (p. 8) where “(t)echnology ignites opportunities for learning, engages today’s students as active learners and participants in decision-making on their own educational futures and prepares our nation for the demands of a
global society in the 21st century” (p. 46). But in order to accomplish this great task, fundamental transformations, or “systemic change” (p. 46) must take place, requiring all stakeholders—teachers, administrators, students, and parents—to contribute to the solution as well as the process of getting there. The Golden Age report (2004) goes on to explain the need for educational technologies to facilitate new educational models. The obvious intent of the 2004 report was to urge the integration of technology into an educational system that focuses on the future needs of students, which is echoed in the 2010 National Educational Technology Plan (NETP).

The most recent NETP (2010) highlights the importance of utilizing technologies to aide teachers for teaching, students for learning, and stakeholders for assessing and evaluating productivity and therefore, educational success. In addition to technology being used for teaching and learning, the plan outlines the need to leverage technology-based assessment systems in order to measure progress and focus on continuous improvement as well as for the Productivity goal of “making more efficient use of time, money, and staff” (p. 73). Surprisingly, and perhaps in direct conflict with the Productivity goal, is the goal for Infrastructure, which could truly jump-start educational transformations by suggesting that all teachers and students have broadband access at school and at home as well as a device for each to use. If, or when, this goal becomes reality, as it most likely will, there becomes an even greater need for teachers and students to be aware of and adept with a wide array of 21st century knowledge and skills.

**Composite Framework for 21st Century Teaching and Learning**

Since the 2001 No Child Left Behind law, or NCLB, the standards movement has become ubiquitous in public education. To that end, a new set of student and teacher outcomes to address the needs of today’s learners has emerged. These new outcomes for 21st century learning
include the ISTE’s NETS (2007, 2008) and those developed by the Partnership for 21st Century Skills (2009). The third component of this research framework is a set of outcomes centered on the 21st century teacher, called TPACK or Technological Pedagogical Content Knowledge. These three sets of expectations for 21st century learning and teaching are the foundation of this research and a guide for teaching and learning today.

**National Educational Technology Standards (NETS)**

In order to meet the needs of learners today and into the future, in 2007, the International Society for Technology in Education (ISTE) began revising or “refreshing” their technology standards for students, teachers, and administrators. Initially developed in the late 1990s (ISTE, 1998-2002), the updated student, teacher, and administrator’s national educational technology standards, or NETS (ISTE, 2007, 2008, 2009), reflect a transformation toward connected, collaborative learning with a focus on higher order thinking skills such as creativity, problem solving, and critical thinking along with the more society-focused areas of leadership and citizenship. Figure 3 shows each of the standard themes for students, teachers, and administrators and Appendix B lists all the NETS in their entirety, comparing the original with the refreshed.

The NETS•T highlights the importance of technology integration, of course, but also stresses the effective teaching and assessment of learning with the standard, “Design and develop digital-age learning experiences and assessments” (ISTE, 2008). Similarly, the NETS•A also mesh well with the NETS•S and NETS•T to create a unified vision for the entire educational organization for at least the next decade of the 21st century and perhaps beyond.
NETS•Students (ISTE, 2007)
1. Creativity and Innovation
2. Communication and Collaboration
3. Research and Information Fluency
4. Critical Thinking, Problem Solving, and Decision Making
5. Digital Citizenship
6. Technology Operations and Concepts

NETS•Teachers (ISTE, 2008)
1. Facilitate and Inspire Student Learning and Creativity
2. Design and Develop Digital-Age Learning Experiences and Assessments
3. Model Digital-Age Work and Learning
4. Promote and Model Digital Citizenship and Responsibility
5. Engage in Professional Growth and Leadership

NETS•Administrators (ISTE, 2009)
1. Visionary Leadership
2. Digital-Age Learning Culture
3. Excellence in Professional Practice
4. Systemic Improvement
5. Digital Citizenship

Figure 3. National Educational Technology Standards (NETS) for Students, Teachers, and Administrators.

In addition to the newly prescribed prevalence and emphasis on creativity, leadership, and digital citizenship in the Refreshed NETS for students, teachers, and administrators, fluency is also an emerging term used in the new NETS to describe a deeper, yet more flexible understanding of certain competencies. In other words, rather than simply checking a box to say someone can do this skill or that one, fluency is more of an internalized and permanent behavior. Seymour Papert (1996) used the term to explain the need to support “technological fluency” over technological literacy where the student is empowered and develops authentic “projects that give a genuine sense of competence” (p. 175). The 21st Century Fluency Project (http://www.fluency21.com) also brings up the concept of long-term development and deep understanding of digital technology-related fluencies and how to use them appropriately for
whatever task or problem arises (Churches, et al., 2010). In *The Digital Diet*, Churches, et al. (2010) use various fluencies to frame each chapter in a summary format, including: solution fluency, information fluency, collaboration fluency, creativity fluency, and media fluency. In each case, the importance of deep knowledge, skills, and understanding of multiple perspectives of these would develop one’s fluency, which is essential in an ever-changing world.

**Partnership for 21st Century Skills (P21)**

The second component relating to 21st century student outcomes is the 21st Century Skills framework from The Partnership for 21st Century Skills, or P21. The Partnership for 21st Century Skills (P21) framework itself is a synthesis of teacher expectations, course or content requirements, and student learning outcomes (Partnership for 21st Century Skills, 2009; Trilling & Fadel, 2009).

In the fall of 2009, Ohio became a partner in the national Partnership for 21st Century Skills and new state curricular standards are now being aligned with the 21st Century Skills (ODE, 2011). Figure 4 shows the 21st Century Skills framework, including the student outcomes (colored arch area) and the teacher and school district support systems (foundation/steps area). The student outcomes include the Core Subjects and 21st Century Themes; Life and Career Skills; Learning and Information Skills; Information, Media, and Technology Skills, while the support systems include Standards and Assessments, Curriculum and Instruction, Professional Development, and Learning Environments. Appendix A presents the P21 Skills and Outcomes.
According to the Partnership for 21st Century Skills (2009), “Mastery of core subjects and 21st century themes is essential to student success.” Core subject include English, math, arts, science, world languages, geography, history, economics, government, and civics, while 21st century themes are to be woven into all of the core subjects. These themes include Global Awareness; Financial, Economic, Business, and Entrepreneurial Literacy; and Civic, Health, and Environmental Literacies. Within these areas of study, the P21 framework rests upon a traditional curriculum, or 3 Rs (Reading, wRiting, and aRithmatic), but also highlight the importance of skills for 21st century success, such as Life and Career Skills, Learning and Innovation Skills, and the Information, Media, and Technology Skills. For this study, the two most direct connections include the Information, Media, and Technology Skills (for technology skills and integration) as well as the Life and Career Skills, which include Leadership.
Comparing ISTE NETS•Students and the Partnership for 21st Century Skills (P21).

Although the P21 framework in its entirety is more complete than the ISTE NETS•Students, similarities or even redundancies exist between them, showing that they both support and enhance each other as a model for teachers and other educational stakeholders looking to improve student learning. For example, the NETS•S includes standards on Creativity and Innovation, while the P21 framework addresses those same skills under “Learning and Innovation Skills” and also included in both are Critical Thinking and Problem Solving as well as Communication and Collaboration. One specific difference is that “Digital Citizenship” is listed as a Student Standard on the NETS, but that same term is not specifically used on the P21 framework, only implied through Leadership and Responsibility (in the Life and Career Skills) and Information Literacy.

Again, both the P21 Framework and the NETS•S work together to provide an ideal model of what is expected for students in the early 21st century. Similar to the 21st Century Skills is Wagner’s “Seven Survival Skills for the New Economy” from The Global Achievement Gap. The seven survival skills are: (a) Critical Thinking and Problem-Solving, (b) Collaboration across Networks and Leading by Influence, (c) Agility and Adaptability, (d) Initiative and Entrepreneurialism, (e) Effective Oral and Written Communication, (f) Accessing and Analyzing Information; and (g) Curiosity and Imagination. In sum, “Schools can no longer ignore the importance of digital competencies or what our children are already doing in the virtual world, with or without the involvement of educators” (Zhao, 2010, p. 195). Table 2 shows the similarities of the NETS•S to the Partnership for 21st Century Skills framework, signifying the importance of certain key skills for students.
Table 2

Similarities Between the NETS•Students and the Partnership for 21st Century Skills Framework
(similarities in bold)

<table>
<thead>
<tr>
<th>ISTE’s NETS•Students</th>
<th>Partnership for 21st Century Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard #1: Creativity and Innovation</td>
<td>Learning and Innovation Skills: Creativity and Innovation</td>
</tr>
<tr>
<td>Standard #2: Communication and Collaboration</td>
<td>Learning and Innovation Skills: Communication and Collaboration</td>
</tr>
<tr>
<td>Standard #3: Research and Information Fluency</td>
<td>Information, Media and Technology Skills: Information Literacy</td>
</tr>
<tr>
<td>Standard #4: Critical Thinking, Problem Solving, and Decision Making</td>
<td>Learning and Innovation Skills: Critical Thinking and Problem Solving</td>
</tr>
<tr>
<td>Standard #5: Digital Citizenship (includes legal and ethical behaviors)</td>
<td>Information, Media and Technology Skills: Information, Media, and ICT Literacies</td>
</tr>
<tr>
<td>Standard #6: Technology Operations and Concepts</td>
<td>Information, Media and Technology Skills: ICT Literacy</td>
</tr>
</tbody>
</table>

Both the 21st Century Skills and the NETS are overarching, forward thinking outcomes for schools to work from over the next several years or more. Because they are so broad and cannot be easily assessed or included into every classroom (yet), doesn’t mean that they should not be identified as a goal to reach for in our quest to make students better prepared for their future. Susan Brooks-Young (2010) references this forward thinking practice with a sport analogy from Dryden’s book Total Gretzky, “As Walter Gretzky told his son, ice hockey great, Wayne, ‘Skate to where the puck is going to be, not to where it has been’” (p. 9). In this case, P21 and ISTE, as well as the U.S. Department of Education with their NETP, want to push schools to look ahead, do more, and prepare students for where they need to be 5, 10, or 15 years from now (Dator, 2004). In addition to the student outcomes for learning provided by ISTE’s
NETS and the Partnership for 21st Century Skills P21 framework, an additional framework helps to define best practices for teachers is called TPACK.

**TPACK: 21st Century Teacher Expectations**

Another component of the 21st Century teaching and learning composite framework is the TPACK model. TPACK stands for Technological Pedagogical Content Knowledge and is a framework for teachers’ effective technology integration (Koehler & Mishra, 2009; Mishra & Koehler, 2006; 2010). Based on Shulman’s (1986, 1987) teacher knowledge framework, TPACK is made up of three kinds of knowledge that teachers use for effective teaching – subject matter or content knowledge, pedagogical knowledge, and technological or technology integration knowledge. Figure 5 shows this model and its overlapping components due to the integrative or connected nature of the three types of knowledge. Mishra and Koehler (2006) argue, “a conceptually based theoretical framework about the relationship between technology and teaching can transform…teacher education, teacher training, and teachers’ professional development” (p. 1019). In sum, the TPACK model represents and simplifies the complex relationships among technology, pedagogy, and content during the teaching and learning process.

The three separate, yet connected, overlapping, or intersecting areas (technology, pedagogy, and content knowledge) can be combined into pairs of knowledge types that teachers utilize when teaching, such as Technological Content or Pedagogical Technology Knowledge. According to Mishra and Koehler (2010), “The TPACK approach goes beyond seeing these three knowledge bases in isolation. On the other hand, it emphasizes the new kinds of knowledge that lie at the intersections between them” (¶ 4). This statement is similar to one of the goals of this research, which is to examine the intersection of ideas where similar or even disparate concepts intersect, overlap, make a connection, and/or show a relationship.
The intersection of content and pedagogy is not a new or novel idea. John Dewey (1916) talked about the importance of a teacher knowing both content and pedagogy and the use of student-centered learning opportunities -- “The problem of teaching is to keep the experience of the student moving in the direction of what the expert already knows. Hence, this displays the need that the teacher know both subject matter and the characteristic needs and capacities of the student” (Dewey, 1916, p. 216). Today and into the foreseeable future, students’ “characteristic needs and capacities” include digital technologies because they use them in every other aspect of their lives. So, why should students need to “power down” when they go to school? (November, 2010). Instead, teachers can harness these tools to engage students in learning how to use them safely and efficiently for their own learning as well as for their daily lives.
Mishra and Koehler (2006) remind us that there is no one framework that can tell the full story of the complexities involved in the processes of teaching and learning. Therefore, for this study, the TPACK framework was combined with the student-centered NETS•S and the Partnership for 21st Century Skills frameworks for providing effective learning to students. In other words, within the Technology, Pedagogy, and Content Knowledge that teachers must utilize, they must also be aware of and prepare students based on the guidelines and standards put forth by ISTE and the Partnership for 21st Century Skills. In their most recent work, Mishra, Koehler, and Henriksen (2011) recognize the importance of connecting content knowledge and TPACK as a whole to 21st century learning. Their separation and redefinition of content into 7 areas or skills called “trans-disciplinary cognitive tools” again highlights the idea of intersecting, overlapping realms of content, pedagogy, and technology integration—Perceving, Patterning, Abstracting, Embodied Thinking, Modeling, Deep Play or Transformational Play, and Synthesizing. Several concepts are also present in the NETS•S and 21st Century Skills frameworks, demonstrating a common thread connecting all three frameworks used in this study.

For this study, the content knowledge (CK) relationship was not specifically assessed for the reason that content is always present in teaching of any kind, whether facilitative, Socratic, or didactic (although, in some cases, a teacher’s content knowledge may not be completely up to par!). For most teachers, content focus is the primary foundation of entire curricula and daily lesson planning. Therefore, it does not necessarily need to be addressed in a study of 21st century teacher dispositions. In other words, the question, “What am I going to teach next week?” (the content or ‘stuff’) usually comes up before “How will I teach that to my students?” (their strategies, ‘actions,’ or ‘means’). In contrast, and in regards to the TPACK model, technology is not always included when planning a lesson. Therefore, the technology component was
addressed and measured in this study while teachers’ content knowledge was not addressed or measured since it is always present at some level. Pedagogy was addressed through questions related to teacher leadership practices and the demographic information, but it was not directly assessed with a “pedagogy” (or teaching methodologies) measure.

**Conditions for Successful Technology Integration**

In order for students to be successful in a 21st century educational environment where technology is integrated into learning, certain conditions have shown promise for improving student learning and engagement. Examples of these conditions include constructivist teaching, student-centered learning, and a focus on critical thinking or higher order thinking skills.

**21st Century Classroom: Constructivist, Student-Centered, and H.O.T.S**

Today’s students are navigating an educational system that was designed for 19th or 20th century students (Friedman, 2005; November, 2010b; Pink, 2005; Prensky, 2001; Wallis, 2006). In order to prepare today’s students for their future, teachers need to assign and assess more open-ended, critical thinking, engaging, authentic tasks. These tasks include the use of student-centered, constructivist learning that focuses on higher order thinking skills or HOTS (Becker, 2000a, 2000b; Brooks & Brooks, 1993; ChanLin, et al., 2006; Moersch, 2010; November, 2010b; Richardson, 2006; Sandholtz, et al., 1997; Warlick, 2004). The use of technology in learning opens up multitudes of opportunities to integrate all these best teaching practices – individualized, student-centered learning, constructivist, HOTS lessons with authentic tasks that require critical thinking and action. The following sections explain how constructivist, student-centered HOTS can bring about improved student learning for the 21st century.

**Constructivist Methodology.** The constructivist teaching methodology can be defined as the teacher being a facilitator or guide to student learning, not the knowledge-giver or speaker of
facts to memorize (Brooks and Brooks, 1993). By definition, constructivist teaching is student-centered and therefore the students are the ones doing the majority of the “work” in the classroom. Consequently, this action alone can lead to resistance early on if students are used to more passive and lower-level means of learning, as the ACOT teachers experienced (Sandholtz, et al., 1997). A pedagogical change to a more active student role calls for redirecting the act of teaching more toward student learning (rather than the act of teaching itself), and therefore, toward students’ long-term understanding rather than toward short-term performances (Katz, 1985). Brooks and Brooks (1993) report that with short-term, passive types of learning, often focused on lower levels of Bloom’s (1956) Cognitive Taxonomy, educators may “win the battle, but lose the war” (p. 40) since the long-term gains or understandings are never realized, leaving the students unchallenged, less successful, and therefore unprepared than they should be.

Student-centered, constructivist learning is prevalent in educational research and national best practices guidelines. Metiri Group and NCREL (2003) describe engaged learning as student-centered learning, while ISTE’s refreshed NETS for Teachers (2008) and the Partnership for 21st Century Skills (2010; Trilling & Fadel, 2009) both include a student-centered focus. Moreover, Moersch’s (2010) revised LoTi scale focuses on student-centered learning opportunities at all levels of technology use, even non-use. While in Becker and Ravitz’s (1999) early research of over 400 teachers, they found teachers who integrated technology into their teaching were more likely to move toward student-centered, constructivist teaching practices—and this was during a time well before the prevalence of the Internet or world wide web in classrooms, let alone interactive Web 2.0, interactive white boards, projectors, and the like. Brooks-Young (2010) summarizes, “when imagining innovative ways for students to use technology, you can think in terms of project-based learning and constructivism. Both approaches are student-based and rely
on teamwork, supporting communication, and collaboration during and outside the school day” (p. 42), all of which are components of NETS and the P21 framework.

In order to clarify the research, the use or non-use of technology does not necessarily result in student-centered or constructivist learning. In one example, Judson (2006) found that teachers’ computer use was observed in both constructivist and traditional, direct instruction classrooms, while Becker and Riel (2000) found similar results. Similarly, Moersch’s work (1995; 2010) includes the descriptors for student-centered learning and constructivism in all levels, including “Non-use” of technology. In other words, it’s not the technology use that creates a learner-centered or constructivist classroom and vice-versa. But some researchers argue that the technology creates a reason to change teaching to more student-centered learning or constructivist methodology in order to improve student learning for 21st century skills (Becker & Riel, 2000; Brooks-Young, 2010; Sandholtz, et al., 1997).

**21st century skills attainment through student-centered constructivism.** Vannatta and Beyerbach (2000) found that “An important characteristic of a progressive technology-using educator is a dynamic, constructivist vision of technology integration” (p. 144). Moersch (1998) also describes technology-integrating teachers commonly employing constructivist practices by using students’ input, interests, and ideas to support a lesson. Similarly, Marc Prensky (2010), who coined the term “digital natives,” recently coined a new term “partnering pedagogy” to essentially describe a constructivist teaching strategy that requires teachers to get student input and feedback, take on self-directed, collaborative activities or projects, and encourage student sharing of their answers or ideas, similar to Brooks-Young’s (2010) vision.

But employing student-centered learning in 21st century classrooms to improve student learning is not a new concept or recent research finding. ACOT teachers found themselves
transitioning from a teacher-centered methodology of instruction to a constructivist, student-centered approach. One teacher, realizing that she was doing all the presenting and therefore doing the primary load of work and learning—decided to transfer that to the students? “I was a wonderful presenter. I was the one doing all the work and consequently most of the learning” (Sandholtz, et al., 1997, p. 160). They go on to describe this shift in teacher methodologies from instruction to construction of knowledge and skills, characteristics of each style are shown in Table 3. Tapscott (1998, p. 143) produced a similar comparison table, recognizing a shift in how students learn from Broadcast Learning to Interactive Learning, where the teacher is the facilitator, learning is customized and can even be fun!

Table 3

<table>
<thead>
<tr>
<th></th>
<th>Instruction</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom activity</td>
<td>Teacher centered; didactic</td>
<td>Learner centered; interactive</td>
</tr>
<tr>
<td>Teacher role</td>
<td>Fact teller; always expert</td>
<td>Collaborator; sometimes learner</td>
</tr>
<tr>
<td>Student role</td>
<td>Listener; always learner</td>
<td>Collaborator; sometimes expert</td>
</tr>
<tr>
<td>Instructional emphasis</td>
<td>Facts, memorization</td>
<td>Relationships, inquiry, invention</td>
</tr>
<tr>
<td>Demonstration of success</td>
<td>Quantity</td>
<td>Quality of understanding</td>
</tr>
<tr>
<td>Assessment</td>
<td>Norm referenced; multiple choice items</td>
<td>Criterion referenced; portfolios and performances</td>
</tr>
<tr>
<td>Technology use</td>
<td>Drill and practice (right/wrong answers)</td>
<td>Communication, collaboration, information access, expression</td>
</tr>
</tbody>
</table>

Furthermore, students developed more responsibility and ownership of their learning in these constructivist classrooms as compared to traditional classrooms (Sandholtz, et al., 1997). At first, students were frustrated with the change from traditional receiving and regurgitating knowledge, but eventually realize the benefits of the hands-on, minds-on explorations. Similarly, the participating teachers also went through this transformation from discomfort and feeling
overwhelmed to acceptance and “enjoying opportunities for exploration and discovery” (p. 143). Teachers need to move away from the transmittal of information toward student-centered construction of understanding (ChanLin, et al., 2006). Vannatta and Beyerbach (2000) also found that through teachers’ experiences in their grant project, participants developed more constructivist views toward using technologies in the classroom for student learning.

Brooks and Brooks (1993) report similar success with the use of student-centered constructivist pedagogies, encouraging teachers to allow students to focus on big ideas, use student interests to guide problems of inquiry, and facilitate a learning environment for students to use higher order thinking skills (HOTS) to create connections, synthesize hypotheses and develop solutions. Each of these areas of study (problem solving, creating connections, synthesis) correspond to 21st century skills and student outcomes described in the NETS for students, and therefore could easily be integrated into technology-ready classrooms of today. Jonassen, Howland, Moore, and Marra (2003) wrote Learning to Solve Problems with Technology: A Constructivist Perspective, which outlines many teacher roles, such as facilitator, coach, guide, partner, monitor, or guard. In their research, they found “real benefits to be harvested by putting today’s networked computer technologies in the hands of students, especially when students are asked to use those technologies in ways that are active, constructive, collaborative, intentional, complex, contextual, conversational, and reflective” (p. 66).

**H.O.T.S.: Higher Order Thinking Skills.** The last, but not least, focus of a 21st century education is higher order thinking skills, or HOTS. These thinking skills refer to the upper levels of Bloom’s (1956) taxonomy of cognitive functioning in learning, most often including Application, Analysis, Synthesis, and Evaluation. Bloom’s lower levels are Knowledge and
Comprehension, middle levels are Application and Analysis, and highest levels are Synthesis and Evaluation. Figure 6 shows the traditional Bloom’s Taxonomy and a “revised” Blooms taxonomy for digital-learning (Anderson & Krathwohl, 2001) that includes “Create” (rather than synthesis) at the highest level in place of Evaluation, which is now one step lower, and also displays the thinking skills as action verbs rather than nouns. For example, the action verb of Evaluating is used rather than the noun of Evaluation. For this study, the upper levels of the traditional Bloom’s and Revised Blooms are considered HOTS—analysis/analyzing, synthesis/synthesizing, evaluation/evaluating, and creating.

<table>
<thead>
<tr>
<th>Bloom’s Taxonomy (Bloom, 1956)</th>
<th>Bloom’s Revised Taxonomy (Anderson &amp; Krathwohl, 2001)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Higher Order Thinking Skills</strong></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>6 Creating</td>
</tr>
<tr>
<td>Synthesis</td>
<td>5 Evaluating</td>
</tr>
<tr>
<td>Analysis</td>
<td>4 Analyzing</td>
</tr>
<tr>
<td>Application</td>
<td>3 Applying</td>
</tr>
<tr>
<td>Comprehension</td>
<td>2 Understanding</td>
</tr>
<tr>
<td>Knowledge</td>
<td>1 Remembering</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Lower Order Thinking Skills</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering</td>
</tr>
</tbody>
</table>

*Figure 6. Bloom’s (1956) Taxonomy of Cognitive Learning and Anderson and Krathwohl’s (2001) Revised Bloom’s Taxonomy.*

Another key educational model for teaching and levels of learning is displayed in Dale’s Cone of Experience (Dale, 1969). Similar to Bloom’s taxonomy that has advancing levels, Dale’s Cone also shows a gradual progression of learning opportunities from concrete experiences to more abstract ones. Figure 7 shows the various types of instruction or learning opportunities and the gradual, implied progression from concrete to abstract, which Dale subscribed to the variation and alternating back and forth from concrete to abstract strategies. In both Bloom’s taxonomy (1956) and Dale’s Cone of Experience (1969), there are varying levels
of challenges and opportunities for learning (teaching strategies) that teachers can employ to offer students to just scratch the surface level of a concept or allow them to delve more deeply, and thus understand more completely and for longer periods of time, especially if varied.

Figure 7. Edgar Dale’s cone of experience (1969).

With higher levels of learning, such as evaluation and synthesis, along with the process of hands on, simulation or real-life practices and scenarios, engaged students will be able to attain higher levels of learning for longer-term successes (Dwyer, 1994; Dwyer, Ringstaff, & Sandholtz, 1991; Marzano, Pickering, & Heflebower, 2011; Sandholtz, et al., 1997; Warlick, 2004). Furthermore, technology facilitates or provides the vehicle or means for these types of
learning environments—such as simulations, reflective writing or presentations, collaborative and cooperative project-based learning, and designing, synthesizing, or creating a new perspective or argument (Brooks-Young; 2010; Dwyer, 1994; Dwyer, et al., 1991; Sandholtz, et al., 1997). One example is a small 2002 study, where Hopson, et al., found a positive correlation in students’ higher order thinking skills for those students who learned in a technology enriched classroom environment. A more recent meta-analysis by Tamim, Bernard, Borokhovski, Abrami, and Schmid, (2011) examined over a thousand studies from the 1980s through 2007 on the effects of classroom computer use on student achievement. They found low to moderate effect sizes (0.30 to 0.35) for their two analyses and determined when teachers used computers to “support cognition” or facilitate student thinking, achievement was significantly higher than when teachers used it to simply present content. As the ancient Chinese proverb states (or Albert Einstein—there’s some debate here who gets credit), "teach me and I learn, ... involve me, I understand". Ultimately, in technology-enriched classrooms, students are able to be more involved and do more things in more ways than in classrooms without such resources.

As repeatedly displayed by the teachers in the ACOT project (Sandholtz, et al., 1997), if technology integration is to be deep, meaningful, and effective, it must include lessons that challenge students’ higher order thinking skills. Furthermore, as described by Moersch over a decade ago (1998), the goal of effective learning with technology is to utilize it “as a seamless medium to maximize their students’ thinking, reasoning, communication, and problem-solving skills” (p. 51) and “to advance student’s ability to think and reason and solve authentic problems” (p. 53). All of these researchers refer to technologies available during the 1980s and 1990s, well before the widespread use of the Internet, World Wide Web, and Web 2.0 tools in classroom instruction. Today, there are many more ways and opportunities for students to engage
in higher levels of learning through the available technologies and pedagogical strategies
(Becker, 2000a; Brooks-Young, 2010; Richardson, 2006; Solomon & Schrum, 2010; Trilling &
Fadel, 2009; Warlick, 2004).

**Technology Integration for Teaching and Learning**

Although not essential for effective teaching and learning to occur, ICT tools still remain
a critical part of improving student success in relation to a complete 21st century education. The
idea behind effective ICT integration versus merely using digital technologies is more than the
ubiquity or quantity of the tools in a classroom. The key is a matter of quality—what teachers
choose to use digital technologies for in regards to student learning outcomes. Do teachers use
ICTs to do things that were not possible before or merely to redo what has already been done
previously without digital tools (Dwyer, 1991, 1994; Sandholtz, et al., 1997; Warlick, 2004)? In
relation to student learning outcomes, the NETS for Teachers, or NETS-T (ISTE 2008), defines
effective integration as being able to: Facilitate and Inspire Student Learning and Creativity,
Design and Develop Digital-Age Learning Experiences and Assessments, Model Digital-Age
Work and Learning, and Promote and Model Digital Citizenship and Responsibility. The final
NETS-T, to Engage in Professional Growth and Leadership, is the only standard not directly
related to student learning and performance, but yet serves as a type of leadership in one’s own
development in an ever-changing world.

Therefore, most of what teachers do should be directed toward higher-level student
learning outcomes through the use of appropriate digital technologies, other tools, and strategies
in order to bring those to fruition. Solomon and Schrum (2010) declare that “Educators will use
sound pedagogical judgment to determine which tools—web-based and traditional—are best to
use for student learning and when and how to use them” (p. 11). This includes using these tools
for: content delivery; tools for student creation, understanding, communication; student assessment; and for classroom and learning management/tasks such as communications, attendance, grades, paperwork, and special education reporting. Furthermore, connected, networked learning via the Internet allows for more collaborations and extends the learning environment beyond the boundaries of time and location. Students can now learn at any hour of the day or learn from practically anywhere on the planet (Bonk, 2009; Cross, 2006). Simply stated, given access to the right tools and an intentionally constructed learning environment based on sound curriculum, student learning can occur in a myriad of places or times—learning from or with anyone at anytime from anywhere on the planet. Because of this anytime, anywhere learning, it’s important for teachers to know how to create effective, meaningful 21st century learning environments, whether those are face-to-face, online, or a mixture.

**Research on Teachers’ Technology Integration**

Several major studies or streams of research have been conducted in the past 20 to 30 years that provide an overview of ICT or educational technology integration in classrooms across the United States. This section highlights a few of those areas and findings to provide a baseline for this study, including that effective technology integration in schools requires time, leadership, and ongoing, focused, reflective professional development. The Apple Classrooms of Tomorrow project is one example of an in-depth, sustained technology integration project where teachers were encouraged to use computer technologies to accomplish new ways of teaching and learning (Dwyer, 1994; Dwyer, et al., 1991; Sandholtz, et al., 1997).

**Apple Classrooms of Tomorrow (ACOT)**

Educational technology, including technology integration, has been around since the birth of personal computers, but it was not until the late 1980s and early 1990s when research on their
effectiveness in the classroom blossomed. One of the most cited, groundbreaking studies of computer use in schools during that period was conducted in partnership with Apple Computer, Inc. called Apple Classrooms of Tomorrow, or ACOT (Dwyer, 1994; Dwyer, et al., 1991; Sandholtz, et al., 1997). With a focus on student-centered classrooms and learning, Larry Cuban (in the foreword) explains that the “overall goal (of the program) was to create different forms of learning and teaching, with the help of technology, not have technology determine what was to be learned or how it was to be taught” (Sandholtz, et al., 1997, p. xiii). In other words, the focus was on student learning outcomes followed by what digital tools could help accomplish those outcomes, rather than only focusing on the use of ICT technologies as the only goal.

In the ACOT project, data was gathered for ten years from 32 teachers at five schools across the United States (Dwyer, et al., 1991). From this work, they found that teachers evolve through five stages during the process of learning how to effectively integrate technology in their classrooms: Entry, Adoption, Adaptation, Appropriation, and Invention. This evolution is described as “stages that build a readiness for purposeful change” (p. 50) where teachers increasingly became reflective of their teaching and challenged themselves to become more student-centered rather than curriculum-tethered in their teaching, by focusing more on collaboration and active learning environments for their students. For example, students were considered experts and were challenged to work on and solve complicated, open-ended problems (Dwyer, 1994). Essentially, two main needs emerged from the in-depth ACOT study—that 1) teachers need opportunities to reflect on their teaching practice and beliefs, and 2) administrative support in the form of structural or time adjustments must be in place in order to allow for this reflection and planning (Dwyer, et al., 1991).
Levels of Teaching Innovation (LoTi)

Originally based on the ACOT research and the Concerns-Based Adoption Model or C-BAM (Hord, Rutherford, Huling-Austin, & Hall, 1987), the LoTi assesses eight stages of teacher’s instructional practices from 0 (Non-use) to 6 (Refinement) (Moersch, 2010), see Table 4. Moersch’s LoTi or Levels of Technology Implementation (1995) became the Levels of Teaching Innovation (2010) due to changes in the ISTE NETS and the Partnership for 21st Century Skills. The LoTi model is important to consider in technology integration research because it is a practical assessment of teachers’ general technology use for teaching and learning.

Table 4

<table>
<thead>
<tr>
<th>LoTi Levels</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0—Non-use</td>
<td>Direct instruction approach to a collaborative, student-centered learning environment; practices do not involve the use of digital tools and resources.</td>
</tr>
<tr>
<td>Level 1—Awareness</td>
<td>Information dissemination to students using lectures or teacher-created multimedia presentations; typically focus on lower cognitive skill development. Digital tools used for curriculum management, lecture enhancement, or reward.</td>
</tr>
<tr>
<td>Level 2—Exploration</td>
<td>Content understanding and supports mastery learning and direct instruction. Students use digital tools for extension or enrichment activities, or information gathering.</td>
</tr>
<tr>
<td>Level 3—Infusion</td>
<td>Emphasizes engaged learning and higher order thinking. Teacher-centered strategies for concept attainment, inductive thinking, and scientific inquiry models, while students use digital tools to carry out teacher-directed tasks.</td>
</tr>
<tr>
<td>Level 4a—Integration (mechanical)</td>
<td>Students explore real-world issues and solve authentic problems using digital tools and resources. Teachers rely on prepackaged materials, assistance from other colleagues, or professional development workshops.</td>
</tr>
<tr>
<td>Level 4b—Integration (routine)</td>
<td>Students fully engaged in exploring real-world issues and solving authentic problems using digital tools and resources. Emphasis is on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and issues resolution that require higher levels of student cognitive processing and in-depth examination of the content.</td>
</tr>
<tr>
<td>Level 5—Expansion</td>
<td>Students collaborate beyond the classroom to solve problems and resolve issues. Emphasis is on learner-centered strategies. Students use digital tools and resources to answer student-generated questions that dictate the content, process, and products embedded in the learning experience.</td>
</tr>
<tr>
<td>Level 6—Refinement</td>
<td>Students regularly collaborate beyond the classroom to solve problems and resolve issues. The instructional curriculum is entirely learner based. The content emerges based on the needs of the learners according to their interests, needs, and aspirations and is supported by unlimited access to the most current digital applications and infrastructure available.</td>
</tr>
</tbody>
</table>
The levels listed in Table 4 are also known as the LoTi H.E.A.T. (Higher order thinking, Engaged learning, Authentic connections, and Technology use) levels, which represent increasing amounts of technology-enhanced student-centered learning and constructivist teaching practices. For example, Level 4b (Integration), “Emphasis is on learner-centered strategies that promote personal goal setting and self-monitoring, student action, and issues resolution that require higher levels of student cognitive processing and in-depth examination of the content” and Level 6 (Refinement), “The instructional curriculum is entirely learner based. The content emerges based on the needs of the learners according to their interests, needs, and aspirations.”

Even at Level 0 or Non-use, the LoTi represents student-centered learning is still possible without the use of technology, whether in a direct instruction or constructivist classroom.

“No significant difference” Research Findings

In the late 1980s through the early 2000s, there was a barrage of research that showed “no significant difference” when comparing achievement scores from students who were using computers to those who did not (Cuban, 2001; Joy & Garcia, 2000; Oppenheimer, 2003; Ramage, 2002). Many of these studies referred to computer-aided-instruction (CAI) or online distance education uses (Joy & Garcia, 2000), but some also referred to regular classroom or lab-based uses of computers in K-12 schools.

So, how could there be “no significant difference” in teaching students with or without technology, especially since we’re still talking about technology in the classroom decades later? Upon further investigation, it was determined that a primary reason for “no significant difference” in student outcomes was due to the realization that teacher’s strategies, methods, assessments, etc. did not change, only the tool/delivery method did (Brooks-Young, 2010; Cuban, 2001; Pelgrum & Plomp, 2004; Riel & Becker, 2000; Sandholtz, et al., 1997). Another
reason for the no significant difference results, in some cases, was due to the poorly structured methodologies used by researchers—such as poor research design, difficulty in conducting a truly randomized, scientific study, or a lack of controlling for variables in the analysis (Joy & Garcia, 2000; Ramage, 2002). Teachers in these early studies primarily used the new digital technology tools to do the same things they were doing before—focusing on memorization, recall, and lower-level cognitive learning rather than using the ICTs to engage students in new methods of learning, communicating, and understanding. Often avoided or overlooked were opportunities to use the technology for activities that required higher level thinking involving problem solving, critical thinking (questioning, analysis, evaluation), including learning how to navigate and make sense of the large amounts of information and media messages that technology brings to a connected society, also known as media literacy.

For instance, rather than lecture to a class with notes written on an overhead projector or on the chalkboard, teachers “integrated technology” by typing their notes into PowerPoint and then proceeded to lecture to the students just as they had done before, but this time using technology. In both the low-tech (chalkboard; overhead projector) and high-tech (PowerPoint on TV or projector) versions of this lesson, students are simply listening to the lecture, reading the teacher’s notes, and possibly taking notes as well. If they are only copying the words from the teacher’s notes, they are not even thinking about or processing what is being said or read; often they are too busy focusing on writing every word and cannot respond when the teacher asks a question every 20 minutes or so. In this example, the student is passive, not active, in the learning process, which is not the best way for most students to learn for long-term retention and understanding (Medina, 2009; National Research Council, 2000). As Pelgrum and Plomp (2004) concur, “(c)onscious and carefully planned actions are needed to get beyond ICT use just for
substitution” (p. 57). Furthermore, the “no significant difference” findings are based on comparative student test scores, not tasks requiring creative, higher order thinking processes, which would also need further research to determine effectiveness of that type of instruction.

Another reflection upon the “no significant difference” results from the 1980s and 1990s, is that it describes another era in technology-enhanced teaching and learning—one before the Internet made its way into classrooms across the country. Internet use or the World Wide Web (WWW) did not become prevalent in most schools until the late 1990s or early 2000s. Today, most classrooms have at least one Internet connection, which may still not be utilized by students for direct learning. More commonly, teachers use the Internet or intranet (local network) for daily teacher productivity tasks such as attendance, email, and content or lesson-related research (Vannatta & Fordham, 2004). Furthermore, beginning in 2006 with an influx of new online “Web 2.0” tools, teachers and students now have a “learning lifeline” via a myriad of websites and Web 2.0 tools (often free) that allow them an opportunity to question, inquire, reflect, share, communicate, create, and critique almost any subject of interest, all of which are skills students need today (ISTE, 2007; Partnership for 21st Century Skills, 2009). Unfortunately, many schools do not allow the use of these tools due to their participatory or social nature (Electronic Frontier Foundation, 2003). Even with so much access to digital tools in many schools today, the lingering effects of a dearth of effective, integration-focused, teacher professional development is still affecting student performance with regards to higher levels of student learning, as explained by Ringstaff and Kelley (2002),

A variety of studies indicate that technology will have little effect unless teachers are adequately and appropriately trained… Studies suggest that teachers who receive formal training use technology more frequently for instruction, and this use can lead to significant improvements in student achievement. (p. 12-13)
Perhaps the real meaning of “no significant difference” then should relate to how teachers incorporate technologies into their classrooms—essentially, many teachers did so in a way that was “no significant difference” from what they did before without technology (Jonassen, et al., 2003). In other words, these teachers did not use the technologies to fundamentally change how or what they taught, but instead only used it to automate or prettify what they have always done. As founder and chairman of the One Laptop Per Child non-profit group, Nicholas Negroponte (1995), first observed in Being Digital,

> If a mid-nineteenth century school teacher were carried by (a) time machine into a present-day classroom, except for minor subject details, that teacher could pick up where his or her late-twentieth-century peer left off. There is little fundamental difference between the way we teach today and the way we did one hundred and fifty years ago. (p. 220)

And not much seems to have changed since Negroponte wrote this over 15 years ago. Similar arguments float around still today and little has changed. In a 2006 TIME magazine cover story that proclaimed possible solutions for “How to Build a Student for the 21st Century”, writer Claudia Wallis talks about Rip Van Winkle being able to wake up today after his hundred year slumber and still be able to easily identify schools of today as similar to those in his time. Susan Brooks-Young (2010) describes it as teachers using technology to “simply automate traditional activities” (p. 11) rather than change teaching practices in such ways as to improve student achievement and learning. In order for teachers to effectively use technology in their classrooms, they first need to learn what that looks like, how to plan for it, and how to assess it. In other words, teachers must employ good teaching practices and pedagogies, including being able to teach meaningful and practical lessons never before possible to teach.

**Factors Impacting Teacher Technology Integration: Teacher Characteristics**

For years, researchers have examined whether personal traits or characteristics affect
student learning. In the case of technology-integrating teachers, several factors have been found to show some connection or relationship, while others do not seem to show correlation.

**Dispositions.** Vannatta and Fordham (2004) studied teacher dispositions as predictors of classroom technology use and found that teachers must be professional-development-focused, “committed to ongoing improvement in one's teaching and students” (p. 263). Their findings showed that three attributes affected teachers’ overall use of classroom technology—technology training, time commitment to teaching, and openness to change—but due to little other corroborating research, additional studies are needed to investigate these teacher dispositions in relation to teachers’ technology use. Interestingly, each of these three attributes or dispositions relate to putting effort into their own professional development to become better teachers, which is essential for technology integration and leadership practices as well (Fullan & Smith, 1999; Moersch, 1995, 2010). Furthermore, teachers who are intrinsically motivated, open to change, and focus on continuous improvement and lifelong learning are more likely to effectively integrate technology into their classrooms (Hastings, 2009).

**Demographics.** In other research on factors that affect teachers’ integration of technology in their classrooms, some have shown significance, while others have not or show mixed results. Table 5 shows a summary research on demographic variables and the relationships to technology integration and leadership/teacher leadership.

**Gender.** Regarding technology integration and gender, there are some suggestions that there may be a difference, but the evidence is far from clear. From the 1989 international IEA Comp-Ed survey, the U. S. participants included over 1400 schools and 800 teachers, Becker (2000a) found that exemplary technology-using teachers who used computers more at home and at school were “disproportionally male” (p. 289), which is not surprising, since at that time,
computer science or expertise were male-dominated realms (Crawford, 1995; McCoy, Heafner, & Burdick, 2001). Today, more females than ever use computers (Bhattacharyya & Tollett, 2009). In a smaller, more recent qualitative study, Gao, Wong, Choy, and Vu (2010) found similar results where three new male teachers were taking on technology integration leadership potential.

Table 5

*Research on Demographic Variables in Technology Integration and Leadership Practices*

<table>
<thead>
<tr>
<th>Demographic Trait</th>
<th>Technology Integration</th>
<th>Leadership Practices</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Manning (2002)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Randall (1999)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Singh (1998)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sproule (1997)</td>
</tr>
<tr>
<td>Environment: Where they work and working conditions; subject taught, grade level, etc.</td>
<td>Becker (2000a)</td>
<td>Crowther, et al. (2009)</td>
</tr>
<tr>
<td>Technology Efficacy</td>
<td>Hastings (2009)</td>
<td>NA (only general efficacy)</td>
</tr>
<tr>
<td></td>
<td>James (2006)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sandholtz, et al. (1997)</td>
<td></td>
</tr>
<tr>
<td>Educational Background</td>
<td>NA</td>
<td>Riel &amp; Becker (2000)</td>
</tr>
</tbody>
</table>

For leadership practices, or Kouzes and Posner’s LPI (1997, 2002, 2003) specifically, there have been mixed results regarding gender, but primarily no significant difference between
females and males (Kahl; 1999; LaVine, 1998; Manning, 2002; Singh, 1998; Sproule, 1997). In one instance for the LPI, Randall (1999) found that females reported significantly higher scores. In another large research study of teachers, Riel & Becker (2000) found that even though almost two-thirds of their respondents were female, which is normal distribution for the teaching profession, those with the highest level of leadership practices were more likely to be female—74% of these Teacher Leaders were female.

**Years experience.** Regarding teacher technology integration, Becker (2000) found that experience did matter. Exemplary technology-using teachers were more likely to have more experience—on average, three years more experience than other computer using teachers. Regarding leadership experience, according to Manning (2002), there was no significant difference in the overall leadership score based on gender, but the leader’s experience did matter when differences showed in self and others’ assessments of leadership abilities. In this case, newer managers undervalued their leadership and experienced ones overvalued it based on the self versus other’s scores. For teachers, Riel and Becker (2000) reported that on average, compared to other teachers, the Teacher Leaders had five years more experience and were five years older, which was consistent across other three Engagement categories. In other words, both age and teaching experience decreased with the less engaged teacher categories, where the Private Practice teachers were generally the youngest and least experienced on average.

**Social trait: Level of Extroversion (LoE).** In a study of over 500 students, Rathsock (1998) found that extrovert students had significantly higher computer attitudes than introverts. At that time, there were no online social networks or the interactive participatory tools on the Internet (called Web 2.0 tools or websites). Students’ social nature seemed to be quenched (and continues to be quenched) by interactive online tools such as Facebook, YouTube, and Twitter.
This leads to the question of whether teachers also show a similar relationship when it comes to their technology integration or even leadership practices and their level of introversion or extroversion. Although technology in the classroom was very different at the time, Katz (1992) found that extroverted teachers were more receptive toward using computers, but there is little other recent research regarding teachers’ level of extroversion or introversion and their computer or technology use. For leadership, Northouse (2007) discusses how personality traits, including introversion and extroversion, are used primarily to make people aware of their type and that of others they work with in order to best meet organizational needs. This applies to leaders and subordinates, alike, as all workers can benefit from knowledge about how to work best with others.

**Environment.** Regarding school environment and technology integration, exemplary computer-using teachers were just as likely to be working at low-socio-economic schools as more affluent ones (Becker, 2000a). But they did find specific environments where exemplary computer-using teachers were more common:

(a) the existence of a social network of computer-using teachers at the same school;
(b) sustained use of computers at the school for consequential activities... (such as) writing and publishing, industrial arts, or business applications;
(c) organized support for computer-using teachers in the form of staff development activities and a full-time staff member in the role of computer coordinator; and
(d) acknowledgement of the resource requirements for effectively using computers, for example, smaller class sizes and funds for software acquisition. (p. 279)

For leadership practices, teacher leaders were found in all types of schools, subjects, grade levels, and advantaged or disadvantaged schools (Crowther, et al., 2009). Likewise, Riel and Becker (2000) found Teacher Leaders and Teacher Professionals, the highest two categories of teacher leaders, proportionally distributed across all subject areas and disciplines.

**Level of reflection.** Sandholtz, et al. (1997) talk about a time for reflection, a time needed
to think about and absorb, discuss, and plan, including working out any concerns or issues that might arise or have to be worked out ahead of time. This time might be important to any and all teachers, but was especially important to their teachers who were working to find ways to integrate technology in meaningful ways. Combined with technology training and demonstrations, reflecting on one’s teaching, especially with colleagues, is also important for effective technology integration (Vannatta & Fordham, 2004). In the leadership area, Riel and Becker (2000) found that Teacher Leaders were more successful in creating learning environments that matched their educational philosophy, “Quality teaching requires thoughtful reflection” (p. 32). These teachers not only were reflective themselves, but required it of their students as well.

**Professional development.** Teachers are continually offered and are required to take graduate classes as well as in-services, workshops, or trainings that fall under the construct of professional development. Dwyer, et al. (1991), Sandholtz, et al. (1997), James (2006), and Vannatta and Fordham (2004) all concur that researched-based professional development facilitates teachers’ technology integration. Each of these studies are discussed further in terms of the importance of professional development and support for technology-integrating teachers. With respect to teacher leadership and technology integration, Teacher Leaders participate in more technology integration and instructional strategies sessions than did other teacher groups and about twice as much compared to Private Practice Teachers, which is the lowest category of teacher leadership behaviors (Riel & Becker, 2000).

**Educational level.** In regards to teachers’ educational background, or how much formal schooling they have completed, Riel and Becker (2000) found that 64% of the Teacher Leaders were more likely to have graduate degrees as compared to Private Practice teachers at 42%. In
Ohio, there may be some disparity with this wide margin since, for a period of time before 2010, teachers were required to obtain a Masters degree within their first 10 years of teaching. Riel and Becker (2000) also found that teachers’ success in their undergraduate studies displayed differences in the type of teacher they’d become. In this case, 50% of Teacher Leaders had a GPA over 3.5, compared to only 28% of Private Practice teachers.

**Professional Development and Support**

“If teachers are to prepare an ever more diverse group of students for much more challenging work—for framing problems; finding, integrating and synthesizing information; creating new solutions; learning on their own; and working cooperatively—they will need substantially more knowledge and radically different skills than most now have and most schools of education now develop” (National Research Council, 2000, p. 190).

Professional development is a critical component in not only effective and successful technology integration, but is tied to leadership practice as well. According to Solomon and Schrum (2010), “The elements that could bring about change are professional development and leadership. Given time, teachers will find their own advantages in learning to use the tools and integrate them into the curriculum” (p. 11). In addition to needed improvements to undergraduate teaching programs (National Research Council, 2000; Ohio Legislative Office, 1996), “(R)adical changes are required in how teachers learn and in their opportunities to learn” (Fullan, 1995, p. 266), including professional development as a core part of teachers’ daily work. Fullan (1995) believes that the form of professional development needed is one where it becomes an integral part of a teacher’s workday rather than something done outside work hours and usually alone. Zeitz (1995) further explains the importance of professional development in technology integration that still holds true today, and it involves more than just time,

The only way we can bring about change in our schools is by investing in our teachers. We need to invest time, money, and support in involving them in change. We need to provide release time during the school day for teachers to learn about technology…” (and)
to allow them to plan collaboratively how they might implement their new technology skills in their classrooms. (p. 64)

These types of professional development to improve technology integration and teaching practice cannot occur without support (Becker, 2000a; Beglau, et al., 2011; Fullan & Smith, 1999; Guskey, 1995; Inan & Lowther, 2010a, 2010b; ISTE, 2011a, 2011b). Leyopoldt’s (1971) stand that “learning is change” reminds us that teachers need to be supported during their professional development in order to move through the process of change. This support can take the form of financial (funding), additional staff, or scheduling adjustments to allow time for learning to take place during school hours along with one’s teaching colleagues (Fullan, 1995; Guskey, 1995; Smylie, 1995). Furthermore, according to Sandholtz, et al., (1997, p. 36), varying levels of support are needed for “instructional evolution in technology-rich classrooms” as teachers progress through these phases: Entry, Adoption, Adaptation, Appropriation, and Invention. In fact, the teachers in the ACOT study who had the most support were the ones able to make the most changes, which included support from other teachers who participated, their local building and district administration, and the project team, who provided the initial summer institute.

**Development Process Takes Time**

In addition to ongoing support from colleagues and school administration, Sandholtz, et al. (1997) clarified that the progression through these stages/phases can take years to achieve. Therefore, short-term attempts lasting one to three years or so will not produce the deep changes in teacher practices and student learning that is possible. Changing teachers’ beliefs requires more than merely adding technology to the classroom, but the realization that technology can serve as a “symbol of change, granting teachers a license for experimentation” (Sandholtz, et al., 1997, p. 171). As teachers experimented, questioned, and reevaluated their old, outdated
methods, lessons were transformed into more effective and appropriate learning experiences for their students. The only concern was that this process took years, was at times difficult, but yet was necessary in order to progress through the “five stages of instructional evolution” (p. 171). In this case, the use of the term “evolution” is appropriate, in that it signifies change over time, usually a relatively long period of time. Guskey (1995) also echoes the reality that learning can sometimes be painful or difficult, possibly more so when technologies are involved. Inan and Lowther (2010a) found strong correlation between support and teacher beliefs about computer use as well as their readiness to integrate computer technologies in their teaching.

In addition to support, there is a need for continual researched-based professional development in digital technology tools as well as effective, high level uses focused on student learning (Beglau, et al., 2011; Dwyer, et al., 1991; Sandholtz, et al., 1997). During their intensive learning process, teachers felt a sense of revitalization and a sense of achievement and improved professionalism (Sandholtz, et al., 1997). Furthermore, the expectations for all learners were increased and varied instructional methods were utilized due to the different technologies. In fact, many teachers cited their ability “to reach students who had not excelled using traditional approaches” (Sandholtz, et al., 1997, p. 173). Research conducted in the United Kingdom (James, 2006) echoes the need for continual, ongoing, long-term professional development in order to foster lasting, improved change in teacher practices. Even more recently in North America, Fullan (2007) proclaims that traditional professional development is not enough. The typical one-shot workshops or in-service days may help some, but cannot begin to create the meaningful and deep sustained changes needed to alter classroom and school culture. Instead, teachers need continual and collaborative learning within their own classroom environments and supported through communities that extend beyond school walls (Beglau, et al., 2011; ISTE,
2011b). But in getting to this point, he reminds us that it is a “joint effort” and takes time (Fullan, 2007, p. 36). Another way to look at this type of ongoing, embedded learning is to “reculture” schools into learning organizations (Fullan & Smith, 1999; Senge, 1990) and remind teachers that their own learning, as well as sharing ideas with other teachers, is a part of professional teaching practice (Beglau, et al., 2011; Riel & Becker, 2000).

**Continual, Ongoing, Perpetual Learning**

In fact, ongoing learning is one of the cornerstones or even a prerequisite for the 21st century. Over 40 years ago, Alvin Toffler’s famous quote from *Future Shock* foreshadowed the importance of ongoing education and relearning or professional development, which is often quoted as “The illiterate of the 21st century will not be those who cannot read or write, but those who cannot learn, unlearn, and relearn” (Thoman & Jolls, 2005; Toffler, 2011). This concept originated from print (Toffler, 1970) as two parts: “By instructing students how to learn, unlearn, and relearn, a powerful new dimension can be added to education” (p. 414) and from psychologist Herbert Gerjuoy, “Tomorrow’s illiterate will not be the man who can’t read; he will be the man who has not learned how to learn” (p. 414). Either way, the 21st century will be about learning and unlearning for everyone.

**Differentiated Professional Development**

Similar to student needs, a one-size-fits-all professional development plan for technology integration is not sufficient when teachers are all at different stages in their technology knowledge and skills (Koehler & Mishra, 2009; Moersch, 1995, 2010). Therefore, just like for their students, teachers also need differentiation in their learning of effective ways to integrate ICTs into their curriculum. Forms of professional development include collaboration, discussion, planning, and developing assessments and lessons with colleagues (Beglau, et al., 2011;
Sandhotlz, et al., 1997; Smylie, 1995) plus a little “nudging” (Guskey, 1995) by other teacher and administrative leaders through shared power and authority (Smylie, 1995) and reciprocal teacher leadership.

**Ohio’s Professional Development and Support Efforts**

Since the ACOT research of technology integration efforts (Dwyer, 1991, 1994; Sandholtz, et al., 1997), some key findings have surfaced, including the importance of on-site professional development and the realization that the changes in teacher practice as well as student learning will take years to materialize. Similar findings are reported by Oppenheimer (2003), who goes so far as to call teacher training “education’s holy grail” (p. 305) and devotes an entire chapter to explaining its importance. But it helps to consider the early beginnings of technology in schools and the priorities established, often out of the hands of classroom teachers.

In the late 1990s and early 2000s, teacher professional development primarily consisted of low-level computer skills attainment and little about pedagogy, assessment, and the actual planning process needed to effectively integrate ICTs into the classroom (Dwyer, 1991; Harris & Hofer, 2011) leaving teachers unaware of options and alternatives available to them to improve student learning. Exceptions would include those schools with exemplary computer-using teachers from the 1989 I.E.A. Comp-Ed Survey (Becker, 2000a) who assisted their teachers with onsite support and staff development. Unfortunately for many Ohio schools, onsite support and professional development was not a primary focus of the Ohio SchoolNet programs during the mid to late 1990s (Ohio State Legislative Office, 1996).

Ohio SchoolNet was a state agency that was established to facilitate and develop technology use and infrastructure in schools within the state. But in hindsight, SchoolNet primarily funded grants to schools for providing hardware and network infrastructure rather than
professional development or onsite support (Ohio State Legislative Office, 1996). At the time, infrastructure such as network copper and fiber optic cables and computer stations were needed to increase access to all schools in the nation – a goal of then Vice-President Al Gore (CITE) – as well as to increase the computer-to-student ratio. Even so, at that time, very few schools had the foresight, nor saw the need, to budget the suggested 30% of their entire budgets to professional development of some kind (Office of Technology Assessment, 1995). This lack of professional development funding cumulatively affected the level of technological skills and integration proficiency of numerous teachers who, in turn, did not fully utilize these powerful tools in their classrooms for over a decade—not because they did not want to, but because they did not know how. Table 6 summarizes findings from a 1996 report by the Ohio State Legislative Office of Education Oversight (1996a), showing that Ohio, as of the late 1990s, was still in the early stages for technology use in classrooms, but still had support from administration, showing its importance for student learning.

Table 6

*Report findings from the Ohio State Legislative Office of Education Oversight (1996a)*

<table>
<thead>
<tr>
<th>How many schools are prepared?</th>
<th>(Only) 36% of city schools, 44% of rural schools, and 65% of suburban schools are prepared to use computers and networks.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of “not-ready” schools, how many need improved electrical service?</td>
<td>Approximately 90% of the schools not meeting (Ohio’s) criteria for readiness need increased electrical service.</td>
</tr>
<tr>
<td>Overall Tech Support at schools?</td>
<td>27% of the schools have no one available to repair computer hardware, software, or network equipment.</td>
</tr>
<tr>
<td>Full-time Overall Tech Support?</td>
<td>Only 7% have someone serving their school fulltime.</td>
</tr>
<tr>
<td>How many teachers want to use computers for student learning?</td>
<td>Approximately 93% of survey respondents report teachers want computers for student use.</td>
</tr>
<tr>
<td>Administrative support?</td>
<td>98% of respondents report principals strongly support computers for student use; 96% report strong support by district-level administration.</td>
</tr>
</tbody>
</table>
In addition to aging buildings’ electrical systems that required significant upgrades and therefore cost, SchoolNet’s professional development and technical assistance were also significant obstacles for most schools due to high cost and required expertise. Even as late as 2008, Ohio’s SchoolNet Plus (eTech Ohio, 2011) primary focus was on hardware in the form of computers and servers, but did allow for up to 30% of the funds to be directed toward peripherals, software, professional development, which is an improvement over earlier funding that allowed for hardware and networking only.

Teachers in Ohio are already required to complete additional education after obtaining their bachelor’s degree with teaching certification. After completing their undergraduate degree, Ohio teachers are required to continue their professional development through additional approved coursework, trainings, or workshops in order to keep their licensure (ODE, 2011). In order to renew their teaching license, teachers must complete 180 hours of instruction (equating 18 continuing education units, or CEUs) or take six graduate semester hours from an accredited institution. This averages out to 36 hours per year in a five-year license cycle.

The Need for Teacher Leadership

“(E)very school needs two types of leaders: those who lead from outside the classroom and those who lead from inside… I want to lead without losing my identity as teacher”
(Damani, 2011, p. 7).

“I lead because I teach.”
(Dr. Rosemary Papalewis, in the Foreword to Wilmore, 2007, p. xi)

Technology Integrating Teacher Leaders as Change Agents

Over the past decade or two, teachers have independently and collaboratively seen the need for more technology integration and have consequently led the push for more technology integration in K-12 education (Becker, 2000a; Brooks-Young, 2010). These teachers have been
“leaders” in the sense that they have been ahead of the trend or pending wave, while pushing the need for more educational technology resources, student outcomes focused on or requiring technology skills and literacies, and teacher training or professional development (Sandholtz, et al., 1997). These teachers have become formal and informal leaders and instructional coaches in their schools and beyond by working with department or grade level colleagues, building and district staff, or even with other teachers across town, their state, nation, or even the globe via face-to-face conferences, teleconferences or webinars, online professional networks, PLNs (personal/professional learning networks), or email listservs. Some examples of these Technology Integration Teacher Leaders’ networks include: ISTE Ning (http://www.iste-community.org), Blogmeister’s teacher listserv, and various state educational technology organizations, such as the state educational technology organization, MACUL (Michigan Association for Computer Users in Learning).

In response to this evolution and complexity of a teacher’s role (National Research Council, 2000) over the last few decades, the term “teacher leadership” has emerged from studies on effective schools, including transformative or large-scale changes and in regards to technology integration within classrooms (Bardin, 2008; Brown & Rojan, 2002; Crowther, et al., 2002; Katzenmeyer & Moller, 2001; Staples, Pugach, & Himes, 2005; Walling, 1994). Although leadership within an educational setting is most often associated with principals and superintendents, due to today’s constant change scenarios, all or at least most teaching professionals will be required to exhibit some form of leadership in order to improve and transform the educational paradigm to meet the needs of students in the 21st century, with and without technology (Fullan, 1994; Katzenmeyer & Moller, 2001). Individually or in teams,
teachers are taking on leadership roles in schools, both formally and informally (Kimmelman, 2010; Walling, 1994).

In fact, today’s teachers are more educated, more credentialed and experienced (Lambert, 2006) and perhaps appropriately (or thankfully) they are being called upon to do more than ever before. Katzenmeyer and Moller (2001) define the essence of “teachers leaders” as “professionals who (are) life-long learners create their own unique strategies in response to their students’ needs,” (p. 21). Teacher leadership begins with seemingly little things such as sharing lessons with colleagues or bringing ideas to the principal, or even taking the project management lead of a school improvement project following it to completion by bringing others on board, including other teachers, administrators, staff, parents, students, or community members. In other words, teacher leaders are diverse in their skills and effective with their means.

**Definitions of Teacher Leadership**

Perhaps due to the fact that the study of teacher leadership is fairly new, there seems to be a lack of consensus on what specifically constitutes a teacher leader. Danielson (2006) states that teacher leadership is an informal, voluntary role, and it “rarely involves large-scale, systematic change” (p. 18), so formal roles such as department chair, master or lead teacher or mentor rarely apply since those are more “quasi-administrator” roles. In contrast, Katzenmeyer and Moller (2001) assert that there can and should be more than one instructional leader in a school and that teacher leadership constitutes shifting “the leadership role from one individual to a community of professionals committed to improved student learning” (p.2). Unlike Danielson (2006), Katzenmeyer and Moller (2001) believe teacher leaders to be catalysts or agents of change in a school, especially due to their close proximity to students, the primary purpose and recipients of many of the change efforts.
This type of professional role extends beyond a focus on student learning and success in one’s classroom to a direct and intentional dedication to the improvement of education as a whole. Katzenmeyer and Moller (2001) suggest that teacher leaders are lifelong learners in their quest to work with students and share strategies and lesson ideas with other teachers. Rallis, Rossman, Phlegar, and Abeille (1995) call teacher leaders “dynamic teachers” who assume changing and new roles at different times in their careers, such as Moral Steward, Constructor, Philosopher, Facilitator, Inquirer, Bridger, and Changemaker. And yet another perspective, from over 30 years ago, is that teacher leaders influence both student and teacher behaviors within the school environment (Brownlee, 1979). Because the role they take on is voluntary and not an administration-appointed position such as lead teacher or department chair, teacher leadership “represents the highest level of professionalism” (p. 1) or in other words, a sort of service to one’s colleagues, community, or profession as a whole—a prime example of Greenleaf’s (1977) concept of “servant leadership.”

**Skills of Teacher Leaders**

In sum, teacher leaders can be characterized in four main skills (Danielson, 2006), which include: collaboration, facilitation, planning, action and evaluation. In addition to Danielson’s (2006) four skills, Crowther, et al. (2002; 2009) describes a combination of extraordinary and ordinary tasks that set apart teacher leaders from other teachers to create the Teachers as Leaders Framework, finding that teacher leaders have these characteristics more often than not. Teacher leaders:

1. Convey conviction about a better world
2. Strive for authenticity (or pedagogical excellence; Crowther, et al., 2009)
3. Facilitate communities of learning
4. Confront barriers in school’s culture and structures

5. Translate ideas into sustainable systems of action

6. Nurture a culture of success

Ultimately, without teachers being involved in the entire decision-making process, reforms will rarely succeed (Crowther, et al., 2002; Katzenmeyer & Moller, 2001).

Factors Affecting Teacher Leadership

Teacher leaders can be found in all schools and districts (Becker & Riel, 2000), but certain structural and cultural factors can either enable or inhibit teacher leadership (Danielson, 2006). Table 7 summarizes these factors, along with a list of supporting conditions for effective teacher leadership.

Table 7

| Structural and Cultural Factors Enabling or Inhibiting Teacher Leadership (Crowther, et al., 2002; Danielson, 2006; Fullan, 1994; Katzenmeyer & Moller, 2001). |
|---|---|---|
| **Cultural** | Enablers | Inhibitors |
| | • Culture of inquiry and risk taking (within a safe environment) | • Administrators threatened by teacher leadership |
| | • Democratic norms, participate in decision making | • Teacher reluctance due to a classroom-only focus and/or lack of confidence |
| | • Teachers as professionals; collegiality | • “I just want to teach” mindset |
| | • Teachers as learners | • Peer pressure |
| | • Ideas valued | • Lack of principal support |
| | • Teacher autonomy | |
| | • Positive partnership with open, honest communication channels | |
| **Structural** | | Enablers |
| | • Mechanisms for involvement in school governance | • Lack of time built into normal work day or “no time” |
| | • Mechanisms for proposing ideas | • Numerous other pressures or expectations or “too much” |
| | • Time for collaboration during school hours | |
| | • Opportunities for skills acquisition | |
Teachers as Professionals. A clarification of the enabling of “Teachers as Professionals Culture” (Danielson, 2006) is that in order to create lasting and sustainable change, teacher leadership must be shared among multiple teachers rather than just one individual. This creates the necessary supportive culture in order for educational change to occur (Crowther, et al., 2002; Fullan, 1994). Later, Fullan (1999) explains the process of “reculturing” as well as restructuring in order to make a difference in student learning, which takes not only teacher leaders, but administration and a culture of a learning organization where ongoing or continual development is practiced. Moreover, the learning is done together in a collaborative, facilitative fashion rather than forced through positional authority (Crowther, et al., 2002). Over time, principals and other administrators will become accustomed to sharing and benefitting from teacher leadership, but first will need to promote teacher leadership by, among other things, communicating a clear strategic intent, incorporating the aspirations and ideas of others, knowing when to step back and creating opportunities out of perceived difficulties (Crowther, et al., 2002).

National Standards for Teacher Coaches in Technology and Leadership. In 2001, the international educational technology organization, ISTE, recognized the contributions and importance of these educational technology teacher leaders within schools, so they developed the Educational Technology Leader and Educational Technology Facilitator standards (ISTE, 2011a), which later became the NETS•C or National Educational Technology Standards for Coaches (Beglau, et al., 2011; ISTE, 2011b). For teachers who are skilled in technology integration and or leadership, whether local, national, or global, these standards act as a guide for teachers’ professional development toward teaching improvement. Moreover, these standards factor in the importance of the leaders and facilitators (whether informal or formal designated) to serve as change agents (Fullan, 1993a) for their schools with an overall focus on improving
teaching and therefore student learning. One example of teachers as change agents in working to improve teaching and student learning through technology integration and teacher leadership is the Instructional Technology Resource Teachers (ITRT) from Virginia (Virginia Department of Education, 2008). Due to a state mandated and funded program, all Virginia school districts have a ITRT to work with teachers to effectively integrate various technologies and tools into their teaching. Beglau, et al., 2011 also discuss other successful models of instructional coaching-based professional development programs in Arizona, Kansas, Missouri, Pennsylvania, and Wyoming that can be used as models for Ohio and other states.

The Importance of Teacher Leadership in the 21st Century

Harvard education scholar Chris Dede (1993) knew long ago of the importance of varied levels of leadership in schools when he stated that “Education reform can achieve genuine, lasting success only when each stakeholder accepts the responsibility of leading” (p. 7), which most certainly includes teachers at the forefront. Also during the mid 1990s, teacher leadership was found to be critical to the ongoing school success in the form of creating and sustaining positive change or reforms, “(T)eachers must be at the center of improvement and reform” (Walling, 1994, p. 1). Now well into the 21st century, teachers are being called on to fulfill more responsibilities than just their classroom teaching and student learning (Crowther, et al., 2002, 2009; Katzenmeyer & Moller, 2001) due to budget cuts, fast-paced change, and a global economy (Friedman, 2005). If schools are to transform their practices to meet the future needs of their students, teachers leadership must be an essential part of creating the solutions and sustaining those changes (Crowther, et al., 2002, 2009; Danielson, 2006; Fullan, 1993a, 1993b, 2007; Institute for Educational Leadership, 2008; Katzenmeyer & Moller, 2001; Murphy, 2005; Riel & Becker, 2008; Wilmore, 2007).
Measuring Teacher Leadership Through Business Leadership Practices

Perhaps in an attempt to classify, analyze, and solve problems with public education, there has been a tendency for school board members, politicians, and even the general public to compare and make connections or analogies between educational organizations and businesses (Cuban, 2004). As with any simplified comparison of complex enterprises, although there are innumerable inconsistencies and differences, there are some parallels and overlaps—one being in the area of leadership practices. Many business leadership practices cross-organizational boundaries and are applicable just as well in an educational setting as in a hierarchical business, and some others even apply to teacher leadership.

One time-tested and well-researched model or framework for leadership practices is Kouzes and Posner’s (1987; 2002) five Leadership Practices (or subscales) that exemplify leaders—Model the Way, Inspire Shared Vision, Challenge the Process, Enable Others to Act, Encourage the Heart. Primarily referenced and utilized to measure leadership in business environments, these five Leadership Practices and the corresponding Inventory (LPI) was used in this study with teachers due to the many parallels and generic leadership principles and practices that also apply in an educational setting as well due to the overwhelming use, validity, reliability, and clarity of the instrument. In addition, Kouzes and Posner also penned the Student Leadership Challenge (2008) that included references to the same principles of leadership in context to students. So, a natural fit may be to create a teacher version as well, which this study may help justify or debunk. The development and use of the Teacher-LPI or T-LPI, which is a modified version used in this research study, is discussed further in chapter 3.

In addition to the five Leadership Practices, a 6th practice called "Refine the Craft" was added to the LPI instrument, which relates to a teacher’s level of professional development and
reflection. Even Kouzes and Posner (2002) recognize the importance of this type of practice, “In the end, we realize that leadership development is ultimately self-development” (pg. xxviii), but provide no explanation as to why it’s not a specific practice, other than including “seeking innovative ways to change, grow, and improve” under the “Challenge the Process” practice. Most of these connections to “Challenge the Process” deal with pursuit of excellence and improvement for the organization rather than the individuals within the organization (fellow teachers or students) or, perhaps even more importantly, one’s own improvement and development as a professional educator. Furthermore, since the Leadership Practices Instrument (LPI) does not include strong descriptors that would directly relate to teachers’ development and learning in their craft of teaching, this sixth practice was added, including the more direct corresponding questions on the instrument. Other researchers discuss the importance of teachers or professionals as learners, such as Katzenmeyer and Moller (2001) and Steven Covey (1989) with his suggestion to take time to “Sharpen the Saw” analogy for leaders to make time to work on and improve themselves as individuals so they can best lead others.

From other research in teacher technology integration, several examples epitomize the various leadership principles discussed in Kouzes and Posner’s works. Table 8 lists these examples for each of the practices. Note that some examples deal with teacher “leadership” among colleagues, while other examples refer to the type of leadership teachers exhibit with their students.
Table 8

*Research Connecting Kouzes and Posner’s (1987; 2002) Leadership Practices (plus the “Refine the Craft” practice) to Teacher Technology Integration Practices*

<table>
<thead>
<tr>
<th>Leadership Practice</th>
<th>Teacher Technology Integration Example</th>
</tr>
</thead>
</table>
| **Model the Way**   | • Sandholtz, et al., (1997) many teachers who participated in the summer ACOT institutes would later facilitate trainings and in-service workshops to demonstrate lessons and teaching strategies  
• The NETS•T (2008) include a standard for teachers that centers on the importance of modeling, “Model Digital-Age Work and Learning” |
| **Inspire Shared Vision** | • Sandholtz, et al., (1997) upon returning to their schools after the summer institute, some teachers took on more official leadership roles by helping to set a future vision for the school and by participating in committees. |
| **Challenge the Process** | • Sandholtz, et al. (1997) found that teachers who participated were more demanding of resources needed to improve student learning.  
• Becker (2000) discusses how exemplary computer-using teachers often require more support and resources (in form of technology fixes, hardware, software, and training) due to their teaching strategies using computers, thus challenging the system in order to provide the best educational experience for their students.  
• Fullan (1993a) discusses teachers as change agents to work with administration to transform school practices. Fullan and Smith (1999) discuss how technology helps teachers communicate and manage the change process. |
| **Enable Others to Act** | • Sandholtz, et al., (1997) reported that many teachers who participated in summer ACOT would informally share their newfound lesson ideas and technology skills with other teachers upon returning to their schools.  
• Riel and Becker (2008) cite the necessity of teachers engaging their colleagues to critically examine teaching practices, which includes how to integrate technology as well as other teaching strategies and methods.  
• The NETS•C (2011b) focus on instructional coaches who work with teachers to improve teaching related to 21st century technologies and instruction. |
| **Encourage the Heart** | • Warlick (2004) and Richardson (2006) both discuss the importance of expressing one’s voice, whether students or teachers. Using digital tools in reflective practice for learning or to celebrate one’s accomplishments by public posting of their works, technology enables further learning connections and communication about one’s learning and development. |
| **Refine the Craft** | • Becker (2000) describes the “importance of staff development activities and a full-time staff member in the role of computer coordinator” (p. 279); and that “exemplary teachers had more formal training in using and teaching with computers” (p. 283).  
• The NETS•T (2008) includes a teacher standard on the importance of professional development—“Engage in Professional Growth and Leadership” |
Teacher Leadership and Business Leadership Principles

Leadership research is commonplace in the business world and in school administration circles, but now these research principles are extending beyond administrative offices into teacher’s classrooms. Therefore, there are many common themes and practices that are important and beneficial for business leaders as well as teacher leaders. Wilmore’s (2007) research on teacher leadership includes several references to business leadership gurus such as Steven Covey (*Seven Habits of Highly Effective People*), Jim Collins (*Good to Great*), and Warren Bennis (*On Becoming a Leader* and *Herding Cats*), as do various authors in Ackerman and Mackenzie’s *Uncovering Teacher Leadership* (2007). For that reason, teacher leaders can also benefit from lessons learned in the business world and rely on their research, with some adaptation for situations unique to the education realm, in order to improve their leadership practices.

Technology Integration and Leadership: Foundations for 21st Century Teaching Practice

“The more powerful technology becomes, the more indispensable good teachers are.” (*Fullan & Smith, 1999, p. 2*)

Today’s teachers require both technology integration and leadership skills in order to successfully prepare students for their future lives (National Research Council, 2000; Riel & Becker, 2000, 2008; Solomon & Schrum, 2010). To meet these proficiencies, teachers can refer to three guiding frameworks: TPACK, NETS, and P21. Compared with the TPACK framework, which is centered on the teacher, NETS were developed for students, teachers, and administrators and share similar themes, encouraging a systemic focus on 21st century skills developed for all parties involved in the educational process. Table 9 identifies the connections between these frameworks, teacher leadership practices and technology integration. Additionally, Table 10 shows a more in depth explanation of how each framework of standards relates to teacher leadership practices and technology integration.
### Table 9

**Overview: Theoretical Frameworks (TPACK, 21st Century Skills, and NETS) Addressing Technology Integration and Teacher Leadership Practices**

<table>
<thead>
<tr>
<th>Theoretical Frameworks</th>
<th>Technology Integration</th>
<th>Leadership Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPACK</td>
<td>X</td>
<td>Implied*</td>
</tr>
<tr>
<td>21st Century Skills</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>NETS•S&amp;T</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Implied --- means these must occur due to these initiatives in order for them to be successfully implemented

### Table 10

**Detailed: Theoretical Frameworks (TPACK, 21st Century Skills, and NETS) Addressing Technology Integration and Teacher Leadership Practices**

<table>
<thead>
<tr>
<th>Theoretical Frameworks</th>
<th>Teacher Technology Integration</th>
<th>Teacher Leadership Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPACK</td>
<td>• T = Technological Knowledge (along with Pedagogical and Curricular Knowledge) – all these work in concert and cannot be separated in effective 21st century teaching/learning</td>
<td>• A model of effective teaching preparation, which is considered a leadership practice</td>
</tr>
</tbody>
</table>
| 21st Century Skills (P21) | • Information, media, ICT literacy  
• Communication strategies: online, via portable devices  
• Collaboration: asynchronous and synchronous work online  
• Critical Thinking: use of various tools to promote, foster, facilitate higher levels of student interaction, thinking, reflection, analysis, and learning  
• Creativity & Innovation: use digital tools to create new knowledge, products, and artifacts | • Communication & collaboration and working with others effectively  
• Life & career skills, which include flexibility and adaptation, initiative and self-direction, and leadership and responsibility |
| NETS                   | • All NETS relate to technology integration | • NETS-T: 5) Engage in Professional Growth and Leadership  
• NETS•S: 5) Digital Citizenship (which includes “exhibit leadership for digital citizenship”) |
Furthermore, 21st century student outcomes are also addressed in these three guiding frameworks. Table 11 below shows the relationship between each of these framework components or area of research and how each relates to teacher and student skills and preparations.

Table 11

**Theoretical Framework Components Compared to Teacher and Student Aspects of Teaching and Learning**

<table>
<thead>
<tr>
<th>Theoretical Framework</th>
<th>Teacher Skills &amp; Preparation</th>
<th>Students Skills &amp; Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPACK (Mishra &amp; Koehler, 2006)</td>
<td>Direct focus on the integration and synthesis of Technology, Pedagogy, and Content Knowledge</td>
<td>Indirectly - Improved learning when teacher is skilled in and integrates all three areas</td>
</tr>
</tbody>
</table>
| 21st Century Skills (P-21.org, 2010) | Directly: - teacher lesson preparations must address these outcomes Indirectly: - creating conditions for learning these skills | Direct focus on: - required skills for future (in work, school, or as citizen), including:  
  - Core subjects & 21st century themes  
  - Creativity & innovation  
  - Communication & collaboration  
  - Critical thinking & problem-solving  
  - Information, media, ICT literacy  
  - Life & career skills |
  1. Facilitate and Inspire Student Learning and Creativity  
  2. Design and Develop Digital-Age Learning Experiences and Assessments  
  3. Model Digital-Age Work and Learning  
  4. Promote and Model Digital Citizenship and Responsibility  
  5. Engage in Professional Growth and Leadership | Direct focus (NETS•Students, 2007):  
  1. Creativity and Innovation  
  2. Communication and Collaboration  
  3. Research and Information Fluency  
  4. Critical Thinking, Problem-Solving & Decision-Making  
  5. Digital Citizenship  
  6. Technology Operations and Concepts |

**Summary of Chapter 2**

Practical examples of both types of teacher leadership definitions is exemplified in Sandholtz, et al., (1997) where a great number of the teachers who participated in the summer
ACOT institutes would informally share their newfound lesson ideas and technology skills with other teachers upon returning to their schools, including facilitating trainings and in-service workshops. Furthermore, some teachers, as reported by their principals, even took on more official leadership roles by participating in committees and helping to set a future vision for the school.

In another research study, Riel and Becker (2000) surveyed 4000 U. S. teachers and established four levels of “Professional Engagement”—from Teacher Leaders, the most highly engaged in sharing and working with their colleagues even on a voluntary basis, to the lowest level of engagement, Private Practice Teachers, who did very little or no interaction with other colleagues beyond what they were required to do. In between these are the second-most engaged level, the Teacher Professionals, followed by the Interactive Teachers, who were only slightly more engaged in interactions and sharing with other teachers. Of these four groups, the Teacher Leaders and Teacher Professionals, the two most engaged groups, were more likely to: (a) devote more time and effort to their own education and development; (b) promote more constructivist, student-centered instruction, both with and without the use of technology; (c) integrate technology into their teaching practice for meaningful, collaborative student projects and sharing; and (d) be highly active computer users. One of their most startling findings was that the Teacher Leaders were ten times more likely (40%) to be designated as a “Highly Active Computer User” as compared to the Private Practice teachers (4%). According to Riel and Becker,

Again, it is the isolated teachers, a majority of the teachers in classrooms today, who are less likely to use the intellectual resource that is transforming many teachers' practices in this new century—the networked personal computer. Their isolation is both physical and intellectual. (p. 33)

Additional findings comparing these four groups of teachers based on their engagement levels
were discussed earlier in the demographics section.

The two examples of the ACOT project and Riel and Becker’s survey of thousands of teachers provide a realization that even as far back as the late 1980s and 1990s, technology-integrating teachers were already taking on leadership roles and making a difference. These examples plus the three frameworks discussed earlier—ISTE’s NETS, 21st Century Skills, and TPACK, complete the larger picture of the need for teachers who have the skills, knowledge, and dispositions required to effectively teach students of the early 21st century.

**Introduction to Chapter 3**

Chapter 3 will discuss the methodology of the research study as well as the survey development and procedures for deployment and analysis.
CHAPTER III. METHODOLOGY

This chapter describes the research design and methodology used for this study. A description of the research design, participants, instrumentation, data collection methods, research questions, data analysis, validity and reliability are presented and discussed under the corresponding sections.

Research Design

The research design for the study was correlational and used a cross-sectional survey to examine the relationship between teachers’ technology integration and their leadership practices. This study examined which leadership practices and demographic or background experiences best predict technology integration. In addition, several group differences were examined in relation to teachers’ technology integration and leadership practices.

Participants

In mid-December 2011, the cross-sectional survey was sent electronically to over 1600 public K-12 school teachers from northwest Ohio through a district contact, most often the Technology Director. A convenience sample of northwest Ohio teachers K-12 in-service teachers was obtained through researcher contacts made with the district Technology Directors/Coordinators from the following high performing northwest Ohio suburban public school districts: Bowling Green, Maumee, Perrysburg, Rossford, Springfield, and Sylvania. Demographic information for each of these districts is found in Table 12.
Table 12

Participant’s School District Data (from 2010-11 District Report Cards)

<table>
<thead>
<tr>
<th>Suburban Northwest Ohio School District</th>
<th>Total Students</th>
<th>Total Teachers (Estim.)</th>
<th>% Non-White</th>
<th>% Economically Disadvantaged</th>
<th>ODE Grade Card Designation (In Order, most recent first)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowling Green City Schools</td>
<td>2936</td>
<td>205</td>
<td>19.1</td>
<td>34.4</td>
<td>Excellent with Distinction Excellent with Distinction Excellent</td>
</tr>
<tr>
<td>Maumee City Schools</td>
<td>2688</td>
<td>190</td>
<td>16.0</td>
<td>31.7</td>
<td>Excellent Excellent Effective Excellent with Distinction</td>
</tr>
<tr>
<td>Perrysburg Exempted Village Schools</td>
<td>4597</td>
<td>280</td>
<td>12.0</td>
<td>12.0</td>
<td>Excellent Excellent Excellent with Distinction Excellent with Distinction</td>
</tr>
<tr>
<td>Rossford Exempted Village Schools</td>
<td>1852</td>
<td>140</td>
<td>10.9</td>
<td>46.4</td>
<td>Excellent with Distinction Excellent Excellent Excellent</td>
</tr>
<tr>
<td>Springfield Local Schools</td>
<td>3958</td>
<td>290</td>
<td>31.1</td>
<td>36.2</td>
<td>Excellent Excellent Excellent with Distinction Excellent Effective</td>
</tr>
<tr>
<td>Sylvania City Schools</td>
<td>7312</td>
<td>550</td>
<td>14.4</td>
<td>18.0</td>
<td>Excellent Excellent Excellent with Distinction Excellent with Distinction</td>
</tr>
</tbody>
</table>

**Instrumentation**

The 21st Century Technology Integration and Teacher Leadership (21-TITL) instrument was developed from an existing leadership instrument and a newly developed technology integration survey. A section on demographic and background variables was also included. The entire survey of 56 questions took approximately 12-20 minutes to complete and all questions
were Likert scale or multiple choice. The 21-TITL consisted of four sections: 1) School Environment and Background (6 items); 2) Teacher Leadership Practices (18 items); 3) Technology Integration (10 items); and 4) Demographics and Experiences (22 items). The full survey (see Appendix C) is explained in more detail in the following sections, including question and section origination, validity and reliability (if applicable). Table 13 shows a summary of the information collected from each section of the survey.

Table 13

Summary of the 21st Century Technology Integration and Teacher Leadership (21-TITL) Sections

<table>
<thead>
<tr>
<th>Section</th>
<th>Item Numbers</th>
<th>Measure(s)</th>
<th>Source* or Based On</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1-6</td>
<td>School Environment and Background</td>
<td>▪ Christensen &amp; Knezek (2001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ Vannatta &amp; Banister (2009)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ Big 5 Personality (Extraversion) - Goldberg (1993)</td>
</tr>
<tr>
<td>B</td>
<td>7-24</td>
<td>Teacher Leadership Practices</td>
<td>▪ Leadership Practices Inventory (LPI), (Kouzes &amp; Posner, 2003)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ 6th Practice added, Refine the Craft</td>
</tr>
<tr>
<td>C</td>
<td>25-34</td>
<td>Technology Integration</td>
<td>▪ Bloom’s Taxonomy (Bloom, 1956; Anderson &amp; Krathwohl, 2001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ Computer as Tutor, Tool, Tutee (Taylor, 1980)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ LoTi (Moersch, 1995)</td>
</tr>
<tr>
<td>D</td>
<td>35-56</td>
<td>Demographics and Experiences</td>
<td>▪ Christensen &amp; Knezek (2001)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ Modified Stage of Technology Adoption (mSTA) (Christensen &amp; Knezek, 2001; Russell, 1995)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▪ Vannatta &amp; Banister (2009)</td>
</tr>
</tbody>
</table>

School Environment and Background

The first section elicits information regarding participants’ school environment as it relates to technology access and perceived support, followed by personal background questions about technology efficacy, social trait (level of introversion or extroversion), and level of
professional reflection. These factors were combined with more traditional demographics in the last section to provide a more complete picture of the participants of this study.

**Teacher Leadership Practices**

Teacher leadership was determined using the Teacher Leadership Practices Inventory (T-LPI) that was adapted by the researcher primarily from Kouzes and Posner’s Leadership Practices Inventory (LPI) (2003), which contains 30 questions divided into five categories, six questions in each category. The five categories are based on Kouzes and Posner’s *Leadership Challenge* (1987) that defines Five Practices of Leadership: Model the Way, Inspire a Shared Vision, Challenge the Process, Enable Others to Act, and Encourage the Heart. In addition to the five practices from Kouzes and Posner’s LPI, the researcher developed a sixth category or practice, called Refine the Craft.

For the Teacher Leadership Practices Inventory (T-LPI), only 15 of the 30 Likert scale questions from the Kouzes and Posner’s (2003) original LPI instrument were used. The 15 questions were selected due to their direct relation to teacher dispositions or practices rather than more traditionally business-related or focused, hierarchical leadership roles. For example, “I follow through on the promises and commitments that I make” and “I find ways to celebrate accomplishments” were included in the T-LPI, but “I build consensus around a common set of values for running our organization” and “I publicly recognized people who exemplify commitment to shared values” were not because the statement implies a more business-focused formal leadership tone that would apply to most business and industry settings rather than schools or teacher practices.

In addition to these “traditional leader” statements, some other questions were not used in order to keep the five sections of the LPI equal in the number of questions for each. In other
words, after removing some questions for teacher-leadership appropriateness, some sections included three questions from the original five, while others had four. Therefore, the researcher thought it would be best to keep each section equal, thus removing some originally deemed acceptable statements in order to keep the sections balanced for analysis. One example is the removal of a fourth statement, “I treat others with dignity and respect” for the Enable Others to Act section, because (hopefully) most teachers would aspire to this claim, so its removal would not greatly affect results for this section. Consistently using only three items for each section may statistically affect the strength of each category to stand on its own, but keeping each section to three questions made the overall total score equal for each section and not more heavily weighed because of an extra question in some sections. Moreover, additional statistics were not required before analysis, such as equating or averaging each section before completing T-LPI correlational analysis with the other variables. The T-LPI’s selected and non-selected items from Kouzes and Posner’s (2003) complete LPI question items are listed in Appendix D.

In order to address the increasing need for teachers to be learners themselves in an ever-changing world, the researcher added a sixth category of three questions, called Refine the Craft. Drawn in part from the NETS for Teachers (2008) that encourages teachers to “Engage in Professional Growth and Leadership” and Steven Covey’s “Sharpen the Saw” habit from his Seven Habits of Highly Effective People (1989), this sixth category assesses the teacher’s practice of professional development, ongoing learning, and their quest for new knowledge, skills, and experiences that foster individualized professional growth.

All 18 questions in the T-LPI were scored on a 6-point Likert scale from Almost Never (1) to Almost Always (6), which was modified from the LPI’s 10-point scale in order to simplify responses and because follow-up surveying to monitor personal improvements were not
employed. [Kouzes and Posner (1997) reported that repeat administrations was a strong reason for utilizing a 10-point scale rather than the original 5-point scale.] The reason the researcher chose to use a 6-point scale versus the original 5-point scale was due to Kouzes and Posner’s second reason for changing scales—they did not want to provide a middle response. With an even number of responses, respondents are forced to choose toward one end or the other rather than the indecisive middle (Kouzes & Posner, 1997).

For the T-LPI section, the values 1 through 6 were used, meaning that the third response was quantitatively half of the highest response. The response selections were: 1=Almost Never, 2=Rarely/Seldom, 3=Once in a While/Occasionally, 4=Sometimes, 5=Often/Usually/Frequently, and 6=Almost Always. Therefore, the Teacher Leadership Practices (T-LPI) section determines the Leadership Practices trait score of 18-108, represented by the sum of the 18 Likert items. For the use of their instrument, Kouzes and Posner were contacted in order to obtain permission to use their survey items. In May 2011, permission was granted, and full disclosure of the study’s findings will be reported to Kouzes and Posner upon completion.

**Technology Integration**

The Overall Technology Integration Scale (OTIS) survey section was adapted in part from Bloom’s taxonomy (1956), Vannatta and Fordham’s (2004) Teacher Attribute Survey, and Moersch’s LoTi or Levels of Technology Implementation (1995), later revised to Levels of Teaching Innovation (2010). The intent was to create an instrument to measure teachers’ use of readily available digital technology tools and their level or type of use within the classroom. A 10-item section was used to determine the level and frequency of use (Show/Observe, Memorize/Comprehend, Apply, Analyze/Adapt, or Synthesize/Evaluate/Design) for a variety of common digital tools (e.g., PowerPoint, spreadsheets, blogs/wikis, podcasts, digital cameras,
etc.). A 6-point Likert scale (0-5) was used for the level of technology integration (0=none; 1=Teacher-centric, 3=Blended; and 5=Student-centric) along with a 4-point (1-4) scale (Rarely, Monthly, Weekly, Daily) that represented frequency of use.

Previous instruments that have been used to measure teacher technology integration often provided only a basic count of what tool is used and/or how often, but have not considered the type or kind of use for each tool (Moersch, 1995; Vannatta & Banister, 2009; Vannatta & Fordham, 2004). For instance, spreadsheets can be used for simple, cognitively low-level recall exercises such as quizzing multiplication tables and basic math facts or it can be used for higher level, student-generated formulas and graphs that demonstrate a conclusion or analysis that was performed on a given or (better yet) obtained set of data. Because of this uncertainty with a generic “use” of a tool, for the technology integration portion of this instrument, a scale or level of use from teacher-centered to student-centered was employed.

The Overall Technology Integration Scale (OTIS) assesses the teacher use of technology integration based on Bloom’s taxonomy, the original and the revised versions (Anderson & Krathwohl, 2001; Bloom, 1956). The chosen level of integration or use is multiplied by the frequency of use for each tool (Rarely, Monthly, Weekly, Daily). For the technology integration level, a scale of 0-5 is used, where a response of 0 signifies no use and 1-5 represent increasing levels of use by the teacher and/or students for teaching and learning activities, again, primarily based on Bloom’s taxonomy. Table 14 shows the five different levels and the descriptors of teacher and student uses for each level and how each relates to Bloom’s taxonomy. Therefore, these levels of use are a gradual inverse representation from teacher-centered to student or learner-centered uses (see Figure 8) and represent the call for a paradigm shift in teaching and learning over the past couple decades toward more focus on student engagement and activity
(e.g., active learning) (Tagg, 2003; Warlick, 2004). A commonly used phrase is that today’s 21st century teacher, as opposed to a 20th century teacher, has evolved from the ‘sage on the stage’ to the ‘guide on the side.’

Table 14

Five Levels of Teacher and Student Technology Use (Integration) on the Overall Technology Integration Scale (OTIS) Survey

<table>
<thead>
<tr>
<th>Integration Level</th>
<th>Bloom’s Taxonomy Level(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NA</td>
<td>Non-Use</td>
</tr>
<tr>
<td>1</td>
<td>Show/Observe</td>
<td>Teacher-centered/controlled; students are passive viewers of the information usually presented with a digital technology tool</td>
</tr>
<tr>
<td>2</td>
<td>Memorize/Comprehend</td>
<td>Mostly teacher-centered; some student interaction with technology for learning; usually in form of right/wrong answers with or without feedback</td>
</tr>
<tr>
<td>3</td>
<td>Apply</td>
<td>Mix of teacher and student centered uses to apply knowledge to a new situation using some digital technology tool</td>
</tr>
<tr>
<td>4</td>
<td>Analyze/Adapt</td>
<td>Mostly student-centered; some teacher control or creation of technology use</td>
</tr>
<tr>
<td>5</td>
<td>Synthesize (Create)/Evaluate/Design</td>
<td>Student-centered/controlled; teacher as facilitator or “guide on the side” who prepares the learning environment and assesses the product/process</td>
</tr>
</tbody>
</table>

Figure 8. Overall Technology Integration Scale (OTIS).
Validity and Reliability

The 21-TITL instrument was primarily developed by the researcher with the exception of a portion of the Teacher-Leadership Practices Inventory (T-LPI) section, which was adapted and condensed from valid and reliable Leadership Practices Inventory (LPI) from Kouzes and Posner (2003) and includes an additional subscale, Refine the Craft, developed by the researcher. The researcher also developed the Overall Technology Integration Scale (OTIS) section of the instrument and, therefore, validity and reliability were needed. A cadre of seven former or current K-12 teachers in Northwest Ohio who would not be taking the full survey examined the OTIS section. Input was gathered from the cadre through an invitation email, online form, and follow up phone interviews in order to improve clarity, instructions, and ease of use from a teacher’s perspective. After implementing the suggestions from the cadre, another group of teachers was selected to pilot the entire survey.

Additionally, an expert panel of five additional educators in areas representing educational technology, curriculum, change, and leadership assessed the entire instrument and its component sections with respect to: format, content of the items for each section, and language clarity and readability of the directions and individual items. After implementing the suggested improvements to the instrument from the cadre and expert panel, a second group of K-12 teachers was asked to pilot the entire survey. Pilot participants evaluated the context of the questions, the understandability of the questions and directions, estimated time to complete the survey, and suggested changes for improvement in these areas. Necessary changes were made to the survey and instructions based on this feedback in order to validate the survey and increase response rates (Fraenkel & Wallen, 2006). Since this survey as a whole is new, reliability will be established as various groups use the instrument over time.
Procedures

**HSRB Approval of Online Survey**

In order to proceed with the research study, the BGSU Human Subjects Review Board (HSRB) application was submitted for the online survey deployment immediately following the committee’s approval of the research proposal in mid-October 2011. Preliminary approval was received in early 2009 due to the nature of the research (online, confidential survey of adults) and final HSRB approval was obtained in mid-December (see Appendix E).

**Instrument Deployment and Data Collection**

After HSRB approval, principals, technology directors, and/or superintendents of northwest Ohio K-12 public school districts were contacted to begin notifying their faculty about the survey opportunity and process. After approval of the research from the district leadership, each district distributed the survey invitation letter in an email format to teachers through internal email on December 12. The invitation email contained an introduction to the survey, goals, estimated time, benefits and risks, and a link to the online survey (see Appendix F). All survey responses were kept confidential and the data collected for analysis did not contain email addresses—those were solicited on a separate online form for a random drawing to improve the response rate. Respondents had approximately three weeks to complete the survey and follow-up reminders were sent to all districts to forward to their teachers at the end of the first and second weeks, for a total of three notifications or reminders.

Due to the longer length of the survey, incentives were used in an attempt to increase the response rate. A random drawing for certificates in $20 or $50 denominations was held from all completed responses. At the end of the survey, participants were directed to a separate site where they were asked to include an email address so they can be contacted if they are selected in one
of the drawings. A random number generator was used to select the drawing winners from emails listed on a numbered spreadsheet and those teachers were contacted through email and later sent an electronic gift certificate.

**Research Questions**

1. Do technology integration factors significantly *relate* to Leadership Practices and Level of Reflection?

2. Which of the six (6) leadership practices subscales best *predicts* a teacher’s level of technology integration focus?

3. Does technology integration or leadership practices *differ* by demographic or background variables?

4. Which factors best *predict* a teacher’s technology integration (Overall Technology Integration)?

5. Which factors best *predict* a teacher’s leadership practices (T-LPI)?

**Data Analysis and Variables**

A comprehensive statistical analysis of teachers’ leadership practices, technology integration, and demographic variables follows and includes descriptive statistics, such as measures of central tendency (mean, median, mode, range, and standard deviation). Table 15 lists each variable, the corresponding survey item number, and the possible values associated with each.
Table 15

21st Century Technology Integration and Teacher Leadership (21-TITL) Survey Subscales Paired With Survey Item Number and Value Ranges

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survey Item(s)</th>
<th>Value(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School Environment and Background</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Technology Access/Availability</td>
<td>a. #1</td>
<td>a. 0-8</td>
</tr>
<tr>
<td>b. Website/Online Tool Access</td>
<td>b. #2</td>
<td>b. 0-8</td>
</tr>
<tr>
<td>c. Overall Perceived Overall Tech Support</td>
<td>c. #3</td>
<td>c. 0-8</td>
</tr>
<tr>
<td>d. TOTAL Environment</td>
<td>d. Sum #1-3</td>
<td>d. 0-24</td>
</tr>
<tr>
<td>e. Technology Efficacy</td>
<td>e. #4</td>
<td>e. 0-8</td>
</tr>
<tr>
<td>f. Social Trait</td>
<td>f. #5</td>
<td>f. 0-8</td>
</tr>
<tr>
<td>g. Level of Reflection</td>
<td>g. #6</td>
<td>g. 0-8</td>
</tr>
<tr>
<td><strong>Leadership Practices Inventory (T-LPI)</strong></td>
<td></td>
<td>Each T-LPI item is 1-6</td>
</tr>
<tr>
<td>a. Model the Way</td>
<td>a. Sum #8, 14, 23</td>
<td>a. 3-18</td>
</tr>
<tr>
<td>b. Inspire Shared Vision</td>
<td>b. Sum #18, 22, 24</td>
<td>b. 3-18</td>
</tr>
<tr>
<td>c. Challenge the Process</td>
<td>c. Sum #9, 12, 21</td>
<td>c. 3-18</td>
</tr>
<tr>
<td>d. Enable Others to Act</td>
<td>d. Sum #7, 10, 15</td>
<td>d. 3-18</td>
</tr>
<tr>
<td>e. Encourage the Heart</td>
<td>e. Sum #13, 17, 19</td>
<td>e. 3-18</td>
</tr>
<tr>
<td>f. Refine the Craft</td>
<td>f. Sum #11, 16, 20</td>
<td>f. 3-18</td>
</tr>
<tr>
<td>g. T-LPI</td>
<td>g. Sum #7-24</td>
<td>g. 18-108</td>
</tr>
<tr>
<td><strong>Overall Technology Integration Scale (OTIS)</strong></td>
<td></td>
<td>Each TIF item is 0-5; frequency is 1-4</td>
</tr>
<tr>
<td>a. TOTAL TIF</td>
<td>a. Sum #25-34 (type)</td>
<td>a. 0-50</td>
</tr>
<tr>
<td>b. TOTAL Frequency</td>
<td>b. Sum #25-34 (freq.)</td>
<td>b. 10-40</td>
</tr>
<tr>
<td>c. TOTAL TIF x Frequency</td>
<td>c. Sum (Type x Freq) for #25-34</td>
<td>c. 0-200</td>
</tr>
<tr>
<td>Demographics and Experiences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| a. Grade Level              | a. #35 | a. 1=PreK-2  
2=3-5<sup>th</sup>  
3=6-8<sup>th</sup>  
4=9-12<sup>th</sup> |
| b. Subject(s) Teaching      | b. #36 | b. 1-15 (responses) |
| c. School District          | c. #37 | c. 1=BG  
2=Maumee  
3=Perrysburg  
4=Rossford  
5=Springfield  
6=Sylvania |
| d. Teaching Experience      | d. #38 | d. 1=1  
2=2-4  
3=5-9  
4=10-14  
5=15-19  
6=20-24  
7=25+ |
| e. Wireless Access          | e. #39 | e. 0= Not sure/ Don't know  
1= No wireless access  
2= Some Rooms/Areas  
3= Most Rooms/Areas  
4= ALL Rooms/Areas |
| f. Computer/Device Availability | f. #40 | f. 1= School-provided Laptop  
2=School-provided Desktop  
3=School-provided Cell/Smart Phone  
4=My personal Laptop  
5=My personal Desktop  
6=My personal Cell Phone  
7=My personal Smart Phone  
8=None of the above (or only access to shared computers or cell phone) |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>g.</td>
<td>Computer Use in Hours/Week (Management)</td>
<td>g. #41</td>
</tr>
<tr>
<td>h.</td>
<td>Computer Use in Hours/Week (Instructional)</td>
<td>h. #42</td>
</tr>
<tr>
<td>i.</td>
<td>% Computer Use at Home</td>
<td>i. #43</td>
</tr>
<tr>
<td>j.</td>
<td># Computers in Classroom</td>
<td>j. #44</td>
</tr>
<tr>
<td>k.</td>
<td># Computers w/ Internet</td>
<td>k. #45</td>
</tr>
<tr>
<td>l.</td>
<td># Voluntary PD Sessions</td>
<td>l. #46</td>
</tr>
<tr>
<td>m.</td>
<td>Modified Stage of Technology Adoption (mSTA) – Current Self</td>
<td>m. #47</td>
</tr>
<tr>
<td>n.</td>
<td>Modified Stage of Technology Adoption (mSTA) – 3 years ago (self)</td>
<td>n. #48</td>
</tr>
<tr>
<td>o.</td>
<td>Modified Stage of Technology Adoption (mSTA) – Colleague Avg.</td>
<td>o. #49</td>
</tr>
</tbody>
</table>
In addition to descriptive analyses, survey data was analyzed using inferential statistics—correlation, Analysis of Variance (ANOVA), t-test of independent samples, and multiple regression. The two main variables (technology integration and leadership practices) were examined in relation to numerous independent variables using Pearson Correlation and multiple regression. Additionally, t-tests of independent samples were also employed in order to examine group differences by demographics, such as gender, while ANOVA was used to determine if significant differences exist based on school type, level of extroversion, years of teaching experience, or stage of technology adoption. Table 16 lists each research question, variables, and the type of inferential statistic that were employed.
**Table 16**

*Research Questions, Variables, and Data Analysis Procedures*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Independent Variable(s) - IV</th>
<th>Dependent Variable(s) - DV</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do technology integration factors significantly relate to Leadership Practices and Level of Reflection?</td>
<td>• Leadership Practices (sub-scales; total)                                                   • Overall Technology Integration</td>
<td>Pearson correlation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Modified Stage of Technology Adoption (mSTA)                                                • Technology Efficacy</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Reflection on Teaching Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Which of the six (6) leadership practices subscales best predict a teacher’s overall technology integration?</td>
<td>Leadership Practices                                                                        • Model the Way</td>
<td>Overall Technology Integration</td>
<td>Multiple regression</td>
</tr>
<tr>
<td></td>
<td>• Inspire a Shared Vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Challenge the Process</td>
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<td></td>
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<tr>
<td></td>
<td>• Enable Others to Act</td>
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<tr>
<td></td>
<td>• Encourage the Heart</td>
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<td></td>
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<tr>
<td></td>
<td>• Refine the Craft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Does technology integration or leadership practices differ by demographic or background variables?</td>
<td>• Age Group                                                                                 • Modified Stage of Technology Adoption (mSTA)</td>
<td>Overall Technology Integration</td>
<td>ANOVA</td>
</tr>
<tr>
<td></td>
<td>• Tech-efficacy (low/high)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Social Trait (Extro-Introversion)</td>
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<td></td>
<td>• Level of PD</td>
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<td></td>
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<tr>
<td></td>
<td>• Reflection on Teaching Practice</td>
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<td></td>
<td>• Years Experience</td>
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<tr>
<td></td>
<td>• Computers in Classroom (#)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Total Computing Hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Gender</td>
<td></td>
<td>T-test of independent samples</td>
</tr>
<tr>
<td>4. Which factors best predict a teacher’s technology integration (Overall Technology Integration)?</td>
<td>• Age Group                                                                                 • Modified Stage of Technology Adoption (mSTA)</td>
<td>Overall Technology Integration</td>
<td>Multiple regression</td>
</tr>
<tr>
<td></td>
<td>• Tech-efficacy (low/high)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Social Trait (Extro-Introversion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reflection on Teaching Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Level of PD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• T-LPI and Subscales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Years Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Computers in Classroom (#)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Total Computing Hours</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Which factors best predict a teacher’s leadership practices (T-LPI)?

<table>
<thead>
<tr>
<th>Factors</th>
<th>Leadership Practices</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Stage of Technology Adoption (mSTA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tech-efficacy (low/high)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Trait (Extro-Introversion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflection on Teaching Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of PD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<tr>
<td>Overall Technology Integration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers in Classroom (#)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Computing Hours</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multiple regression
CHAPTER IV. RESULTS

The purpose of this study was to examine the relationship between teachers’ leadership practices and their technology integration. This chapter describes the demographical results and statistical analyses from the 21st Century Technology Integration and Teacher Leadership (21-TITL) online survey, completed by 361 Northwest Ohio K-12 teachers from six school districts. Participant’s demographic and background data is presented first, followed by technology and leadership-related characteristics, and finally, the data relating to the five research questions.

Response Rate

Approximately 1,655 teachers, serving about 23,000 students, were invited to participate in the online survey. The overall return rate for all participants was 21.8% (361 of 1,655), which was lower than expected for an online survey of this length (Nulty, 2008). The main factor that most likely lowered the expected response rate was that the survey invitation was sent out in mid-December when many teachers are preparing for the holidays, winter break, and the end of the semester. A second factor that possibly affected participation was that each school district representative sent out the emailed survey invitation to their teachers rather than allowing them to receive the invitation directly from the researcher. In some cases, the invitation email was redirected a second time to principals to forward to their teaching staff, which in some cases did not get forwarded to teachers. In an attempt to increase the response rate, the researcher sent two follow-up email reminders to be forwarded to teachers, and provided an incentive for completion, which is described in the instrumentation section.

Participant Demographics and Background Experiences Factors

The following eight tables show the demographic and background experiences factors of the 361 teacher participants from six suburban Northwest Ohio school districts, primarily
surrounding the city of Toledo. The highest number of participants came from Sylvania, comprising over 31% of the respondents, while other districts made up from 10.8% to 16.3% of the sample. Table 17 shows the distribution of school district participation, followed by teacher’ Subjects and Grade Level Taught, Experience and Age, Level of Reflection, Professional Development (Voluntary), Education Level, and Gender.

Table 17

*School District Survey Participation*

<table>
<thead>
<tr>
<th>School District</th>
<th>Students (Estim.)</th>
<th>N (Estim.)</th>
<th>n</th>
<th>% District Response Rate</th>
<th>% of Survey Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowling Green</td>
<td>2,900</td>
<td>205</td>
<td>39</td>
<td>19.0</td>
<td>10.8</td>
</tr>
<tr>
<td>Maumee</td>
<td>2,600</td>
<td>190</td>
<td>39</td>
<td>20.5</td>
<td>10.8</td>
</tr>
<tr>
<td>Perrysburg</td>
<td>4,500</td>
<td>280</td>
<td>53</td>
<td>19.0</td>
<td>14.7</td>
</tr>
<tr>
<td>Rossford</td>
<td>1,800</td>
<td>140</td>
<td>58</td>
<td>41.4</td>
<td>16.1</td>
</tr>
<tr>
<td>Springfield</td>
<td>3,900</td>
<td>290</td>
<td>59</td>
<td>20.3</td>
<td>16.3</td>
</tr>
<tr>
<td>Sylvania</td>
<td>7,300</td>
<td>550</td>
<td>113</td>
<td>20.5</td>
<td>31.3</td>
</tr>
<tr>
<td>Total</td>
<td>23,000</td>
<td>1,655</td>
<td>361</td>
<td>21.8</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Subjects and Grade Levels Taught**

The majority (26.9%) of teacher participants consisted of elementary teachers, teaching three or more subjects, followed by English/language arts and special education, both at 14.1% (Table 18). Math, science, and social studies teachers made up the remaining larger groups of teachers, at 11.6%, 11.6%, and 10.0%, respectively. Table 19 shows teacher participant grade levels taught, with the majority of respondents (31.6%) being high school teachers, grades 9-12, followed by grade 3-5 teachers (21.9%), 6-8 (20.8%), and PreK-grade 2 at 17.5%.
Table 18

Subject(s) Taught (N = 361)

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or More (e.g. elementary teacher)</td>
<td>97</td>
<td>26.9</td>
</tr>
<tr>
<td>Arts (music, visual, theatre)</td>
<td>15</td>
<td>4.2</td>
</tr>
<tr>
<td>Business</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>Computer/Technology</td>
<td>14</td>
<td>3.9</td>
</tr>
<tr>
<td>English/Language Arts</td>
<td>51</td>
<td>14.1</td>
</tr>
<tr>
<td>English Language Development (ELL, ESL)</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>Family Consumer Science</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>Health</td>
<td>9</td>
<td>2.5</td>
</tr>
<tr>
<td>Math</td>
<td>42</td>
<td>11.6</td>
</tr>
<tr>
<td>Physical Education</td>
<td>9</td>
<td>2.5</td>
</tr>
<tr>
<td>Science</td>
<td>42</td>
<td>11.6</td>
</tr>
<tr>
<td>Social Studies / History</td>
<td>36</td>
<td>10.0</td>
</tr>
<tr>
<td>Special Education</td>
<td>51</td>
<td>14.1</td>
</tr>
<tr>
<td>Prefer Not Answer</td>
<td>8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Table 19

Grade Level Currently Teach (N = 361)

<table>
<thead>
<tr>
<th>Grade Teaching</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreK – 2nd</td>
<td>63</td>
<td>17.5</td>
</tr>
<tr>
<td>3rd – 5th</td>
<td>79</td>
<td>21.9</td>
</tr>
<tr>
<td>6th – 8th</td>
<td>75</td>
<td>20.8</td>
</tr>
<tr>
<td>9th – 12th</td>
<td>114</td>
<td>31.6</td>
</tr>
<tr>
<td>2 or more of these</td>
<td>28</td>
<td>7.8</td>
</tr>
<tr>
<td>Prefer Not Answer</td>
<td>2</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Experience and Age

Teachers’ years of experience and age ranges are shown in Tables 20 and 21. The highest percentage of respondents were from the most experienced group of teachers at 25+ years (24.4%), followed by teachers with 5-9 and 10-14 years, each at 20% of the respondents. The average years of experience for these teachers was from 15-19 years, which follows the national
trend from 2008 data (Coopersmith, 2009, p. 11), where the average years of experience was 13 (four years ago). First-year teachers made up only 1.4% of the sample, while teachers with 2-4 years of experience made up 6.1%. In sum, over 90% of the respondent teachers had 5 or more years of experience. Similarly, respondents’ age ranges were mostly (almost 80%) from age 30-59, while 20-29 year old teachers comprised 12.7% and 60+ represented 6.6% of the total participant pool.

Table 20

<table>
<thead>
<tr>
<th>Teaching Experience in Years (N = 360)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1 (first year)</td>
</tr>
<tr>
<td>2-4</td>
</tr>
<tr>
<td>5-9</td>
</tr>
<tr>
<td>10-14</td>
</tr>
<tr>
<td>15-19</td>
</tr>
<tr>
<td>20-24</td>
</tr>
<tr>
<td>25+</td>
</tr>
<tr>
<td>Prefer Not Answer</td>
</tr>
</tbody>
</table>

Table 21

<table>
<thead>
<tr>
<th>Age Range (N = 361)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>20-29</td>
</tr>
<tr>
<td>30-39</td>
</tr>
<tr>
<td>40-49</td>
</tr>
<tr>
<td>50-59</td>
</tr>
<tr>
<td>60+</td>
</tr>
<tr>
<td>Prefer Not Answer</td>
</tr>
</tbody>
</table>

Level of Reflection

Teachers were asked to rate their level of reflection about their teaching practice in a single item. In this 9-point scale item, teachers indicated how often they think about what they
are doing next, what they have done, or how to improve. The 0-8 scale ranged from Never (0) to Sometimes (4) to Always (8) with responses in between these values also accepted (see Table 22). Over 97% of respondents indicated that they were at least “Sometimes” (4) reflective and of those, level 6 was the most common response with 34.1% of responses. The highest level of reflection, “Always” (8) was selected by 12.0% \((n = 43)\) of respondents.

Table 22

*Reflection Level About Teaching Practice \((N = 358)\)*

<table>
<thead>
<tr>
<th>Level</th>
<th>(n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Never</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>4 - Sometimes</td>
<td>32</td>
<td>8.9</td>
</tr>
<tr>
<td>5</td>
<td>46</td>
<td>12.8</td>
</tr>
<tr>
<td>6</td>
<td>122</td>
<td>34.1</td>
</tr>
<tr>
<td>7</td>
<td>107</td>
<td>29.9</td>
</tr>
<tr>
<td>8 - Always</td>
<td>43</td>
<td>12.0</td>
</tr>
</tbody>
</table>

**Professional Development**

A common aspect of being a teacher is attending professional development opportunities, whether required by the school district or on a voluntary basis. Survey participants were asked to indicate on average how often they attend voluntary (non-mandated) trainings, workshops, or any other professional development (PD) opportunities over the past three years: Never, Rarely (1-2/year), Sometimes (3-6/year), Often (about 1/month), or Frequently (2+/month). With negatively skewed distribution, most respondents, 180 (50.0%), indicated they attended voluntary PD “Sometimes” or 3-6 times per year, followed by 120 (33.3%) Never or Rarely, and 60 (16.7%) Often or Frequently attended voluntary PD. Table 23 shows the distribution for each selection.
Table 23

*Voluntary Professional Development (PD) Attended (on Average in Past 3 Years) (N = 360)*

<table>
<thead>
<tr>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>21</td>
</tr>
<tr>
<td>Rarely (1-2/year)</td>
<td>99</td>
</tr>
<tr>
<td>Sometimes (3-6/year)</td>
<td>180</td>
</tr>
<tr>
<td>Often (about 1/month)</td>
<td>47</td>
</tr>
<tr>
<td>Frequently (2+/month)</td>
<td>13</td>
</tr>
</tbody>
</table>

**Teacher Education Level**

Survey participants were asked to indicate their highest level of education or degree from a higher education institution. Over 80% of the survey respondents had obtained at least a masters degree, while only 3.3% had only a bachelors degree with no additional graduate coursework, as shown in Table 24. Compared to the 2008 national sample of teachers (Coopersmith, 2009) where only 51.8% of teachers nationally had a masters degree or higher (p. 13), suburban Northwest Ohio teachers from the participating six districts education level is much higher at 82.6% with at least a masters degree.

Table 24

*Highest Education Level Completed (N = 361)*

<table>
<thead>
<tr>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelors degree</td>
<td>12</td>
</tr>
<tr>
<td>Graduate course work (no degree)</td>
<td>51</td>
</tr>
<tr>
<td>Masters degree</td>
<td>176</td>
</tr>
<tr>
<td>Masters +30 graduate hours (course work)</td>
<td>102</td>
</tr>
<tr>
<td>Doctoral/Specialist course work (in program)</td>
<td>8</td>
</tr>
<tr>
<td>Specialist degree</td>
<td>11</td>
</tr>
<tr>
<td>Doctoral degree (PhD, EdD, etc.)</td>
<td>1</td>
</tr>
</tbody>
</table>
Gender

Over three quarters of survey respondents were female (77.7%; n=279) and males represented 22.3% (n=80), with two non-respondents. On average, the number of female teachers in United States’ public schools as of 2008 was 75.9% (Coopersmith, 2009, p. 9), so this population was just slightly above average for female representation.

Descriptive Statistics: Technology and Leadership Characteristics

The following section presents the results from factors of survey items or the combination of certain items, including technology-related factors, School Environment and Background, Computer Availability, Digital Tool Use and Frequency, Computer Use (hours), Computers in the Classroom, and Teachers’ Modified Stage of Technology Adoption (mSTA), followed by leadership factors, Teacher Leadership Practices, Total Leadership Positions, and College/University Teaching.

School Technology Environment and Background

Teachers were asked to rate the level of Technology Access, Online Access, their Overall Tech Support, and their own Technology Efficacy, which are shown below in Table 25. Teachers from the six districts surveyed responded above the stated “average” or median on a scale of 0-8 for all four areas, with Online Access being the lowest and most varied ($M = 4.81$; $SD = 2.15$). Teachers’ mean Technology Efficacy score, one’s perceived ability to be able to effectively integrate technology in the classroom, was 5.64 out of eight. The Overall Tech Support mean was 5.45, followed by the Technology Access at 5.29, signifying that although teachers may not have everything they want or need regarding technology to support classroom learning, the Overall Tech Support they are receiving from both the technology department and school administration is above average.
Table 25

**School Technology Environment and Background**

<table>
<thead>
<tr>
<th>Scale</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Access</td>
<td>0-8</td>
<td>361</td>
<td>5.29</td>
<td>1.73</td>
<td>6.0</td>
</tr>
<tr>
<td>Online Access</td>
<td>0-8</td>
<td>358</td>
<td>4.81</td>
<td>2.15</td>
<td>5.0</td>
</tr>
<tr>
<td>Overall Tech Support</td>
<td>0-8</td>
<td>357</td>
<td>5.45</td>
<td>1.72</td>
<td>6.0</td>
</tr>
<tr>
<td>Tech Efficacy</td>
<td>0-8</td>
<td>360</td>
<td>5.64</td>
<td>1.56</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Computer Availability**

In regards to computer access that teachers had available to use for teaching-related duties, all but two teachers (over 99%) have access to a computer either at work or home, as shown in Table 26. For school-provided computers, desktops were most common at 69.0%, followed by laptops at 44.0%. At home, about 82% of respondents had access to either a desktop or laptop computer for teaching-related tasks. In addition to computers, teachers are using cell phones, mostly their personal cell phone—over 50% of respondents indicated using either a “smart” or traditional cell phone for teaching-related tasks or communications.

Table 26

**Computer(s) Availability (N = 361)**

<table>
<thead>
<tr>
<th>Computer Type</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>School-provided Laptop</td>
<td>159</td>
<td>44.0</td>
</tr>
<tr>
<td>School-provided Desktop</td>
<td>249</td>
<td>69.0</td>
</tr>
<tr>
<td>School-provided Cell/Smart Phone</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>Personal Laptop</td>
<td>187</td>
<td>51.8</td>
</tr>
<tr>
<td>Personal Desktop</td>
<td>109</td>
<td>30.2</td>
</tr>
<tr>
<td>Personal Cell Phone</td>
<td>84</td>
<td>23.3</td>
</tr>
<tr>
<td>Personal Smart Phone</td>
<td>99</td>
<td>27.4</td>
</tr>
<tr>
<td>No computer available</td>
<td>2</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Technology Integration (Digital Tool Use and Frequency)

The following two tables display the results for teachers’ integration of information and communication technologies (ICT) or digital tools into teaching and learning. The first table (27) represents the integration level or who is the primary digital tool user (teacher or student), while the second table (28) shows the frequency of this type of integration or use for the digital tool. Both of these sets of responses were combined to generate the Overall Technology Integration score.

**Digital tool level of integration/use.** The first part of the Technology Integration survey requested teachers to identify how they use 10 digital technology tools in teaching and learning. Five responses or levels ranged from Teacher-Centered or Teacher-Active (1) to Blended (3) to Student-Centered or Student-Active (5), with responses 2 and 4 being in between these choices. For example, if students modify a teacher-created Excel spreadsheet to create graphs and charts with their own collected data, that would be represented with a response of 4 for Technology Integration Level of Use, since the students are the ones mostly using the tool, but the teacher created a template for them to use.

**Most and least used digital tools.** The tools used or integrated most into teaching and learning activities were Word Processing software (98% stating some sort of use), then Web Searching (over 96%), followed by Presentation Software (86%). The least used tools were Blogs/Wikis (68.5% no use) and Web 2.0 (66.9% no use), equating to at least 30% of teachers using these tools in some way for teaching and learning (see Table 27).

**Teacher-centered, blended, and student-centered use of digital tools.** Teacher-Centered/Teacher-Active digital tools (1) are those where the teacher is in control of making and/or showing the work—students only observe or receive something created with that tool. In
other words, there is no hands-on use of the tool by the students for a level 1 or Teacher-Centered use. The tools selected most often for Teacher-Centered use were: Spreadsheets/Databases (55.3%), Digital Pictures/Video (found) (33.9%), Digital Pictures/Video (taken) (32.3%), and Presentation Software (31.3%). The least Teacher-Centered digital tools were Web 2.0 (12.8%), Concept Maps/Graphic Organizers (14.9%), and Blogs/Wikis (16.3%).

For Blended (3) use of digital tools, those that are used equally by teachers and students, Word Processing is the most commonly used (48.6%), followed by Web Searching (40.4%) and then Concept Maps/Graphic organizers and Found Digital Pictures (31.2 and 30.2%, respectively). The most Student-Centered/Student-Active (5) digital tools were Presentation Software (9.7%), Word Processing (9.3%), and Web Searching (7.3%). Therefore, participants in this study identified Presentation Software as students’ primary digital tool used for knowledge creation and synthesis. Blogs/Wikis (1.4%) and Spreadsheets/Databases (2.0%) were used the least for Student-Centered integration.

Table 27

<table>
<thead>
<tr>
<th>Digital Tool</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>%</th>
<th>No Use</th>
<th>Teacher Centered</th>
<th>Blended</th>
<th>Student Centered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs / Wikis</td>
<td>349</td>
<td>0.63</td>
<td>1.13</td>
<td>68.5</td>
<td>16.3</td>
<td>2.6</td>
<td>10.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Concept Maps / Graphic Organizers</td>
<td>343</td>
<td>1.52</td>
<td>1.52</td>
<td>40.5</td>
<td>14.9</td>
<td>7.0</td>
<td>31.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Digital Audio / Podcasts</td>
<td>342</td>
<td>0.93</td>
<td>1.31</td>
<td>54.7</td>
<td>22.5</td>
<td>4.7</td>
<td>13.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Digital Pictures / Video (found)</td>
<td>351</td>
<td>1.87</td>
<td>1.41</td>
<td>17.1</td>
<td>33.9</td>
<td>9.4</td>
<td>30.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Digital Pictures / Video (taken)</td>
<td>353</td>
<td>1.41</td>
<td>1.41</td>
<td>32.6</td>
<td>32.3</td>
<td>8.8</td>
<td>19.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Presentation Software</td>
<td>351</td>
<td>2.08</td>
<td>1.48</td>
<td>14.0</td>
<td>31.3</td>
<td>10.3</td>
<td>31.1</td>
<td>3.7</td>
</tr>
<tr>
<td>Spreadsheets / Databases</td>
<td>349</td>
<td>1.10</td>
<td>1.04</td>
<td>30.4</td>
<td>55.3</td>
<td>2.6</td>
<td>8.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>
In addition to whether or not a technology tool was integrated or used at various levels or teaching and learning strategies, the frequency of that tool’s use was also reported—Rarely, Monthly, Weekly, or Daily. Table 28 shows the responses for how frequently a digital tool was used in the classroom at the specified level. As identified with the digital tool integration/use data (Table 27), Word Processing was most commonly used, but the frequency response shows that the majority of teachers used it daily (55.0%)—by far the most commonly used technology tool, followed by daily use of Presentation Software (25.3%) and Web Searching (25.2%). Digital picture taking was the least used tool on a daily basis at 3.2%, but still garnered about 67% use at some frequency.

Other commonly used tools, classified as used weekly, include Web Searching (38.4%), Found Digital Pictures (31.6%), and Concept Maps/Graphic Organizers and Presentation Software (both at 29.0%). Of those using these digital tools, three tools most frequently used on a monthly basis were Taken Digital Pictures (37.3%), Found Digital Pictures (33.7%), and Digital Audio/Podcasts (30.8%). Lastly, of the least often used digital tools, Blogs/Wikis and Web 2.0 were used the least frequently or “rarely,” at 56.6 and 54.9%, respectively. Other rarely used tools included Digital Audio/Podcasts (45.6%), Taken Digital Pictures (43.4%), and Concept Maps/Graphic Organizers (33.8%).

<table>
<thead>
<tr>
<th>Spreadsheets / Databases</th>
<th>349</th>
<th>1.10</th>
<th>1.04</th>
<th>30.4</th>
<th>55.3</th>
<th>2.6</th>
<th>8.9</th>
<th>0.9</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web 2.0</td>
<td>329</td>
<td>0.81</td>
<td>1.39</td>
<td>66.9</td>
<td>12.8</td>
<td>3.0</td>
<td>10.9</td>
<td>2.7</td>
<td>3.6</td>
</tr>
<tr>
<td>Web Searching</td>
<td>354</td>
<td>2.22</td>
<td>1.43</td>
<td>13.3</td>
<td>25.1</td>
<td>8.2</td>
<td>40.4</td>
<td>5.6</td>
<td>7.3</td>
</tr>
</tbody>
</table>

**Digital tool frequency of integration/use.**
Table 28

Digital Tool Frequency of Integration

<table>
<thead>
<tr>
<th>Digital Tool</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>1 Rarely</th>
<th>2 Monthly</th>
<th>3 Weekly</th>
<th>4 Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs / Wikis</td>
<td>166</td>
<td>1.81</td>
<td>1.06</td>
<td>56.6</td>
<td>16.3</td>
<td>16.9</td>
<td>10.2</td>
</tr>
<tr>
<td>Concept Maps / Graphic Organizers</td>
<td>231</td>
<td>2.19</td>
<td>1.03</td>
<td>33.8</td>
<td>25.5</td>
<td>29.0</td>
<td>11.7</td>
</tr>
<tr>
<td>Digital Audio / Podcasts</td>
<td>195</td>
<td>1.85</td>
<td>0.94</td>
<td>45.6</td>
<td>30.8</td>
<td>16.4</td>
<td>7.2</td>
</tr>
<tr>
<td>Digital Pictures / Video (found)</td>
<td>285</td>
<td>2.45</td>
<td>0.97</td>
<td>18.6</td>
<td>33.7</td>
<td>31.6</td>
<td>16.1</td>
</tr>
<tr>
<td>Digital Pictures / Video (taken)</td>
<td>249</td>
<td>1.79</td>
<td>0.83</td>
<td>43.4</td>
<td>37.3</td>
<td>16.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Presentation Software</td>
<td>300</td>
<td>2.69</td>
<td>1.06</td>
<td>18.7</td>
<td>27.0</td>
<td>29.0</td>
<td>25.3</td>
</tr>
<tr>
<td>Spreadsheets / Databases</td>
<td>255</td>
<td>2.36</td>
<td>1.04</td>
<td>25.5</td>
<td>29.4</td>
<td>28.6</td>
<td>16.5</td>
</tr>
<tr>
<td>Web 2.0</td>
<td>162</td>
<td>1.77</td>
<td>1.01</td>
<td>54.9</td>
<td>22.8</td>
<td>12.3</td>
<td>9.9</td>
</tr>
<tr>
<td>Web Searching</td>
<td>302</td>
<td>2.75</td>
<td>0.98</td>
<td>13.2</td>
<td>23.2</td>
<td>38.4</td>
<td>25.2</td>
</tr>
<tr>
<td>Word Processing</td>
<td>333</td>
<td>3.32</td>
<td>0.89</td>
<td>5.1</td>
<td>12.9</td>
<td>27.0</td>
<td>55.0</td>
</tr>
</tbody>
</table>

Computer Use for Professional Tasks

Teachers commonly use a computer for teaching or other job-related tasks. Table 29 shows how many hours they spend working on a computer doing Management-related tasks (such as grade book, IEPs, making seating charts, school/district emails, parent emails or communications, newsletters) or Instruction-related tasks (such as finding/preparing lessons or lesson plans, researching, creating assessments, grading, practicing with new tools/strategies, communicating with students). On average, teachers spent about 6-10 hours per week on both Management and Teaching/Instruction related tasks, with only 8.0% spending less than two hours on Management and 7.5 spending less than two hours on Teaching/Instruction tasks. Over
a quarter (26.1%) of teachers surveyed reported using a computer for Management tasks for at least 11 hours per week, while almost one-third (31.1%) spent 11 or more hours working on Teaching/Instruction tasks.

Table 29

*Computer Use for Professional Tasks (Hours Per Week)*

<table>
<thead>
<tr>
<th></th>
<th>(n)</th>
<th>(M)</th>
<th>(SD)</th>
<th>(&lt;2) Hrs.</th>
<th>1-3 Hrs.</th>
<th>2-6 Hrs.</th>
<th>3-11 Hrs.</th>
<th>4-16 Hrs.</th>
<th>(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Tasks</td>
<td>361</td>
<td>1.88</td>
<td>1.14</td>
<td>8.0</td>
<td>34.3</td>
<td>31.6</td>
<td>13.6</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>Instruction Tasks</td>
<td>360</td>
<td>2.03</td>
<td>1.17</td>
<td>7.5</td>
<td>28.6</td>
<td>32.8</td>
<td>15.3</td>
<td>15.8</td>
<td></td>
</tr>
</tbody>
</table>

Generally speaking, the more time teachers work on a computer, the more time they spend on Instruction-related tasks as opposed to Management tasks. In other words, teachers who worked less than five hours per week, spent more time on Management tasks, while those who worked six or more hours per week, on average, spent more time on Instruction-related tasks.

Furthermore, Table 30 displays the percentage of this computer-based work that occurs at home, with 23.1% of teachers spending over 50% of these work hours at home and only 2.8% stating they do all teaching-related computer work at school, not at home. The remaining teachers spend either 1-25% of those hours on the computer at home (39.7%) or spend 26-50% of their time away from school working on the computer for teaching-related tasks (34.4%).

Table 30

*Percent of Professional Tasks Completed at Home/Non-School (\(N = 360\))*

<table>
<thead>
<tr>
<th></th>
<th>(n)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% at home (all done at school)</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>1-25%</td>
<td>143</td>
<td>39.7</td>
</tr>
<tr>
<td>26-50%</td>
<td>124</td>
<td>34.4</td>
</tr>
<tr>
<td>51-99%</td>
<td>83</td>
<td>23.1</td>
</tr>
<tr>
<td>100% at home/non-school</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
**Computers in the Classroom**

In order to integrate digital technologies into teaching and learning, computing devices, usually computers, are needed. But these computers are not always readily available or actually in a teacher’s classroom. Table 31 shows the distribution of computers actually in the respondents’ classrooms. Over half of the teachers sampled (57%) had either 1 computer or 2-3 computers in their classroom, while 30.5% had 4-6 computers, 4.8% had 7-11 computers and 6.4% had 12 or more computers. A single, teacher computer was the most common response at 38.5 percent. Of those computers in the classroom, essentially all seem to be connected to the Internet. (NOTE: obviously some respondent error in that there are more Internet-connected computers than computers, such as for responses 1 and 5, since the Internet-connected computer values should be equal or less than actual computers).

Table 31

*Computers in the Classroom*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Computers</td>
<td>357</td>
<td>2.19</td>
<td>1.21</td>
<td>0.8</td>
</tr>
<tr>
<td>Internet-connected</td>
<td>354</td>
<td>2.19</td>
<td>1.23</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Teachers’ Modified Stage of Technology Adoption (mSTA)**

Another technology-related factor was the single item measuring teacher’s Modified Stage of Technology Adoption (mSTA), (Christensen & Knezek, 1999; Russell, 1995) which is shown in Tables 32 and 33. Normally assessed through a multiple-question instrument to determine their overall Stage of Technology Adoption, the researcher had respondents self-select the stage (1-7) that best matched their stage based on the descriptors for each level, which
included the seventh stage, Assisting Others, added by the researcher. Therefore, this item is identified as modified or mSTA (see Appendix G for descriptions of each level).

Tables 32 and 33 show the descriptive statistics for teachers’ mSTA scores today (Current Self), Self mSTA 3 years ago, and an average mSTA of their Colleagues today. With regard to Current mSTA scores, teachers saw themselves as more technologically proficient and capable than their average peers with a mean score of 5.55 out of 7, compared to colleagues’ average of 4.57, almost a full step lower. This would place the individual teachers in the middle of the “Adaptation to Other Contexts” level, whereas their peers, on average, would be in the “Familiarity and Confidence” level.

Table 32

Modified Stage of Technology Adoption (mSTA) from 1-7

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Self</td>
<td>357</td>
<td>5.55</td>
<td>1.17</td>
<td>6.0</td>
<td>6</td>
</tr>
<tr>
<td>Self (3 years ago)</td>
<td>357</td>
<td>4.51</td>
<td>1.60</td>
<td>5.0</td>
<td>4</td>
</tr>
<tr>
<td>Colleagues (on average)</td>
<td>357</td>
<td>4.57</td>
<td>1.09</td>
<td>5.0</td>
<td>5</td>
</tr>
</tbody>
</table>

Teachers did recognize growth in their own technology integration and competence, which is shown by the lower average for teachers three years ago and frequency of levels being skewed lower. One example would be for level six, Creative Application to New Contexts, where three years ago, only 58 (16.2%) teachers considered themselves at this level, but now, 119 (33.3%) do—exactly one-third of all respondents.
Table 33

*Modified Stage of Technology Adoption (mSTA) Levels (1-7) Frequencies for Current Self, Self 3 Years Ago, and Colleagues Today (N = 357)*

<table>
<thead>
<tr>
<th>Modified Stage of Technology Adoption (mSTA)</th>
<th>Current Self</th>
<th></th>
<th>Self 3 Years Ago</th>
<th></th>
<th>Colleagues (average)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Awareness</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>2.8</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>2. Learning the Process</td>
<td>6</td>
<td>1.7</td>
<td>35</td>
<td>9.8</td>
<td>9</td>
<td>2.5</td>
</tr>
<tr>
<td>3. Understanding Application of Process</td>
<td>14</td>
<td>3.9</td>
<td>51</td>
<td>14.3</td>
<td>47</td>
<td>13.2</td>
</tr>
<tr>
<td>4. Familiarity and Confidence</td>
<td>39</td>
<td>10.9</td>
<td>80</td>
<td>22.4</td>
<td>108</td>
<td>30.3</td>
</tr>
<tr>
<td>5. Adaptation to Other Contexts</td>
<td>97</td>
<td>27.2</td>
<td>76</td>
<td>21.3</td>
<td>117</td>
<td>32.8</td>
</tr>
<tr>
<td>6. Creative Application to New Contexts</td>
<td>119</td>
<td>33.3</td>
<td>58</td>
<td>16.2</td>
<td>69</td>
<td>19.3</td>
</tr>
<tr>
<td>7. Assisting Others</td>
<td>82</td>
<td>23.0</td>
<td>47</td>
<td>13.2</td>
<td>6</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**Summary of Technology-Related Factors**

Table 34 displays a summary of the six technology-related factors from this survey that are used in the inferential analyses discussed later in the research questions. The six factors are:

School Technology Environment, Technology Efficacy, Overall Tech Integration, Total Computer Use (hours), Computers in Classroom, and Current Self Modified Stage of Technology Adoption (mSTA). Three of these factors refer to single survey items (Technology Efficacy, Computers in the Classroom, and Current Self Modified Stage of Technology Adoption), while the other three are a combination of survey items.

School Technology Environment consists of combining scores from Technology Access, Online Access, and Overall Tech Support, creating a scale from 0 to 24 (each was 0-8). The mean score for School Technology Environment was 15.46 out of a possible 24 ($SD = 4.69$). Summing each tool’s use multiplied by its frequency created the Overall Technology Integration
score. Since each product pair (use x f) ranged from 0-20, the sum of these products ranges between 0 and 200. The Overall Technology Integration mean was 36.33 with a wide-ranging SD of 22.28. The final technology-related factor that was created from more than one survey item was Total Computer Use, where the responses for Management-Tasks Computer Use and Instructional Task Computer Use were added together and recoded to create a scale from 0-8. For Total Computer Use, the mean score was 3.91, with a SD of 1.94. This factor or variable was later converted into four groups or categories (Low to High Use) for inferential analyses, which is explained later in this chapter.

Table 34

**Summary of Technology Related Factors Used in Inferential Analyses**

<table>
<thead>
<tr>
<th>Technology Factors</th>
<th>Item(s)</th>
<th>Scale</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Technology Environment</td>
<td>Sum (1, 2, 3)</td>
<td>0-24</td>
<td>15.46</td>
<td>4.69</td>
</tr>
<tr>
<td>Technology Efficacy</td>
<td>4</td>
<td>0-8</td>
<td>5.64</td>
<td>1.56</td>
</tr>
<tr>
<td>Overall Tech Integration</td>
<td>Sum[Use(25…34) x Freq(25…34)]</td>
<td>0-200  (0-5 Use x 1-4 Freq.)</td>
<td>36.33</td>
<td>22.28</td>
</tr>
<tr>
<td>Total Computer Use (hours)</td>
<td>Sum (39, 40)</td>
<td>0-8</td>
<td>3.91</td>
<td>1.94</td>
</tr>
<tr>
<td>Computers in Classroom</td>
<td>42</td>
<td>0-5</td>
<td>2.19</td>
<td>1.21</td>
</tr>
<tr>
<td>Modified Stage of Technology Adoption (mSTA) - Current Self</td>
<td>45</td>
<td>1-7</td>
<td>5.55</td>
<td>1.17</td>
</tr>
</tbody>
</table>

**Total Leadership Positions**

Teachers were asked to identify positions of leadership they have held, which included five possible responses: department chair or lead teacher, mentor for colleague or new teacher, elected teacher union representative, coaching of any kind, or co-curricular advisor. A Total Leadership Positions score represents the number of leadership positions one has held and ranges from 0 and 5. The survey did not allow for multiple counts for a particular response, such as if a teacher coached three different sports. The distribution of Total Leadership Positions held is
shown in Table 35, with most teachers selecting only one leadership position \((n=105)\), followed by two \((n=92)\) then three positions \((n=67)\). Over 14.4% of the respondents \((n=52)\) reported holding no positions of leadership.

Table 35

*Total Leadership Positions (N=361)*

<table>
<thead>
<tr>
<th>Positions Held</th>
<th>(n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>52</td>
<td>14.4</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
<td>29.1</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>25.5</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>18.6</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>9.7</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>2.8</td>
</tr>
</tbody>
</table>

**College/University Teaching**

A separate, but similar form of leadership to those previously mentioned is college or university teaching. While the positions in the last section dealt with positions held within or in conjunction with their primary teaching job, teaching a college course to undergraduates or graduate students is an additional and separate responsibility, something that approximately 66 teachers (18.3%) of the sample has or continues to teach college students at some level (see selections 3-7 in Table 36). In addition, 41.3% \((n=149)\) of respondents would like to teach at the college level at some point and slightly less (40.4%, \(n=146\)) reported no interest or experience. These seven responses were combined into four groups for inferential analyses, which are examined later in Research Question 3, how technology integration and leadership practices differ by background or experiential variables.
Table 36

*College/University Teaching Experience and Groups (N=361)*

<table>
<thead>
<tr>
<th>College Teaching Experience</th>
<th>n</th>
<th>College Teaching Experience Groups</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Never/Don’t Plan To</td>
<td>146</td>
<td>None/Not Again (1, 3)</td>
<td>165</td>
</tr>
<tr>
<td>2. Never, But Hope To</td>
<td>149</td>
<td>Hope To (2)</td>
<td>149</td>
</tr>
<tr>
<td>3. Have Taught But Not Again</td>
<td>19</td>
<td>Sometimes (4, 5)</td>
<td>40</td>
</tr>
<tr>
<td>4. Have Taught Plan To Again</td>
<td>29</td>
<td>Often/Frequently (6, 7)</td>
<td>7</td>
</tr>
<tr>
<td>5. Sometimes</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Often</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Frequently</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Teacher Leadership Practices**

The survey results for participants’ Teacher Leadership Practices Inventory (T-LPI) and corresponding six subscales are listed in Table 37. The subscales with the highest average were Enable Others to Act (15.27), Model the Way (15.19), and Refine the Craft (14.45), while the lowest three subscales were Encourage the Heart (14.30), Inspire a Shared Vision (14.05), and Challenge the Process (13.70). The T-LPI score mean was 86.97 out of a possible 108, with a SD of 9.20.

Table 37

*Teachers Leadership Practices (T-LPI) Factors*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Scale</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model the Way</td>
<td>3-18</td>
<td>361</td>
<td>15.19</td>
<td>1.62</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Inspire Shared Vision</td>
<td>3-18</td>
<td>361</td>
<td>14.05</td>
<td>2.26</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Challenge the Process</td>
<td>3-18</td>
<td>361</td>
<td>13.70</td>
<td>2.31</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Enable Others to Act</td>
<td>3-18</td>
<td>361</td>
<td>15.27</td>
<td>1.71</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Encourage the Heart</td>
<td>3-18</td>
<td>361</td>
<td>14.30</td>
<td>2.04</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Refine the Craft</td>
<td>3-18</td>
<td>361</td>
<td>14.45</td>
<td>2.24</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>T-LPI</td>
<td>18-108</td>
<td>361</td>
<td>86.97</td>
<td>9.20</td>
<td>87</td>
<td>87</td>
</tr>
</tbody>
</table>
Results by Research Question

Five research questions regarding the relationship between teachers’ leadership practices and technology integration were investigated for this study. The resulting descriptive data summaries are listed by research question, along with the corresponding inferential analyses and results.

**Research Question 1: Do technology integration factors significantly relate to Leadership Practices and Level of Reflection?**

A Pearson Correlation matrix was generated to examine the relationship among technology use factors (Overall Technology Integration, Modified Stage of Technology Adoption (mSTA), Technology Efficacy) leadership practices (T-LPI and six subscales), and Level of Reflection.

**Technology integration factors.** Among technology related factors, the strongest correlation was between teachers’ reported Modified Stage of Technology Adoption (mSTA) and Technology Efficacy ($r = .610$). Overall Technology Integration and Modified Stage of Technology Adoption (mSTA) also showed a moderate correlation ($r = .478$), followed by Overall Technology Integration and Technology Efficacy ($r = .340$), all significant to the $p < .001$ level.

**Technology integration, leadership, and reflection.** Table 38 lists the correlation results for Overall Technology Integration scores and T-LPI (Leadership Practices) scores, showing a significant, yet weak, correlation of $.289$ ($p < .001$). Within the T-LPI, the Challenge the Process subscale showed slightly stronger correlation ($r = .362$, $p < .001$). Other technology-related factors showed moderate correlation with teachers’ Overall Technology Integration,
Stage of Technology Adoption \((r = .478)\) and their Technology Efficacy \((r = .340)\), both significant to the \(p < .001\) level.

In addition to the moderate relationship between Overall Technology Integration and T-LPI, there were significant \((p < .001)\) low to moderate correlations between teachers’ Technology Efficacy and T-LPI \((.340)\), Modified Stage of Technology Adoption (mSTA) and Challenge the Process subscale \((.314)\), and their level of Reflection with their T-LPI \((.441)\) and several subscales.

**Refine the Craft subscale.** For this survey, the Refine the Craft subscale was created and added to the existing five LPI subscales from Kouzes and Posner (1997, 2002). Refine the Craft intends to measure a teacher’s commitment to furthering their professional practice through additional and ongoing learning opportunities. In assessing the new subscale’s correlations with other subscales, Refine the Craft had the third highest correlation with the T-LPI score at .781, with Challenge the Process and Inspire a Shared Vision next \((r = .824\) and \(.819,\) respectively), followed by the remaining LPI subscales at .719 (Encourage the Heart), .701 (Model the Way), and .645 (Enable Others to Act). Refine the Craft subscale also had the highest correlation with the Reflection variable, a moderate correlation at .486 and significant to the \(p < .001\) level.
Table 38

Research Question #1: Correlation Matrix of Overall Technology Integration, Leadership Practices, and Other Technology-Related Variables

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall Tech Integration</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Modified Stage of Technology Adoption (mSTA) - Current Self</td>
<td>.478**</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Tech Efficacy</td>
<td>.340**</td>
<td>.610**</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Reflection</td>
<td>.180*</td>
<td>.069</td>
<td>.124*</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>5. T-LPI</td>
<td>.289**</td>
<td>.224**</td>
<td>.340**</td>
<td>.441**</td>
<td>---</td>
</tr>
<tr>
<td>Model the Way</td>
<td>.213**</td>
<td>.168**</td>
<td>.150*</td>
<td>.377**</td>
<td>.701**</td>
</tr>
<tr>
<td>Inspire Shared Vision</td>
<td>.271**</td>
<td>.177**</td>
<td>.131*</td>
<td>.352**</td>
<td>.819**</td>
</tr>
<tr>
<td>Challenge the Process</td>
<td>.362**</td>
<td>.314**</td>
<td>.277**</td>
<td>.378**</td>
<td>.824**</td>
</tr>
<tr>
<td>Enable Others to Act</td>
<td>.113*</td>
<td>.120*</td>
<td>.143*</td>
<td>.171*</td>
<td>.645**</td>
</tr>
<tr>
<td>Encourage the Heart</td>
<td>.136*</td>
<td>.057</td>
<td>.067</td>
<td>.197**</td>
<td>.719**</td>
</tr>
<tr>
<td>Refine the Craft</td>
<td>.176**</td>
<td>.154*</td>
<td>.144*</td>
<td>.486**</td>
<td>.781**</td>
</tr>
</tbody>
</table>

Note: * p = .05, ** p =< .001

Research Question 2: Which of the Six Leadership Practices Subscales Best Predict a Teacher’s Overall Technology Integration?

A forward multiple regression analysis was conducted to find the best predictors of a teacher’s overall technology integration. Results indicate that only the Challenge the Process T-LPI subscale significantly predicts a teacher’s Overall Technology Integration score, accounting for 13.1% of variance in Overall Technology Integration, $F(1, 359) = 54.14, p < .001$.

Regression coefficients are presented in Table 39.

Table 39

Regression Coefficients of Challenge the Process T-LPI Subscale Predicting Overall Technology Integration

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>β</th>
<th>r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-11.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-LPI Challenge the Process</td>
<td>3.50</td>
<td>.362</td>
<td>.362</td>
<td>.362</td>
</tr>
</tbody>
</table>
Research Question 3: Do Technology Integration and Leadership Practices Differ by Teachers’ Demographic or Background Variables?

Group differences in Overall Technology Integration and T-LPI were assessed by various demographic or background variables, including: gender, Masters in Educational Technology, Technology Efficacy, Social Trait, Professional Development, Reflection, Modified Stage of Technology Adoption (mSTA), teaching experience, Computers in the Classroom, and Total Computing Hours. Results are presented by independent variables.

Gender differences. Based on a t-test of independent samples analysis (see Table 40), females score significantly higher on Teacher Leadership Practices (T-LPI), with a mean score of 87.73 and males reporting a mean of 84.28 ($p = .003$). For Overall Technology Integration, there was no significant difference ($p = .396$) between females ($M = 35.80$) and males ($M = 38.20$), even though males scored higher, on average.

Table 40
Independent Samples t-Test Results for Gender Differences in Overall Technology Integration and Leadership Practices (T-LPI)

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th></th>
<th></th>
<th>Males</th>
<th></th>
<th></th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Tech Integration</td>
<td>279</td>
<td>35.80</td>
<td>22.00</td>
<td>80</td>
<td>38.20</td>
<td>23.47</td>
<td>-0.850</td>
<td>.396</td>
</tr>
<tr>
<td>T-LPI</td>
<td>279</td>
<td>87.73</td>
<td>8.42</td>
<td>80</td>
<td>84.28</td>
<td>11.27</td>
<td>2.989</td>
<td>.003</td>
</tr>
</tbody>
</table>

Masters degree in educational technology. A t-test of independent samples was conducted and showed that teachers’ with a Masters degree in Educational Technology (Ed-Tech) had an Overall Technology Integration score significantly higher ($M = 43.58$) than those without the Ed-Tech Masters ($M = 32.43; p = .029$), see Table 41. But regarding Teacher
Leadership Practices (T-LPI), there was no significant difference. On average, teachers with an Ed-Tech Masters degree ($M = 85.85$) scored slightly lower in Leadership Practices than teachers without an Ed-Tech Masters ($M = 87.11$).

Table 41

*Masters Degree in Educational Technology Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>Yes</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Tech Integration</td>
<td>321  32.43</td>
<td>40 43.58</td>
<td>-2.193</td>
<td>.029</td>
</tr>
<tr>
<td>T-LPI</td>
<td>321 87.11</td>
<td>40 85.85</td>
<td>0.815</td>
<td>.415</td>
</tr>
</tbody>
</table>

**Technology efficacy.** The variable of Technology Efficacy, originally one item with a scale from 0-8, was categorized into Low (0-4), Moderate (5-6), and High (7-8) to assess group differences. The groups were generated by first examining measures of central tendency, and the histogram. The distribution was divided into three groups fairly equal in size.

A one-way ANOVA was conducted with a Bonferroni post hoc analysis. Both Overall Technology Integration and Teacher Leadership Practices showed significantly different scores based on the teacher’s level of Technology Efficacy (see Table 42). For Overall Technology Integration, all three groups were significantly different from each other, $F (2, 357) = 20.10, p < .001$. In regards to teachers’ Teacher Leadership Practices scores, the Low Efficacy ($M = 84.30$) and High Efficacy ($M = 89.12$) groups showed significant differences $F (2, 357) = 7.48, p < .001$. 
Table 42

Technology Efficacy Group Differences in Overall Technology Integration and Total Leadership Practices

<table>
<thead>
<tr>
<th>Technology Efficacy Group</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
</tr>
<tr>
<td>Low Efficacy</td>
<td>96</td>
<td>26.23</td>
</tr>
<tr>
<td>Moderate Efficacy</td>
<td>147</td>
<td>36.14</td>
</tr>
<tr>
<td>High Efficacy</td>
<td>117</td>
<td>44.74</td>
</tr>
</tbody>
</table>

Social trait (level of extroversion). The one item for teachers’ Social Trait, or level of extroversion, was also represented originally on a nine-point scale of 0-8. Based on the item classifications of Introvert, Blended, and Extrovert, responses were grouped into Introvert (0-3), Blended (4), and Extrovert (5-8), representing approximately 12%, 34%, and 54% of the total participants, respectively. Again, an ANOVA test was conducted with a Bonferroni post hoc analysis. Table 43 presents the group means for the dependent variables. Results indicate that even though Extroverts scored higher on Overall Technology Integration, no significant differences existed between the three Social Trait groups. Regarding Teacher Leadership Practices, the Extrovert group ($M = 88.24$) scored significantly higher than the Introvert group ($M = 84.98$), $F(2, 356) = 3.57, p = .020$.

Table 43

Social Trait Group Differences in Overall Technology Integration and Total Leadership Practices

<table>
<thead>
<tr>
<th>Social Trait Group</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
</tr>
<tr>
<td>Introvert</td>
<td>43</td>
<td>34.91</td>
</tr>
<tr>
<td>Blended</td>
<td>122</td>
<td>33.89</td>
</tr>
<tr>
<td>Extrovert</td>
<td>194</td>
<td>38.01</td>
</tr>
</tbody>
</table>
Professional development. Another teacher background trait that was examined for group differences was the level of voluntary professional development (PD) or learning. Table 44 lists the categories, classified as Low PD (0-Never, 1-Rarely), Moderate PD (2-Sometimes), and High PD (3-Often, 4-Frequently), which were determined based on distributions, with “never” and “frequently” being smaller sample sizes. An Analysis of Variance was conducted, followed by the Bonferroni post hoc. Significant differences were found between the High ($M = 43.53$) and Low PD ($M = 32.50$) groups for Overall Technology Integration, $F(2, 357) = 5.01, p = .007$, and between all groups for Teacher Leadership Practices Inventory (T-LPI), $F(2, 357) = 17.97, p < .001$, High PD ($M = 91.87$), Moderate PD ($M = 87.54$), and Low PD ($M = 83.69$). Results indicate that teachers who attend more voluntary professional development activities have higher levels of technology integration and leadership practices.

Table 44

**Professional Development Group Differences in Overall Technology Integration and Total Leadership Practices**

<table>
<thead>
<tr>
<th></th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>Low PD</td>
<td>120</td>
<td>32.50</td>
</tr>
<tr>
<td>Moderate PD</td>
<td>180</td>
<td>36.45</td>
</tr>
<tr>
<td>High PD</td>
<td>60</td>
<td>43.53</td>
</tr>
</tbody>
</table>

Reflection. A third teacher background or professional trait that was examined for group differences was the their level of reflection about their teaching. Table 45 lists the group categories, which were grouped based upon their distributions from 0 or “Never Reflective” to 4 “Sometimes Reflective” to 8 or “Always Reflective”. The groups were created from the item response of 1-8, no participants chose 0 or “Never Reflective”—Low Reflection (1-4), Moderate Reflection (5 – 6), and High Reflection (7-8). Once again, an Analysis of Variance was
conducted, followed by the Bonferroni post hoc and significant differences were found between
the High \( (M = 40.73) \) and the Moderate \( (M = 34.22) \) and Low Reflection \( (M = 29.03) \) groups for
Overall Technology Integration, \( F(2, 357) = 6.00, p = .003 \), and between all groups for Teacher
Leadership Practices Inventory (T-LPI), \( F(2, 357) = 45.19, p < .001 \). These results suggest that
teachers who are more reflective in their professional teaching practice have higher levels of
technology integration and leadership practices.

Table 45

*Teacher Reflection Group Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th>Group</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
</tr>
<tr>
<td>Low Reflection (1-4)</td>
<td>40</td>
<td>29.03</td>
</tr>
<tr>
<td>Moderate Reflection (5-6)</td>
<td>168</td>
<td>34.22</td>
</tr>
<tr>
<td>High Reflection (7-8)</td>
<td>150</td>
<td>40.73</td>
</tr>
</tbody>
</table>

*Modified Stage of Technology Adoption (mSTA).* Teacher’s Modified Stage of
Technology Adoption (mSTA) was measured with a single survey item for Current Self, Self 3
Years Ago, and Colleague Average (see Tables 32 and 33). Based on measures of central
tendency \( (M = 5.55; \text{mode} = 6) \) and distribution, Table 46 lists the seven levels that were
categorized into three groups in order to examine group differences—Low mSTA (1-4),
Moderate mSTA (5-6) and High mSTA (7). After examining group differences through Analysis
of Variance, in the case of teachers’ Overall Technology Integration scores, all three groups had
significantly different scores, \( F(2, 354) = 41.40, p < .001 \), as teachers with higher mSTA levels
also showed higher Overall Technology Integration. In addition, the Teacher Leadership
Practices (T-LPI) score showed significant differences among the High mSTA \( (M = 89.80) \) and
Low mSTA \( (M = 83.97) \) groups, \( F(2, 354) = 7.27, p = .001 \).
Table 46

*Modified Stage of Technology Adoption (mSTA) Group Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th></th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
</tr>
<tr>
<td>Low mSTA (1-4)</td>
<td>59</td>
<td>20.83</td>
</tr>
<tr>
<td>Moderate mSTA (5-6)</td>
<td>216</td>
<td>34.64</td>
</tr>
<tr>
<td>High mSTA (7)</td>
<td>82</td>
<td>51.55</td>
</tr>
</tbody>
</table>

**Teaching experience.** Although the average scores for Overall Technology Integration and Teacher Leadership Practices vary with teaching experience, neither factor showed significant differences with regard to the age groups listed, 1-4, 5-14, 15-24, and 25+ years (see Table 47). The youngest group of teachers (1-4 years) had the highest mean score for the T-LPI at 90.11, with the lowest standard deviation at 7.57 (\( n = 27 \)) and the next highest score was from the most experienced teachers (25+ years) at 86.68, with the highest standard deviation of 10.03 (\( n = 88 \)).

Table 47

*Teaching Experience Group Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th>Years</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
</tr>
<tr>
<td>1-4</td>
<td>27</td>
<td>35.33</td>
</tr>
<tr>
<td>5-14</td>
<td>144</td>
<td>38.19</td>
</tr>
<tr>
<td>15-24</td>
<td>100</td>
<td>34.18</td>
</tr>
<tr>
<td>25+</td>
<td>88</td>
<td>36.52</td>
</tr>
</tbody>
</table>

**Computers in the classroom.** Teachers reported the number of computers in their classrooms, choosing from six selections ranging from none to 12 or more computers (see Table
Their scores in both Overall Technology Integration, $F(5, 351) = 9.83, p < .001$, and Teacher Leadership Practices, $F(5, 351) = 2.79, p = .017$, showed significant differences. Post hoc results (Bonferroni) indicated significant difference in Overall Technology Integration in that teachers with only one “teacher computer” ($M = 29.72$) reported significantly lower Overall Technology Integration than those with 2-3 computers ($M = 39.64$), 7-11 computers ($M = 47.35$), and 12 or more computers ($M = 59.78$). Teachers with 12 or more computers also reported significantly higher Overall Technology Integration than those teachers with 2-3 ($M = 39.64$) and 4-6 computers ($M = 36.02$). With regard to the differences found in the Teacher Leadership Practices (T-LPI) scores, the only significant difference identified in the post hoc analysis, $F(5, 351) = 2.79, p = .017$, was between teachers with one computer ($M = 84.83$) and those with 4-6 computers ($M = 88.45$). In each case of significantly different scores, the teachers with more computers in their classrooms had higher Overall Technology Integration and Teacher Leadership Practices scores.

Table 48

Computers in the Classroom Group Differences in Overall Technology Integration and Leadership Practices

<table>
<thead>
<tr>
<th># Computers</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>43.67</td>
</tr>
<tr>
<td>1</td>
<td>139</td>
<td>29.72</td>
</tr>
<tr>
<td>2-3</td>
<td>66</td>
<td>39.64</td>
</tr>
<tr>
<td>4-6</td>
<td>109</td>
<td>36.02</td>
</tr>
<tr>
<td>7-11</td>
<td>17</td>
<td>47.35</td>
</tr>
<tr>
<td>12+ (or lab)</td>
<td>23</td>
<td>59.78</td>
</tr>
<tr>
<td>All</td>
<td>357</td>
<td>36.37</td>
</tr>
</tbody>
</table>

**Total computing hours.** As discussed in the descriptive statistics section (Computer Use), teachers were asked to estimate how many hours per week they use a computer for
Management and Instructions-related tasks. These two items were combined, reviewed for central tendencies and distributions, and reassigned to new categories to create the Total Computing Hours variable—consisting of Low (originally responses 2-4 or approximately up to 10 hours per week), Average (5, 6 or 11-20 hours), Above Average (7, 8 or 21-30 hours), and High (9,10 or 31 or more hours per week).

These new groups were examined for differences in teachers’ Overall Technology Integration and Teacher Leadership Practices using Analysis of Variance with post hoc analysis (see Table 49). The Overall Technology Integration scores showed significant differences, $F (3, 357) = 10.97, p < .001$. The Low group, spending approximately 10 or less hours a week on job-related teaching tasks, scored significantly lower than all other groups ($M = 27.50$) and the Average group, who spends approximately 11-20 hours per week on job-related computer tasks, also scored significantly lower on Overall Technology Integration ($M = 36.37$) than the High group ($M = 46.69$), who spend over 31 hours per week on job-related computer tasks. In terms of Teacher Leadership Practices, with a mean score of 83.45, the Low group scored significantly lower than all other groups on the T-LPI, $F (3, 357) = 9.21, p < .001$. Results indicate that teachers who use computers less than 10 hours a week for job-related tasks have lower levels of Overall Technology Integration and Leadership Practices.

Table 49

Total Computing Hours Per Week Group Differences in Overall Technology Integration and Total Leadership Practices

<table>
<thead>
<tr>
<th>Group (Approx. Hours)</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>Low (up to 10)</td>
<td>102</td>
<td>27.50</td>
</tr>
<tr>
<td>Average (11-20)</td>
<td>136</td>
<td>36.37</td>
</tr>
<tr>
<td>Above Average (21-30)</td>
<td>81</td>
<td>42.01</td>
</tr>
<tr>
<td>High (31+)</td>
<td>42</td>
<td>46.69</td>
</tr>
</tbody>
</table>
**Total leadership positions.** Teachers identified up to five positions of leadership they have held, creating a Total Leadership Positions score between 0 and 5. These groups were examined for differences using the Analysis of Variance, where significant differences were identified for both the Overall Technology Integration and Teacher Leadership Practices scores (Table 50). For Technology Integration, $F(5, 355) = 2.57, p = .027$, those teachers who had not identified any leadership positions (None) had a mean score of 30.44, while those who held three positions had a mean of 42.55, which showed group differences in a Bonferroni post hoc test. Teacher Leadership Practices also showed significant differences, $T$-LPI, $F(5, 355) = 2.41, p = .036$, but no specific groups were identified in the Bonferroni test. Teachers who held only one leadership position had the lowest mean score ($M = 85.47$), while those with four or five positions to their credit had mean T-LPI scores of 90.31 and 91.90, respectively.

Table 50

*Teachers’ Total Leadership Positions Group Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th>Positions Held</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>None</td>
<td>52</td>
<td>30.44</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
<td>33.56</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>36.29</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>42.55</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>39.06</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>45.10</td>
</tr>
</tbody>
</table>

**College/university teaching.** Teachers were asked about their experience or desire to teach at the college or university level. Based on measures of central tendency and distributions, the seven original responses were combined into four groups to conduct an ANOVA test on group differences. For the Overall Technology Integration scores, Table 51 shows the significant
differences were identified with a post hoc test between those teachers who have not taught college (None) or will Not Again ($M = 31.72$) and those who Hope To ($M = 38.88$) and those who Sometimes teach college ($M = 46.68$), $F (3, 357) = 6.25, p < .001$. Teacher Leadership Practices also showed significant differences, $F (3, 357) = 4.18, p < .010$, with mean scores gradually increasing from the None/Not Again group ($M = 85.29$) to Sometimes ($M = 89.40$) and even Often ($M = 92.29$), which had limited responses at only seven.

Table 51

*College/University Teaching Group Differences in Overall Technology Integration and Total Leadership Practices*

<table>
<thead>
<tr>
<th>College Teaching Experience</th>
<th>Overall Tech Integration</th>
<th>T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
</tr>
<tr>
<td>None/Not Again</td>
<td>165</td>
<td>31.72</td>
</tr>
<tr>
<td>Hope To</td>
<td>149</td>
<td>38.88</td>
</tr>
<tr>
<td>Sometimes</td>
<td>40</td>
<td>46.68</td>
</tr>
<tr>
<td>Often</td>
<td>7</td>
<td>31.57</td>
</tr>
</tbody>
</table>

**Research Question 4: Which Factors Best Predict Teachers’ Technology Integration? (Overall Technology Integration)?**

In order to determine which factors best predict a teacher’s overall technology integration, a forward multiple regression analysis was performed on several technology-related survey items, demographics, and background variables. The variables included in the analysis were the T-LPI subscales, Modified Stage of Technology Adoption (mSTA), Professional Development, Computer Work at Home, Technology Efficacy, Reflection, Social Trait, Gender, Age Range, Education Level, and Teaching Experience. Two analyses were conducted. The first analysis utilized the T-LPI score with all remaining variable to predict Overall Technology Integration. The second analysis included the T-LPI subscales with the remaining variables.
The first regression analysis generated a two variable model that combine the T-LPI score with the Modified Stage of Technology Adoption (mSTA) score to significantly predict Overall Technology Integration. This model accounts for 27.6% of variance in Overall Technology Integration, \( F(2, 346) = 65.91, p < .001 \), which is shown in Table 52. The second regression analysis, which include the T-LPI subscales, revealed a two factor model significantly predicting Overall Technology Integration—the Modified Stage of Technology Adoption (mSTA) and Challenge the Process (T-LPI subscale) and account for 29.0% of variance in Overall Technology Integration, \( F(2, 346) = 70.82, p < .001 \). Regression coefficients for this model are presented in Table 53. In both models, teachers’ Modified Stage of Technology Adoption (mSTA) score had the highest standardized regression coefficients.

Table 52

*Factors Predicting Teacher’s Overall Technology Integration (Modified Stage of Technology Adoption and Total T-LPI)*

<table>
<thead>
<tr>
<th></th>
<th>( B )</th>
<th>( \beta )</th>
<th>( r )</th>
<th>Partial ( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-51.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Self mSTA</td>
<td>8.54</td>
<td>.447</td>
<td>.491</td>
<td>.455</td>
</tr>
<tr>
<td>T-LPI</td>
<td>0.46</td>
<td>.191</td>
<td>.295</td>
<td>.214</td>
</tr>
</tbody>
</table>

Table 53

*Factors Predicting Teacher’s Overall Technology Integration (Modified Stage of Technology Adoption and T-LPI Subscales)*

<table>
<thead>
<tr>
<th></th>
<th>( B )</th>
<th>( \beta )</th>
<th>( r )</th>
<th>Partial ( r )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-38.69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Self mSTA</td>
<td>7.93</td>
<td>.414</td>
<td>.491</td>
<td>.422</td>
</tr>
<tr>
<td>T-LPI: Challenge the Process</td>
<td>2.27</td>
<td>.235</td>
<td>.370</td>
<td>.255</td>
</tr>
</tbody>
</table>
Research Question 5: Which Factors Best Predict Teacher Leadership Practices (T-LPI)?

Similar to the previous research question, the same variables were used to determine which factors best predict teacher leadership practices (T-LPI)—Overall Technology Integration, modified Stage of Technology Adoption (mSTA), Technology Efficacy, Reflection, Professional Development, Computer Work at Home, Social Trait, Gender, Age Range, Education Level, and Teaching Experience. A multiple regression analysis was conducted (see Table 54) and generated a six factor model (Reflection, Professional Development, Overall Technology Integration, Social Trait, Gender, and Technology Efficacy) to significantly predict Teacher Leadership Practices (T-LPI) and account for 34.8% of variance in Teacher Leadership Practices, $F(6, 342) = 30.39, p < .001$, with Reflection having the strongest unique correlation (Partial $r = .409$).

Table 54

Factors Predicting Teacher Leadership Practices (T-LPI)

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
<th>$\beta$</th>
<th>$r$</th>
<th>Partial $r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>296.26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflection</td>
<td>2.76</td>
<td>.372</td>
<td>.454</td>
<td>.409</td>
</tr>
<tr>
<td>Professional Development</td>
<td>2.31</td>
<td>.217</td>
<td>.309</td>
<td>.253</td>
</tr>
<tr>
<td>Overall Technology Integration</td>
<td>0.06</td>
<td>.152</td>
<td>.295</td>
<td>.170</td>
</tr>
<tr>
<td>Social Trait</td>
<td>0.88</td>
<td>.150</td>
<td>.198</td>
<td>.181</td>
</tr>
<tr>
<td>Gender</td>
<td>-2.32</td>
<td>-.105</td>
<td>-.155</td>
<td>-.127</td>
</tr>
<tr>
<td>Technology Efficacy</td>
<td>0.59</td>
<td>.099</td>
<td>.214</td>
<td>.114</td>
</tr>
</tbody>
</table>

Summary of Results

Multiple factors were examined in this study of relationships between teachers’ technology integration and leadership practices. Demographics, backgrounds, school environment, leadership and technology-related factors were all taken into consideration for this study of 361 teachers from suburban school districts in Northwest Ohio in December of 2011.
Table 55 shows the inferential analysis results from this study based on the five research questions.

A Pearson correlation was conducted and determined that Overall Technology Integration significantly relates to T-LPI (Leadership Practices), $r = .289$. One T-LPI subscale, Challenge the Process, also significantly relates to T-LPI (Leadership Practices), $r = .362$. Other technology or leadership variables that also showed low to moderate correlation with Overall Technology Integration were Modified Stage of Technology Adoption (mSTA) ($r = .478$) and Tech Efficacy ($r = .340$). For leadership practices (T-LPI), three variables were identified: Reflection ($r = .441$), Tech Efficacy ($r = .340$), and Modified Stage of Technology Adoption (mSTA) ($r = .224$), with $p < .001$.

Of the six subscales for the Teacher Leadership Practices Inventory (T-LPI), a forward multiple regression found that the best predictor of the Overall Technology Integration score was Challenge the Process, which accounted for 13.1% of the variance in scores.

In order to determine which variables exhibited group differences, Analysis of Variance (ANOVA) was used along with the Bonferroni post hoc tests. For Overall Technology Integration, there were eight factors that showed significant differences among the groups, all with a positive relationship for higher Overall Technology Integration scores: Masters Degree in Educational Technology, Technology Efficacy, Professional Development, modified Stage of Technology Adoption (mSTA), Computers in the Classroom, Total Computing Hours Per Week, Total Leadership Positions, and College Teaching Experience.

For teacher leadership practices, nine variables were found to have significant differences among the identified groups: Gender (Females), Technology Efficacy, Social Trait (Extroverts), Professional Development, Modified Stage of Technology Adoption (mSTA), Computers in the
Classroom, Total Computing Hours Per Week, Total Leadership Positions, and College Teaching Experience. All of these groups showed a positive significant difference.

Only one variable showed no significant difference for either Overall Technology Integration or Teacher Leadership Practices—Teaching Experience. Upon further examination, a significant negative relationship was found between Teaching Experience and Technology Efficacy, $F(4, 358) = 5.67, p = .000$, demonstrating that newer teachers have higher Technology Efficacy than more experienced teachers, even though that did not show any significance in the Overall Technology Integration scores.

From the variables included in the survey, a forward multiple regression revealed three variables combined to create two models for predicting teachers’ Overall Technology Integration: Modified Stage of Technology Adoption (mSTA), T-LPI, and Challenge the Process (T-LPI subscale). Accounting for 29.0% of variance were teachers’ chosen Modified Stage of Technology Adoption (mSTA) score and their Challenge the Process subscale score, while the T-LPI score and Modified Stage of Technology Adoption (mSTA) accounted for 27.6% of the variance. Modified Stage of Technology Adoption (mSTA) is a measure of one’s skills and knowledge related to technology, but the T-LPI and subscale scores do not address technology directly, only leadership practices and behaviors.

In addition to finding factors to predict Overall Technology Integration, also examined were factors or variables that best predict teacher leadership practices (T-LPI). In this case, six factors combined to create a model that significantly predicts T-LPI, accounting for 34.8% of variance: Reflection, Professional Development, Overall Technology Integration, Social Trait (Extrovert), Gender (Female), and Technology Efficacy.
Table 55

Summary of Inferential Results by Research Question

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Results</th>
</tr>
</thead>
</table>
| 1. Does technology factors significantly relate to Level of Reflection, and Leadership Practices among K-12 Teachers? | • Overall Technology Integration had a .289 correlation with T-LPI (significant to $p < .001$)  
• T-LPI subscale Challenge the Process had a .362 correlation with teachers’ Overall Technology Integration  
• Other factors correlated with Overall Technology Integration at $p \leq .001$ level were:  
  a. Modified Stage of Technology Adoption (mSTA) (.478)  
  b. Tech Efficacy (.340)  
• Correlated with T-LPI at $p < .001$ level were:  
  a. Reflection (.441)  
  b. Tech Efficacy (.340)  
  c. Modified Stage of Technology Adoption (mSTA) (.224) |
| 2. Which of the six (6) Leadership Practices subscales best predicts teachers’ Overall Technology Integration? | • Challenge the Process T-LPI subscale accounted for 13.1% of variance, $F(1, 359) = 54.14$, $p < .001$ |
| 3. Does Overall Technology Integration or Leadership Practices differ by demographic or background variables? | Overall Technology Integration:  
• Masters Degree in Educational Technology  
• Technology Efficacy (Higher TE = Higher OTI)  
• Professional Development (More PD = Higher OTI)  
• Reflection (More = Higher)  
• Modified Stage of Technology Adoption (mSTA) -Current Self (Higher STA = Higher OTI)  
• Computers in the Classroom (More Computers = Higher OTI)  
• Total Computing Hours Per Week (More Hours = Higher OTI)  
• Total Leadership Positions (Generally more = Higher OTI)  
• College Teaching Experience (Generally more = Higher OTI; exception for Often, but low n)  
T-LPI:  
• Gender (Females = Higher T-LPI)  
• Technology Efficacy (Higher TE = Higher T-LPI)  
• Social Trait (Extroverts = Higher T-LPI)  
• Professional Development (More PD = Higher T-LPI)  
• Reflection (More = Higher)  
• Modified Stage of Technology Adoption (mSTA)-Current Self (Higher = Higher T-LPI)  
• Computers in the Classroom (More = Higher T-LPI)  
• Total Computing Hours Per Week (More = Higher T-LPI)  
• Total Leadership Positions (Generally More = Higher T-LPI)  
• College Teaching Experience (More = Higher T-LPI) |
| **4. Which factors best predict Overall Technology Integration?** | Neither (No Significant Differences for Overall Technology Integration or T-LPI)  
• Teaching Experience  
• Modified Stage of Technology Adoption (mSTA)-Current Self and Challenge the Process (T-LPI subscale) account for 29.0% of variance, $F(2, 346) = 70.82, p < .001$  
• Modified Stage of Technology Adoption (mSTA)-Current Self and T-LPI account for 27.6% of variance, $F(2, 346) = 65.91, p < .001$ |
| **5. Which factors best predict a teacher’s Leadership Practices (T-LPI)?** | Six factors (Reflection, Professional Development, Overall Technology Integration, Social Trait, Gender, and Technology Efficacy) create a model to significantly predict Teacher Leadership Practices (T-LPI) and account for 34.8% of variance, $F(6, 342) = 30.39, p < .001$. |
CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this correlational study was to investigate the relationship between teachers’ technology integration and leadership practices. It’s important to reiterate that correlation does not mean nor imply causation. But it does bring to light more questions that need to be addressed and answered regarding the importance, need, and evaluation of technology integration and leadership within educational contexts. This final chapter will review the study, discuss significant statistical findings and their implications, and provide recommendations for future research and practice.

Review of the Study

In mid-December 2011, 361 teachers from six suburban school districts in Northwest Ohio near Toledo completed the 21st Century Technology Integration and Teacher Leadership (21-TITL) online survey. Descriptive and inferential data analyses were conducted to determine group differences, relationships, and predictors for teachers’ technology integration and leadership practices, as well as other demographic and background or experiential criteria. In all, five research questions were examined:

1. Do technology integration factors significantly relate to Leadership Practices and Level of Reflection?
2. Which of the six (6) leadership practices subscales best predict a teacher’s overall technology integration?
3. Does technology integration or leadership practices differ by demographic or background variables?
4. Which factors best predict a teacher’s technology integration (Overall Technology Integration)?
5. Which factors best *predict* a teacher’s leadership practices (Total T-LPI)?

**Discussion of Significant Research Findings and Implications**

The research findings and a discussion of the implications are presented in this section. An overview of the descriptive results is presented first, followed by each of the five research questions investigated in this study.

**Descriptive Results For Demographics, Technology Integration, and Teacher Leadership**

In December of 2011, 361 teacher participants from six suburban Northwest Ohio school districts completed the 56-item online 21-TITL survey. On average, participating teachers:

- have about 15 years of experience and are in their 40s;
- are primarily female (over 77%, which is close to the national distribution);
- are well-educated (over 75% with at least a master’s degree);
- “sometimes” attended voluntary professional development (over 65% going at least three times per year);
- consider themselves very reflective about their teaching (about 75% thinking often about their teaching and how to improve it);
- (almost all, 99.4%) have either a school-provided desktop or laptop computer or use their personal computer for teaching duties;
- have held at least two leadership positions in their building (over 50%); and
- would like to also teach at the college/university level or have done so already (about 50%).

**Technology use and integration.** In terms of the Technology Integration survey (Overall Technology Integration Scale or OTIS), it showed that teachers are not using digital technology tools very often nor using them in student-centered ways. Out of a possible 200 points, the
average Overall Technology Integration score was 36, which is similar to Moersch’s LoTi findings early on where most teachers were at level 2 out of 7 levels (Stoltzfus, 1999). So, there is a long way to go regarding access and training to help teachers and students use these technologies more effectively for teaching and learning (Vannatta & Fordham, 2004). In other words, teachers may be using various technologies, but not in high-level ways that lead to long-term, deep, meaningful learning required of 21st century citizens (Chen, 2010; Warlick, 2004; Zhao, 2009). In addition to teacher technology integration being primarily for lower levels of learning, Hastings (2009) also found that student uses of technology were generally lower level uses.

The technology tool data also indicated that there is little use of the “creation” tools beyond writing papers or creating a PowerPoint presentation and little use of visual tools such as using video or images. Instead, more traditional tools or productivity tools such as word processing, presentation slides, or Internet browsing and research were the most commonly used, perhaps due to their ubiquity in education settings from the mid to late 1990s. Newer tools such as Web 2.0, video production, and spreadsheets offer more creative and visual outlets and often require higher levels of thinking (e.g., synthesis, evaluation, and analysis) in addition to other 21st century skills like communication, digital citizenship, and media literacy (Moersch, 2010; Richardson, 2006; Solomon & Schrumm, 2010; Warlick, 2010).

Comparing LoTi to overall technology integration scores. Since 1995, the LoTi assessment (Moersch, 1995, 1998, 2010) has been used with thousands of teachers to determine their Level of Technology Implementation (or Teaching Innovation). Surprisingly, in over 15 years, teachers’ overall average LoTi score or level has not changed much. Denee Saunders, Assistant Executive Director for LoTi, stated that the national mean level for teachers has not
changed much in 10 years—what she described as “from a low 2 to a high 2”, or the Exploration level (of eight levels: 0, 1, 2, 3, 4a, 4b, 5, 6) (Saunders, 2012). Although there were more teachers in this national sample at levels 3 and higher than in years past, in all, the average still falls in the level 2 range. Unfortunately, Saunders pointed out that there were not many LoTi scores from Ohio in the national sample, so an Ohio LoTi average was not possible to obtain. Nonetheless, these low national average LoTi scores correspond with the low Overall Technology Integration scores in this study. Again, the average was about 36 out of 200 possible points, signifying low-level uses of technology and/or little use of technology for teaching and learning. Hastings (2009) found similar low technology integration scores among a similar group of teachers from Northwest Ohio, who used mostly for their own teacher uses rather than integrating it into student learning activities. These low integration scores ultimately show that teachers are not using technology for higher levels of learning or HOTS (higher order thinking skills). Instead, teachers (and students when they are able to use technology tools) are using technology for memorization, review, digitizing (e.g., typing a paper), and comprehension. As Hastings (2009) points out, “higher levels of technology integration tend to require additional effort from teachers in planning and effective implementation” (p. 126).

The low use of technology for student-centered learning and the lack of much change in national LoTi levels seems to (still) be more of a lack of effective teaching—where teachers do not often use “real-world connections” and “higher level questions,” Saunders (2012) explained. The driving question caused by this lack of significant change in the LoTi score over the past 10 years and the great increase of available technologies is “Why are we not seeing more change?” This concern is the main focus of Moersch’s research and training (Saunders, 2012) and could also be an area of further study across the nation.
Modified Stage of Technology Adoption (mSTA) scores as an “integration leader-finder.” Due to the fact that the modified Stage of Technology Adoption (mSTA) is a measure of technological experience and competence (Christensen & Knezek, 1999; Russell, 1995), it is no surprise that the high mSTA group (7 on the scale) had a significantly higher Overall Technology Integration score than did the Moderate or Low mSTA groups. However, this finding does lend more credibility to the Overall Technology Integration Scale (OTIS) as a measure that correlates with a one-item mSTA identifier, as was used for this survey.

Furthermore, in this study, over 56% of teachers’ view themselves as either stage six (Creative Applications to New Contexts) or seven (Assisting Others), demonstrating that schools now have a large group of teacher-technology experts (leaders) who can be called upon for training their peers, troubleshooting technological problems, or assigning with long-term technology integration planning—or at least they see themselves as this. Either way, building and district leaders should utilize these teachers as either technology integration coaches or teacher leaders in some capacity (ISTE, 2011b; Kopcha, 2010).

Teacher leadership practices. Based on Kouzes and Posners’ (1997) Leadership Practices Inventory (LPI), the Teacher Leadership Practices Inventory (T-LPI) measures the original five leadership practices (Model the Way, Inspire Shared Vision, Challenge the Process, Enable Others to Act, and Encourage the Heart), plus one additional practice or subscale called Refine the Craft, which measures their reflection and professional learning practice. The average scores for each subscale ranged from 13.70 (Challenge the Process) to 15.27 (Enable Others to Act) out of a possible 18. Teachers also scored high on the Model the Way subscale, which along with Enable Others to Act, can be considered “traditional” teacher behaviors or practices,
including: set personal example, follow through, develop cooperative relationships, and listen to diverse points of view.

**Research Finding 1: Relationships Between Teachers’ Technology Integration, Leadership Practices, and Level of Reflection**

In comparing key technology-related factors—Overall Technology Integration, Modified Stage of Technology Adoption (mSTA), and Technology Efficacy—with teachers’ leadership practices (Total T-LPI) and level of reflection, there were several weak to moderate correlations. First, the two main survey sections, Overall Technology Integration and Total T-LPI showed weak correlation to each other ($r = .289$), but the Challenge the Process (T-LPI subscale) had a moderate correlation ($r = .362$) with teachers’ Overall Technology Integration. Both of these correlations were limited in strength, suggesting the Overall Technology Integration Scale (OTIS) and Teacher Leadership Practices Inventory (T-LPI) are not strongly related to each other.

However, the Pearson correlation analysis determined other technology-related factors showed slightly higher levels of correlation to both dependent variables. Technology Efficacy ($r = .340$) and Stage of Technology Adoption ($r = .478$) showed moderate correlation with the Overall Technology Integration score, which demonstrates a connection between a teacher’s confidence in their abilities (efficacy) as well as their current level of technological ability (Modified Stage of Technology Adoption). These findings are important for school districts and their leadership because with targeted professional development, teachers can progress at least one stage higher in their integration abilities (Christensen, 2002). Likewise, this study’s Technology Efficacy score is comparable to one’s comfort and confidence in their ability to use technology, similar to “comfort and interest”, which Challoo, Green, and Maxwell (2011) found...
to positively affect a teachers’ Stage of Adoption for Technology in Education value (comparable to the mSTA for this study). The more comfortable and interested in technology a teacher is, the more likely they are to be using it in the classroom for student learning and achievement.

Regarding teacher leadership practices, which is measured by the T-LPI, the strongest correlation was with the teacher’s Level of Reflection ($r = .441$), followed by weaker associations with Technology Efficacy ($r = .340$) and the Modified Stage of Technology Adoption (mSTA) ($r = .224$). One subscale on the T-LPI, Model the Way, included an item that is reflective in nature (I ask for feedback…), but all other T-LPI scale items were less direct toward direct reflection on one’s actions. The strongest correlation with reflective practice is not too surprising, since a common aspect of leadership is reflection about one’s own actions as well as others and how they affect the overall vision (Day, 2000; Kouzes & Posner, 2002).

In all, there were no strong correlations between these factors with either the Overall Technology Integration Scale (OTIS) or the Teacher Leadership Practices Inventory (T-LPI). Since both instruments are new, additional studies would need to be conducted with additional populations to verify or counter these results. Moreover, as teachers use technology more in their classrooms and engage in higher levels of learning through these available technologies and pedagogical strategies (Becker, 2000a; Brooks-Young, 2010; Richardson, 2006; Solomon & Schrum, 2010; Trilling & Fadel, 2009; Vannatta & Fordham, 2004; Warlick, 2004), the Overall Technology Integration scores will increase, which may also affect the correlation with Teacher Leadership Practices, as other research has identified. However, other studies have shown that teachers who are reflective practitioners have been found to integrate technology more in their
classrooms (Hastings, 2009; Vannatta & Fordham, 2004), thus, more studies are needed in this area.

In past studies, positive relationships have also been found between technology using teachers and their leadership practices, (Dwyer, et al, 1991; Riel & Becker, 2000, 2008; Sandholtz, et al., 1997; Solomon & Schrum, 2010), while several state and national initiative and reports tout the importance of today’s teachers being proficient in technology and leadership (ISTE 2008, 2011b; National Research Council, 2000; Ohio Department of Education, 2009; U.S. Department of Education, 2004, 2010). The key is to intentionally plan and implement technologies in ways that go “beyond substitution” so that more meaningful learning can occur (Pelgrum & Plomp, 2004, p. 57).

**Research Finding 2: Challenge the Process T-LPI Subscale Best Predicts Overall Technology Integration**

The literature on teacher leadership is detailed with examples of teachers extending their role as learning facilitators who also work as leaders to transform schools to meet society’s changing needs (Crowther, et al., 2002; Fullan, 1993a, Katzenmeyer & Moller, 2001). In terms of teacher leadership and technology integration, this research study found that in only one T-LPI subscale, Challenge the Process, best predicted teachers’ Overall Technology Integration score, accounting for 13.1% of the variance. Interestingly, this subscale had the lowest mean of all six subscales, therefore those teachers who reported higher scores in Challenge the Process were more likely than others to: seek out challenging opportunities that test their skills and abilities, challenge other people to try new and innovative ways to do their work (Sandholtz, et al., 1997), and experiment and take risks (Vannatta & Fordham, 2004), even when there is a chance of failure. For administrators, “Recruiting teachers who are willing to take risks, open to
change, dedicated to continuous improvement, intrinsically motivated, lifelong learners will improve the likelihood of successful technology implementation” (Hastings, 2009, p. 137).

Each of those three traits described in Challenge the Process subscale correspond to actions teachers must take to learn how to actively integrate technology into their teaching practices, especially since technology in education is constantly changing and the chance of failure can be high—even right in the middle of a lesson! “Because technology is a dynamic innovation, learning to use it as a personal or instructional tool requires a willingness to make mistakes and learn from them and an ability to take risks” (Vannatta & Fordham, 2004, p. 261). These teachers, Vannatta and Fordham call “open to change,” will also be the ones who choose to make the time to explore, test, practice in order to improve their classroom technology integration practices. Even over a decade ago, at the close of the 20th century, teachers who were integrating technology in their classrooms were already showing “challenger” characteristics. To improve student learning, some were more demanding of resources and support (Becker, 2000; Sandholtz, et al., 1997), while others directly challenged the system (Becker, 2000) or became change agents who transformed school practices (Fullan, 1993a).

The Challenge the Process subscale results may be able to assist teachers and administrators in finding colleagues who like to experiment and take risks, perhaps with a new lesson, or find new ways to challenge themselves to become a better teacher (Becker, 2000; Sandholtz, et al., 1997; Scott & Mouza, 2007; Vannatta & Fordham, 2004). Furthermore, these “Challengers” who are high in “Challenge the Process,” although they may not be a favorite of some administrators, these teachers may be the ones to forge ahead with technology integration initiatives and be leaders among their peers, which can help with other change initiatives (Fullan, 1994; Riel & Becker, 2000).
Research Finding 3: Group Differences in Overall Technology Integration and T-LPI Scores

Several factors were found to have significant differences in the group mean scores for both Overall Technology Integration and Teacher Leadership Practices (T-LPI), suggesting a connection between technology integration leadership practices. Eight factors, technology and leadership-related, showed significantly different scores for these two survey instruments (see Table 56) while three more showed significant differences for only one of the instruments. The type of teacher who scored highest on both Overall Technology Integration and Total T-LPI was a teacher with: high Technology Efficacy and Modified Stage of Technology Adoption (mSTA) scores, participated often in voluntary professional development activities, reflected often on their teaching practice, had more than one computer in her/his classroom, spent over 20 hours per week on a computer working on teacher related tasks, held one or more leadership positions, and has already (or hopes to) teach college students. Each of these factors is discussed in more detail in the following sections.
Table 56

*Significant Group Differences on Background and Experience Factors in Overall Technology Integration and Teacher Leadership Practices*

<table>
<thead>
<tr>
<th>Background/Experience Factor (Positive Relationship or As Listed)</th>
<th>Overall Technology Integration</th>
<th>Total T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Efficacy</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Professional Development</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reflection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Modified Stage of Technology Adoption (mSTA)-Current Self*</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Computers in the Classroom</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Total Computing Hours Per Week</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Total Leadership Positions (Generally more)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>College Teaching Experience (Generally more)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Gender (Females)</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Social Trait (Extroverts)</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Masters Degree in Educational Technology</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Technology efficacy.** Efficacy is a general term that is related to one’s confidence or belief in oneself to do or perform a given task (Bandura, 1986). For this study, teachers’ technology efficacy was measured and compared to their technology integration and leadership practices scores. The finding that teachers’ Technology Efficacy is related to their Overall Technology Integration is not necessarily surprising, but it highlights the importance of assessing and monitoring teachers Technology Efficacy over time, as it shows a connection to both a teacher’s level of technology integration and their leadership practices. For, in order to improve or increase efficacy, Bandura (1997) suggests the need for personal mastery primarily through one’s own experiences or through observing others and vicariously experiencing the outcomes, but also through persuasion and emotional arousal or connection. Each of these opportunities could be available to teachers in their daily practices, such as during professional development or
in-services, co-teaching, or observing a colleague during their teaching. Therefore, technology
efficacy can most likely be improved with directed practice and observing model examples
(Bandura, 1997) in technology integration and leadership, such as of one’s colleagues, mentors,
or master teachers.

One concern regarding teaching experience is the significant differences in Technology
Efficacy between teachers with more experience. Those teachers with 15 or more years
experience were all below average in Technology Efficacy for this population. Teachers with 1-4
years of experience had the highest Technology Efficacy, which is great news if it was developed
and fostered in pre-service training experiences and continues to get stronger with more years of
experience. Unfortunately, their high mark may also be due to a new teacher’s over-confidence
or a lack of awareness of the full spectrum of technology integration in classrooms today.
Because of the small sample size, future research with larger populations of new teachers may
uncover more concrete reasons for their reportedly high Technology Efficacy.

**Professional development.** Teachers who attended voluntary professional development
had significantly higher Technology Integration and Leadership Practices scores. Previous
studies have shown that researched-based professional development facilitates teachers’
technology integration in their classrooms (Hastings, 2009; James, 2006; MacDonald, 2006;
Sandholtz, et al., 1997; Vannatta & Fordham, 2004). Furthermore, regarding teacher leadership,
Riel and Becker (2000) found that teacher leaders participated in up to twice as much
professional development as the least engaged “private practice” teachers. Essentially, these
teachers are “lifelong learners” (Katzenmeyer & Moller, 2001) who see value in the learning
experiences to improve their practice.
**Professional reflection.** A part of most professional practice is the act of reflection, or thinking specifically about what one does and how s/he can improve. For over two decades, educational technology researchers have reported about the need for teacher reflection of their practice (Dwyer, et al., 1991; Riel & Becker, 2000; Sandholtz, et al., 1997; Vannatta & Fordham, 2004). In each of these studies, as well as the findings of this research study, technology integration and teacher leadership practices scores were significantly higher for those teachers who regularly reflected on their teaching. Riel and Becker (2000) explain this finding as simply “Quality teaching requires thoughtful reflection” (p. 32).

**Modified Stage of Technology Adoption (mSTA).** The modified Stage of Technology Adoption refers to a teacher’s level of technology experience, abilities, and comfort. Teachers with higher mSTA reported higher scores on Overall Technology Integration and Teacher Leadership Practices. Since mSTA is a measure of one’s comfort and experience with technology, it would be expected that the Technology Integration practices would also be high. Likewise, those teacher participants who identified themselves as the highest stage, or 7 on the mSTA \( n = 82 \) or 23.0\%, which is called “Assisting Others,” by definition are exhibiting leadership characteristics. ISTE (2011b) developed the NETS•Coaches for these types of technology integration leaders, so they can take on more official leadership roles within schools to lead technology and 21st century skills initiatives as well as mentor and collaborate with classroom teachers toward improved teaching and learning.

Christensen (2002) found that this linear scale was effective in measuring teachers’ initial or baseline level of technology integration. From there, professional development can be individualized in order to move teachers to the next higher stage after meeting established outcomes. Again, the stages can be used as a quick post assessment to follow their progress in
the professional development program. Christensen (2002) found that with this individualized, but collaborative professional development, teachers were advancing at least one stage higher. Another study found a positive relationship between teachers’ Stage of Adoption for Technology in Education (comparable to the mSTA for this study) and their comfort level and interest with technology, making them more likely they are to be using technology in the classroom for student learning and achievement (Challoo, et al., 2011).

**Computers in the classroom.** In general, this study found that the more computers a teacher reported having in their classroom, the higher their Overall Technology Integration score (see Figure 9). With computers available to use, teachers can integrate them into various lessons, allowing for dedicated access when needed for anything from long-term projects to simple just-in-time needs, such as finding a quick answer on the Internet to a question posed in class. The sample sizes were small for groups representing 7-11 computers ($n = 17$) or 12+ computers ($n = 23$). Even though their Overall Technology Integration mean scores are much higher, further investigation with more participants for these groups would be needed in order to statistically validate this general finding. Becker (2000a) found that computer-using teachers were more likely to be in environments where other teachers also used computers and support was organized and sufficient.
Figure 9. Significant group differences in Overall Technology Integration scores by the number of classroom computers.

With regard to Teacher Leadership Practices (Total T-LPI), in all, the mean scores also rose with more computers in a teachers’ classroom, except for those classrooms with 12 or more computers, such as a computer lab setting (see Figure 10). Other than small sample sizes \((n = 23)\), possible reasons for these differences could be related to other factors examined in this study, such as the teachers’ Modified Stage of Technology Adoption (mSTA) or Technology Efficacy of those teachers, or may be totally unrelated and require further exploration. Sandholtz, et al., (1997) noticed that the teachers who began to integrate technology into their classes also began to ask or request more technologies or computers so they could continue with the meaningful lessons they had begun, thereby demonstrating leadership practices. Due to the nature of this study, it is not possible to determine whether the stronger integrating teachers requested the computers or if those computers were already in the classroom and these teachers
found ways to utilize them for student learning experiences. Perhaps those with more computers were able to try more things, take more risks, or “Challenge the Process,” which was shown to be a predictor for Overall Technology Integration. Again, future studies, especially qualitative studies, could examine the causal relationship of the number of computers in the classroom.

![Figure 10. Significant group differences in Total T-LPI scores by the number of classroom computers.](image)

**Total computers hours.** Another computer-related factor was found to demonstrate differences with regard to Teacher Leadership Practices and Overall Technology Integration—Computer Hours per week for teaching-related tasks. On average, teachers who used the computer more hours per week had significantly higher scores in both teacher leadership and technology integration. Vannatta and Fordham (2004) found that in addition to being open to change, teachers who worked beyond their contracted hours and took technology related
professional development were more likely to use technology for teaching and learning.

Although these time variables are not identical to those in this study, all show a commitment to using technology for student learning, even if more time is required of them.

As with the number of computers in the classroom, additional research would need to be conducted to determine whether the computers came first into the classroom, then the increase in integration and leadership practices, or if there are other factors at work. One possibility is that those teachers with more computers and those who spend more time on computers themselves find more ways to use those computers for teaching and learning activities with their students due to that additional exploration time and accessibility.

**College/university teaching and total leadership positions.** The participating K-12 teachers who taught (or want to teach) at a college or university and those who took on leadership roles in their schools also showed significantly higher scores in Overall Technology Integration and Leadership Practices. This finding may signify that it involved a form of leadership in order to perform such additional duties at a higher level or may symbolize Katzenmeyer and Moller (2001) premise that teacher leaders are lifelong learners in their quest to work with students. In addition, these teachers working in K-12 and higher education can share strategies and lesson ideas with other teachers, including pre-service teachers.

Regarding technology integration, many higher education institutions have integrated technology in various forms over the last decade, from course registration and grades, to complete online courses. Because of this, K-12 teachers who also teach college may have higher Technology Integration scores. Further research could be conducted with college faculty to compare these K-12 teachers with full-time faculty to examine the levels of technology integration between the two groups.
**Gender.** Significant gender differences were not evident for Overall Technology Integration but females did have significantly higher Teacher Leadership Practices (T-LPI) \((p = .003)\). Previous LPI studies, not T-LPI, found no significant differences between females and males (Kahl, 1999; LaVine, 1998; Manning, 2002; Singh, 1998; Sproule, 1997). But in teachers, Riel and Becker (2000) saw proportionally females exhibiting more teacher leadership practices than males.

Because of these mixed results, other areas of gender differences were identified using a t-Test of Independent Samples (see Table 57) Males reported significantly higher Modified Stage of Technology Adoption (mSTA) scores \((p = .034)\), while females attended more voluntary professional development \((p = .020)\) and spent more time at home working on the computer for job-related tasks \((p = .045)\). In 2000, Becker (2000a) noted that males were more likely to use computers at work and at home. But more recently, females have been found to use computers more than ever before (Bhattacharyya & Tollett, 2009). Other technology and leadership factors that did not show any significant gender differences in means were: Technology Efficacy, Reflection, and Total Hours Per Week (both Management and Instruction).

Table 57

**Gender Differences (Significant and Non-Significant)**

<table>
<thead>
<tr>
<th>Significant Gender Differences</th>
<th>Non-Significant Gender Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total T-LPI (females higher)</td>
<td>Overall Technology Integration</td>
</tr>
<tr>
<td>Modified Stage of Technology Adoption (mSTA) (males higher)</td>
<td>Technology Efficacy</td>
</tr>
<tr>
<td>Professional Development (females higher)</td>
<td>Reflection</td>
</tr>
<tr>
<td>Home Computer Hours (females higher)</td>
<td>Total Hours/Week-Management</td>
</tr>
<tr>
<td></td>
<td>Total Hours/Week-Instruction</td>
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These varied gender findings bring to the forefront certain assumptions about other significant findings that should be clarified. For example, males may have had significantly
higher Modified Stage of Technology Adoption (mSTA) scores, but even though the STA item showed significant group differences for Overall Technology Integration, males did not have significantly higher Overall Technology Integration scores. Similarly, females attended significantly more voluntary professional development sessions, which also showed significant group differences for Overall Technology Integration and Teacher Leadership Practices (T-LPI), but females only showed significantly different scores on the T-LPI, not Overall Technology Integration. In other words, each finding is separate and should not necessarily be combined or extended to other factors.

Lastly, based on these gender findings, although males have historically been the more prolific users of information and communication technologies (ICT), this data shows that at least for this group of teachers, the gap between males and females as technology users may be closing. Furthermore, with females reporting more professional development opportunities and higher T-LPI (leadership) scores, it may be only a matter of time before female teachers begin to significantly increase their integration of digital technologies into their teaching.

Social trait (level of extroversion). In the case of teacher leadership, extroverts reported significantly higher Teacher Leadership Practices scores than introverted teachers, which is not too surprising since a significant portion of leadership responsibilities is working with others (Crowther, et al., 2009; Greenleaf, 1977; Kouzes & Posner, 2002). In a previous study of over 500 students, this researcher found that extroverted students had higher attitudes toward computers (Rathsack, 1998). Attitudes were not measured with this study, but this could be an area of future research to determine if similar significant differences exist with teachers as well or if student leadership is also significantly higher for extroverted students. No significant difference in teachers’ technology integration scores was found between introvert and extrovert
teachers. Twenty years ago, Katz (1992) found that extroverted teachers were more receptive toward using computers, but due to a shortage of recent literature specifically on introversion and extroversion of teachers, more research would be needed in order to examine possible relationships between technology use (integration) and social traits (introvert/extrovert) of 21st century teachers. These findings related to leader or technology integrating teachers would assist administrators with meeting organizational needs in terms of shared or distributed leadership and change initiatives (Katz, 1992).

Master’s in educational technology degree programs. Teachers who indicated having a master’s degree in educational technology or related field had significantly higher scores on the Overall Technology Integration Scale (OTIS), which should be a validation for both the program’s efforts as well as for the teachers themselves of their success. In order to monitor and track the performance of these educational technology masters students as well as the program’s success, pre-post assessments of their Overall Technology Integration Scale (OTIS) score could be implemented.

In contrast, the educational technology masters students did not have significantly different Teacher Leadership Practices scores. Therefore, educational technology masters programs, as well as any masters programs for teachers (Curriculum and Instruction, Administration, etc.), should explore a stronger focus on leadership practices in their courses in order to capitalize on the interrelatedness between leadership, change, and professional development, all of which come into play with 21st century learning environments (Becker, 2000a; Brooks-Young, 2006; Fullan & Smith, 1999). The relatively new ISTE standards for Coaches (ISTE, 2011b), formerly called Technology Facilitator and Technology Leaders Standards (ISTE, 2011a), can provide a strong basis for leading school transformations in the 21st
century through technology integration and interactive teaching practices focused on student engagement and critical thinking. In addition, general leadership practices, such as Kouzes and Posner’s *Leadership Challenge* (2002) works, can broaden teachers’ view about the extended role of technology-using teachers in schools today.

**Teaching experience.** In 2000, Becker (2000) found that years of experience did matter in terms of being an exemplary technology-using teacher—on average, the exemplary teachers had three more years of experience than other computer using teachers. Around the same time (Riel & Becker, 2000), it was determined that teachers who were the youngest were also the least engaged in professional practice or leadership. For this research study, there was no significant difference found in terms of teachers’ years of experience and their technology integration or leadership practices.

Although not statistically significantly different for Overall Technology Integration, $F(3, 355) = .662, p = .576$, there still remains a considerable difference between the scores for teachers with 5-19 years of experience, compared to 25+, and to those with 20-24 years, as shown in Figures 11 and 12. A similar dip occurred with the 20-24 years experience group for Total T-LPI as well. The 20-24 years experience group was a smaller sample ($n = 39$), but this dip could be a concern for administrators and fellow teachers to monitor. More research with a larger sample size may also provide more concrete answers, perhaps nullifying this instance as only an anomaly.

A similar pattern was found for both the Overall Technology Integration scores and Teacher Leadership Practices Inventory (T-LPI), where the first year teachers have the highest average scores. Similarly, these new teachers also had the highest average Technology Efficacy scores, as discussed earlier. But, since the sample size is very small ($n = 5$), it is impossible to
determine a possible reason for their high scores, which could possibly be due to natural talent, inexperience naiveté or over confidence in abilities, or some combination. For the group analyses, these first year teachers were combined with those with 2-4 years of experience, which actually lowered their Overall Technology Integration scores to be the second lowest of the four Experience groups. In future studies, obtaining a larger sample of new teachers (years 1-5) would be critical to perform stronger statistical analyses and generate stronger conclusions.

*Figure 11.* Non-significant differences in Overall Technology Integration scores by years of teaching experience ($p = .576$). (Below Average Area is Shaded.)
Figure 12. Non-significant group differences in Total T-LPI scores by years of teaching experience \( (p = .235) \). (Below Average Area is Shaded.)

**Research Finding 4: Predictors for Classroom Technology Integration**

A primary purpose of this study was to quantitatively examine how digital tools are being used for teaching and learning and how this use relates to teacher leadership practices. In order to determine which factors best predict teachers’ technology integration, a multiple regression analyses was performed, which generated a model to predict Overall Technology Integration accounting for 29.0\% of the variance in Overall Technology Integration. Specifically, four questions representing two factors from the 21\textsuperscript{st} Century Technology Integration and Teacher Leadership (21-TITL) online survey accounted for 29.0\% of the variance in scores for the Overall Technology Integration score—the single-item Modified Stage of Technology Adoption (mSTA Current Self) and the three-item Challenge the Process T-LPI subscale. Similar to the findings from the first two research questions, the teachers’ Modified Stage of Technology
Adoption (mSTA) and how well they “Challenge the Process” predict their level of actual technology integration in the classroom. Once again, these results show the interconnectedness between teacher leadership and technology integration through teachers’ ability to “challenge the process,” which is comparable to Vannatta and Fordham’s (2004) openness to change disposition. Furthermore, teacher leadership in general is enabled through a culture of inquiry and risk-taking (Crowther, et al., 2002) where these teachers can thrive in the ever-changing realm of technology integration.

In the case of this research question (predictors for technology integration), like other significant variables already discussed (Computers in Classroom; Total Computing Hours), more research would be needed in order to determine whether technology integrating teachers begin to “Challenge the Process” or if teachers who naturally “Challenge the Process” are demonstrating their leadership to provide their students with technology enhanced lessons. Based on Sandholtz, et al., (1997) ACOT findings, as teachers become more knowledgeable about how to improve their students’ learning, they develop a sort of dedication or commitment to make sure their students get to experience those higher levels of technology-enhanced learning opportunities. Therefore, these teachers are willing to take risks and spend more time after hours to learn more (Vannatta & Fordham, 2004) so that their students can benefit.

**Research Finding 5: Predictors for Teacher Leadership Practices**

Leadership is dynamic and complex, requiring multiple skillsets (Crowther, et al., 2002, 2009; Danielson, 2006; Rallis, et al., 1995). In terms of this research, complexity exists—a six factor model was generated to predict Teacher Leadership Practices. The results from the multiple regression analysis indicated that Reflection, Professional Development, Overall Technology Integration, Social Trait, Gender, and Technology Efficacy predict Teacher
Leadership Practices, accounting for almost 35% of the variance \[F (6, 342) = 30.39, p < .001\]. Of these six factors, two are technology-specific—Overall Technology Integration and Technology Efficacy—showing another connection between technology-related factors and leadership. Brownlee (1979) realized that teacher leaders influence the behaviors of others within the school environment—teachers as well as students. Therefore, those teacher leaders who also regularly reflect on their professional practice (Sandholtz, et al., 1997; Vannatta & Fordham, 2004), attend professional development/learning sessions (Dwyer, 1991; James, 2006; Riel & Becker, 2000; Sandholtz, et al., 1997; Vannatta & Fordham, 2004), and work to integrate technologies into their courses (Becker, 2000a; Harris & Hofer, 2011; ISTE, 2008; Mishra, Koehler, & Henriksen, 2011) can be a role model and leader for their students in these areas as well.

**Recommendations**

Based on national and state educational goals for at least the next several years, teacher leadership and technology integration are two key factors that are required of teachers in order to prepare schools and their students for the early 21st century (Crowther, et al., 2002, 2009; Fullan & Smith, 1999; Ohio Department of Education, 2009; U.S. Department of Education, 2010). If the 361 Northwest Ohio teacher participants of this research study are any indication, Ohio teachers are well educated, experienced, and have made great strides regarding technology integration in their classrooms over the last ten to fifteen years. In order to continue with the evolution of teacher practice that this research has uncovered in the areas of technology integration and teacher leadership, four key recommendations are presented to facilitate educational improvement in the 21st century (in order of increasing complexity):

21st Century Teacher Knowledge: TPACK + Leadership

This research study has uncovered several connections between teachers’ technology integration and teacher leadership practices. While most teacher preparation programs are committed to developing technology using teachers by implementing the TPACK framework, a key ingredient is missing in this framework—that of leadership. Because of these findings, the first recommendation from this research is the addition of leadership to the TPACK framework of teacher knowledge, creating either TPACK+L or the reorganized acronym, “CPTaLK” (Content, Pedagogy, Technology, and Leadership Knowledge). In this revised framework, content and pedagogy become the primary focus, but leadership also becomes a critical component of essential teaching practice. As Hastings contends, “before implementing new technologies, teachers need to consider how new technologies impact pedagogy and content” (p. 120).

The leadership aspect comes into play outside of classroom teaching when working with other teachers, sharing best practices, observing, challenging, and encouraging others to try new ideas. But the fundamental relationship is that without the distributed expertise of teacher leadership in schools today, transformative change will not (can not) occur (Crowther, et al., 2002; Katzenmeyer & Moller, 2001; Solomon & Schrum, 2010).

As a framework for teacher professional knowledge and skills, CPTaLK —along with the context of how teachers learn them via collaboration, inquiry, reflection, and sharing (Borthwick & Pierson, 2008; MacDonald, 2006; Vannatta & Fordham, 2004)—provides a full vision of what a 21st century teacher needs to be and what they need to know in order to prepare their students
to be successful. Leadership needs to become a part of this framework because the essence of teacher professionalism (Becker, 2000a; Riel & Becker, 2008; Scott & Mouza, 2007)—working with other teachers, administrators, community members, and even legislators in functions of mentoring, supporting, collaborating, challenging and encouraging—all represent functions of leadership. Moreover, to be successful with school improvement transformations, along with improving teacher competence in pedagogy, content and technology, teacher leadership is the essential component or lynchpin for action and long-term sustainability (Crowther, et al., 2002, 2009; Danielson, 2006; Fullan, 1993a, 1993b, 2007; Institute for Educational Leadership, 2008; Katzenmeyer & Moller, 2001; Murphy, 2005; Riel & Becker, 2008; Wilmore, 2007).

**Improving “CPTaLK” Through Embedded, Needs-Based Professional Development**

“The illiterate of the future are not those who can’t read or write, but those who cannot learn, unlearn, and relearn.” ~ Alvin Toffler (Futurist)

Experience alone as teachers’ on-the-job training is not enough to learn about all the complex aspects of being an effective teacher in the 21st century—one who is proficient (or excels) in technological, pedagogical, and content knowledge and shares that knowledge with other teachers (Beglau, et al., 2011; ISTE, 2011b). The following are three recommendations regarding teacher professional development and its related benefits: 1) Embedded, Needs-Based Professional Development, 2) 21st Century Skills and CPTaLK-focused, and 3) Retaining Institutional Knowledge.

**Embedded, needs-based professional development.** This research study has determined that technology-integrating teacher-leaders participate in more voluntary professional development activities than their colleagues. In short, “Teacher leadership thrives on meaningful professional development experiences, including leadership development” (Katzenmeyer & Moller, 2001, p. 37), which should be needs-based (MacDonald, 2006). Teachers who
participated most in professional development opportunities were significantly more likely to use technology in their classrooms (or at higher, student-focused levels) than those teachers who rarely participated in voluntary professional development (Coffman, 2009; Scott & Mouza, 2007; Vannatta & Beyerbach, 2000). Lastly, even talking about one’s use of technology for teaching and learning can improve uses. MacDonald (2006) found that those teachers who talked about their technology integration practices with other teachers saw an increase in their technology integration.

Providing teachers with collaborative professional development gives them time to develop stronger lessons, improve technology skills, and practice with integrating technology into those lessons (Dwyer, 1991; MacDonald, 2006; Riel & Becker, 2000; Sandholtz, et al., 1997; Vannatta & Fordham, 2004). Early on, such as in the Entry or Adoption stages, teachers need instruction or training in the technology itself (Dwyer, et al., 1991). But as their understanding and comfort levels improve (or their guard is lowered due to being more comfortable), they will increasingly need to think about student outcomes and the process of teaching, learning, and assessment—even be challenged by new ideas, strategies, and expectations—in order to fully evolve to the higher levels of 21st century teaching, leading to more student-centered, constructivist learning opportunities (Vannatta & Beyerbach, 2000).

Likewise teachers’ Leadership Practices scores were also higher for those who attended more voluntary professional development sessions, which Riel and Becker (2008) also found. In order to continue or increase these results, the culture of teacher learning must come to the forefront (Fullan, 1999). “(R)adical changes are required in how teachers learn and in their opportunities to learn” (Fullan, 1995, p. 266). In short, professional development matters and it needs to be a core part of teachers’ work, occurring regularly (Riel & Becker, 2000; Sandholtz,
et al., 1997), and embedded and intentional within the school day or week (Beglau, et al., 2011; Fullan, 2007). DeBose, Jellinek, Mullenholtz, Walker, & Woods-Murphy (2012) also echo the need to “allow training with technology” and to restructure “the school day so (teachers) have time to collaborate with colleagues and engage in professional learning and problem-solving” (¶8). Fullan and Smith (1999) define this culture of learning where the teacher is the learner and schools and supporting networks are learning communities. Moreover, the simple act of allowing teachers to meet and discuss their teaching practices, especially technology integration, has shown improvement in their use of those technologies (MacDonald, 2006; Vannatta & Fordham, 2004).

**Professional development and computer use.** On average, over one-third of teachers surveyed (34%) use a computer for teaching-related tasks (management and instruction) for 20 or more hours each week. Furthermore, results indicate that teachers who use computers less than 10 hours per week for job-related tasks have lower levels of technology integration and lower leadership practices scores. Increased time on a computer leads to more practice and growing expertise in related tasks, which can also raise teachers’ Modified Stage of Technology Adoption (mSTA) scores and possibly Technology Efficacy as well. In this case, experiential learning is key (Bandura, 1997) for teachers to learn how to effectively integrate technology into their curricula. Providing teachers more time on computers and in targeted professional development can lead to the ideal 21st century teacher—one with “digital wisdom” (Prensky, 2009) to teach students not only how to use digital tools, but why and when to do so. In brief, schools need educational leaders who realize the potential for and then utilize technologies to “(enhance) thinking and understanding” (Prensky, 2009, ¶ 30), as well engage them with content and pedagogy strategies.
**Barriers to professional development.** Creating learning opportunities for teachers is not always easily integrated into faculty culture. Fullan and Smith (1999) caution that the school culture must be addressed in relation to the professional development… because “culture wins every time” (p. 10). Therefore, a supportive and collaborative professional culture will aid the continuation of professional development practices as they are practiced, reflected upon, implemented, and sustained (Becker & Ravitz, 1999; Hastings, 2009). Peter Senge (1990) refers to this kind of culture as a learning organization. Furthermore, there is evidence of a connection between collaborative school cultures and Teacher Leaders (Riel & Becker, 2000), leading to the proverbial chicken or the egg question—which came first, the collaborative culture or the teacher leaders?

Several barriers to professional development must be addressed in order to create an effective culture (Becker & Ravitz, 1999; Hastings, 2009; Kopcha, 2010). Scheduling constraints are also often reported as barriers for teacher collaboration, but with creative, shared decision-making, options become available (ChanLin, et al., 2006), such as late-starts or delayed openings once or twice a month, online communities of sharing, or evening and weekend options for longer periods of learning and collaboration. During these times, teachers can meet with colleagues in grade/subject/department teams in order to share best practices, resources, student concerns and facilitate collaborative professional learning. Other options include utilizing free online resources such as blogs, professional organizations and conference websites, or paying for subscription professional development services. But again, cultures of practice and habits will need to be addressed in order to implement these changes successfully (Fullan, 1994).

In order to improve technology integration, teaching, and teacher leadership, in addition to scheduling concerns, another issue is who will provide the needed training for teachers (ISTE,
If no staff member is designated as the professional development specialist, coach, or ITRT (Coffman, 2009), other options do exist. One possibility is to enlist the “Modified Stage of Technology Adoption (mSTA) 7s” or those who identified themselves as “Assisting Others” on the Stage of Technology Adoption scale) to help plan or deliver trainings, hold monthly workshops or trainings in the evening or weekends on requested topics, partner with local colleges/universities to offer trainings or classes, or enlist recently retired teachers (from own district) with needed skills or experiences to provide trainings or mentorships (Kopcha, 2010).

**Example of embedded, needs-based professional development.** A more comprehensive example of an entire state putting the importance of on-site professional development in technology integration and leadership is the ITRT program of Virginia (Coffman, 2009). Each school district is required to have ITRT (Instructional Technology Resource Teachers) on staff at their buildings to provide professional development, coaching, co-teaching with, and mentoring of their peer teachers. Government mandated in 2004, these bold actions cost the state hundreds of millions of dollars, but as of 2012, the program is still in place and seems to have become a worthwhile investment. On a larger scale, it will take not only financial resources, but also human resources at all levels (teacher leaders, school administrators, school boards, communities, and state and federal law makers) to collaboratively figure out ways to create cultures of learning for students and educators, both within and outside the walls of our public school buildings (Jones, Fox, Lenin, 2011; Scott & Mouza, 2007). To accomplish this, teachers need to take on leadership roles in their own classrooms and pedagogical learning, and at the same time, administrative leaders need to support their journey by modifying schedules, “encourag(ing) peer observations, dialogue and reflection” (Dwyer, et al., 1991, p. 52) and reassuring teachers that the hard work is worth it when focused on long term student success.
**21st century skills and CPTaLK – focused professional development.** Mishra and Koehler (2006) suggest that teacher professional development and pre-service practices must include all three TPACK components in order for them to be successful. Therefore, professional developers must focus not only on teaching the technology, but the teaching practices and strategies as well, along with the content being studied or skills to be mastered (Beglau, et al., 2011; Hastings, 2009; ISTE, 2011b), which is a complex process. According to Scott and Mouza (2007), “Effective professional development must respect complexity and find innovative ways of helping teachers develop their thinking and transfer their new learning into practice” (p. 263).

As mentioned in the previous section, 21st century teachers require knowledge and skills focused on TPACK+L or “CPTaLK” (Content, Pedagogy, Technology, and Leadership Knowledge) within the context or environment of professional reflection, inquiry, collaboration, and sharing (Borthwick & Pierson, 2008; Coffman, 2009; Vannatta & Fordham, 2004).

Furthermore, in addition to the world being more connected, it has also become more visual (Medina, 2009). As words were to the 16th until the 20th centuries, images are to the 21st century—pictures, videos, digital storytelling, and infographics are just a few examples (ISTE< 2007). Since “vision trumps all other senses” (Medina, 2009) in terms of how humans process and remember information, teachers need to incorporate visuals in a variety of contexts in order to prepare students for a future filled with visual cues, distractions, and learning opportunities. Brooks-Young (2010) addressed the importance of technology tools in learning, “(O)ur charge (as educators) is to identify and use the tools that will best prepare students to function in society now and in the near future” (p. 2). With the widespread access to digital cameras today, images can be integrated into lessons by teachers and students quickly and easily to communicate meaning or understanding.
In 2000, the National Research Council stated, “What has not yet been fully understood is that computer-based technologies can be powerful pedagogical tools—not just rich sources of information, but also extensions of human capabilities and contexts for social interactions supporting learning” (p. 218). With more digital tool integration, students can create and develop their learning in a way that meets 21st century goals (Chen, 2010; ISTE, 2007; Partnership for 21st Century Learning, 2009; Warlick, 2004). Although this possibility of using these tools is available for teachers and students, this research study and the LoTi research show there is still a long way to go in regards to the pedagogies being used with these tools.

**Retaining institutional knowledge in the era of teacher retirements.** Forward thinking and planning is a critical function of leadership. With that in mind, the final benefit of embedded professional development relates to avoiding a future crisis—finding ways to retain institutional knowledge of currently practicing teachers. Within the next 10 years, up to one-third of teachers will be retiring or leaving teaching (DeBose, et al., 2012). Although not specifically addressed in this study, the sheer number of teacher expertise that will be leaving the schools in Ohio and across the nation will most certainly affect the overall profile of the remaining practicing 21st century teachers, as well as the success of their students. This represents an enormous amount of institutional knowledge and experience leaving, which could derail any recent advances in effective teaching practices. Furthermore, this increase in teacher retirements will add pressure to colleges and universities who will consequently need to prepare more students (of traditional and non-traditional ages) for 21st century teaching.

In order to preserve or tap into the wealth of knowledge and skills of these teachers is to leverage their leadership practices and technology tools, as technology is essential in the process of creating a new learning culture (Fullan & Smith, 1999). In this study, teachers with 25 or more
years of experience had slightly higher than average Overall Technology Integration scores and slightly lower than average Teacher Leadership Practices scores, which were actually higher than teachers with 15-24 years of experience. In other words, these very experienced teachers have skills and knowledge that can benefit a great portion of teachers in a building or district. These experienced teachers can be utilized through embedded professional development activities such as employing a mentoring approach based on teacher leadership development (Kopcha, 2010).

Both digital technology tools and teacher leaders can assist in retaining and communicating what has been learned from past institutional experiences through human and technological networks. Either way, with or without the embedded professional development, teacher leaders are needed in order to capture and preserve the best of these retiring teachers while helping schools embrace the best of new teachers who come on board. After retirement, teachers can continue being leaders through mentoring their replacement, facilitating online or in-person communities, attending weekly grade level/subject/department meetings or professional development offerings. As the saying goes, those who do not remember history are doomed to repeat it. The same applies in school settings where new initiatives commonly return and past experiences need to be communicated in order to avoid repeating past mistakes, let alone the great lessons that leave along with the teacher as they walk out the door.

**Administrative leadership and support is needed, too.** A key component to educational change is visionary leadership that highlights the path or direction of the change, which in a school setting most often comes from administrators, such as principals or superintendents (ChanLin, et al., 2006) or even at the state level (Coffman, 2009; Jones, et al., 2011). Furthermore, Thomas Guskey (2002) suggests that in order to create lasting, meaningful change, school or district leadership must first provide a vision with staff input, followed by
professional development in order to change teacher practices in the classroom—leaving teacher beliefs and attitudes to change later (see Figure 13). In other words, change actions first, believe later. Once teachers begin to see evidence of changes in student learning, they modify their outcomes and then, finally, change their attitudes and beliefs. Without this experiential approach toward a vision with guidance, support, and reflection, teachers rarely see the need to change and therefore do not change their beliefs, which is fundamental for lasting change initiatives (Guskey, 2002; Zhao & Cziko, 2001). In short, teachers need first-hand evidence that the changes work. As Bandura (1997) reminds us, personal experience is the best teacher.

Figure 13. Model for teacher change (Guskey, 2002); “Continual” added.

An example of this type of change occurred in the ACOT schools, Sandholtz, et al., (1997) discusses the need for and importance of site-based, long-term professional development to support those pedagogical changes. But in order for this to occur, school leaders must support and facilitate this process and be dedicated to the commitment because there is a natural “J-curve” (Fullan, 2007) or dip that occurs after implementation due to the need to assimilate changes into daily practice while simultaneously abandoning other habits and behaviors. In other words, this dip is normal, even with support (Fullan & Smith, 1999). The “no pain, no gain” sport analogy applies well to this common slow down in practice or effectiveness. Furthermore, change is rarely painless or easy, thus the reason why very few people truly embrace it.
Therefore, administrative leadership is needed along with teacher leaders to provide role models of technology use and lifelong learning (Hastings, 2009; Jones, et al., 2011; MacDonald, 2006; Vannatta & Fordham, 2004).

Finally, for teachers in school districts that do not offer ongoing collaborative professional development it is suggested that they seek it out themselves—find it, commit to it, and do it—in order to become a better teacher of today’s students. As Sarason (1993) explains, “Teaching is not or should not be for those unwilling or unable to be active agents of educational-institutional change. From the standpoint of the larger society, there is too much at stake to allow teachers to be passive participants in the dynamics and processes of change.” (p. 19)

All teachers have an obligation to improve the teaching profession, or else become “passive objects and perennial victims of change” (Fullan, 1994, p. 251). There is too much at stake for our future as a society—all teachers, not only those identified as teacher leaders, must take on the practice of continual reflection and improvement (Hastings, 2009; Mishra & Koehler, 2006; Vannatta & Fordham, 2004). Figure 14 identifies a simple argument for a focus on learning and changes in practice in order to change teachers’ beliefs to sustain long-term, lasting change.

![Figure 14. Modified model for teacher change through learning.](image)
Creating the Infrastructure For a 21st Century Enabled Learning Community

Providing access to learning is a primary function of public education. Unfortunately, there are financial limits to what schools can provide, especially in today’s economy. But if the goal of public education is to prepare all students for their lives beyond schooling and provide a well-educated citizenry (National Research Council, 2000; Riel & Becker, 2000, 2008; Solomon & Schrum, 2010), then certain modest necessities should be in place in all school districts to help improve the overall community of learning: all-around computer and wireless access in addition to local or national policy changes to improve access to learning tools and environments.

Computer and Internet availability: All-around access. Based on the survey results, the first recommendation would be to provide all teachers with a laptop or supplement teachers to help them purchase their own (e.g., a Teacher Bring Your Own Device/Laptop or BYOD/L model). Although not an original research question, this study showed that teachers who had a school-supplied laptop also attended more voluntary PD sessions ($p = .001$) and worked on a computer for teacher-related tasks more hours per week ($p = .003$). The portability of a laptop is essential for teachers so they can access their productivity and creative works, continue building technology-related skills in the evenings, weekends, and over holiday and summer breaks. SETDA, or the State Educational Technology Directors Association, (Jones, et al., 2011) and the 2010 National Educational Technology Plan (U.S. Department of Education) also suggest the importance in all teachers and students having access to digital devices for teaching and learning purposes.

Another possible teacher technology device similar to laptop functions, but not as versatile, is a smart phone. Over 27% of survey respondents stated that they use their personal smart phones (with Internet access) for school-related tasks, which might include web searches,
email, or calendar functions. Finding out their actual uses would be an interesting inquiry with regards to overall teacher professionalism and productivity. For example, if they are using it for email and text messaging with parents about student performance, are those parents more engaged and supporting in their child’s learning? Furthermore, as smart phones or tablet devices continue to develop more complex functions, they may become a cheaper alternative to some teachers’ laptops (e.g., if the device is used primarily used for email or web browsing). An added benefit to smart phones or tablets, especially the newer ones, is their ability for apps, or small programs, that both teachers and students can use for many learning activities and assessments.

In conjunction with teacher laptops or smart phones is the need for student computing access—either one-to-one (1:1) and/or “bring your own device” (BYOD) (Jones, et al., 2011; U.S. Department of Education, 2010). Separate wireless networks, one private for school personnel and one public access, would provide access throughout all buildings so teachers can access professional development, collaborative planning, and discussion opportunities, while students can have more access to learning opportunities via the local intranet or global Internet.

Within the school buildings, teachers and students require access to technology devices and the Internet for many learning opportunities. Unfortunately, of the teachers surveyed, only about half (52.9%) stated that most or all rooms in their building have wireless access. (Which the researcher examined some responses, noting that some entire participating districts do not have any wireless access, even though teachers responded that they did. Therefore, the actual value was calculated to be somewhat less than 50%.) Teachers can use this wireless access with their laptops or other wireless devices (e.g., smart phones or tablets) for communications, research, lesson planning, or assessment (Hastings, 2009; Jones, et al., 2011; Soloman & Schrum, 2010; U.S. Department of Education, 2010). Likewise, students can also use this
wireless access for various learning experiences, projects, and communications directed by teachers. Access to these devices and tools associated with them would remove a barrier to numerous 21st century skill-building and learning opportunities (ISTE, 2007; Jones, et al., 2011; Partnership for 21st Century Skills, 2009; U.S. Department of Education, 2010).

**Policy changes to improve access.** Two areas of policy changes, one local and one national could open the access for students of all ages to use various Internet based tools with teacher direction and supervision.

**Unblock “Web 2.0” or collaborative websites.** The least used tools were Blogs/Wikis (with 68.5% no use) and Web 2.0 (66.9% no use), meaning that at least 30% of teachers are using these tools in some way for teaching and learning. This is encouraging since these digital tools are generally used in more collaborative and creative ways requiring higher cognitive function as opposed to lower-level information reporting and retrieval web sites or traditional web research. The problem lies in the reason why only 30% are using these dynamic tools—is it due to these sites being blocked or due to a lack of knowledge about using them, both of which can be improved with professional development (Coffman, 2009; Consortium for School Networking, 2011; Hastings, 2009; ISTE, 2007, 2008, 2009; Vannatta & Fordham, 2004).

These tools require that the school district’s website access policy is more open and less restrictive, since many of these “interactive” sites are commonly blocked due to concerns over possible problems with this interaction, communication, and sharing. School districts are beginning to open access to many of these sites because they see the educational value in the higher levels of thinking (Anderson & Krathwohl, 2001; Consortium for School Networking, 2011) and in the guided practice of digital citizenship (ISTE, 2007) where students learn how to use these sites safely and appropriately. If they are constantly blocked, how can students practice
and learn about the skills they need to be safe and courteous online? As CoSN (Consortium for School Networking, 2011) points out, “(C)hildren need to learn how to be responsible users (which)… cannot occur if the young person has no real choice… restrictive school networks may provide more of an appearance of protection than reality since they can be bypassed by students” (¶ 2)

**Update COPPA laws.** An often cited concern for administrators is Web 2.0 tools, which as mentioned earlier, allow for online creation of products, discussions, reflection, and posting or sharing. The federal Children’s Online Privacy Protection Act of 1998 (COPPA) prevents kids 12 and under from using all of these web services through their Terms of Use (ToU) policies. Therefore school districts frown upon some uses of these tools, especially by students under 13 years of age. The COPPA laws were set up to protect kids during a pre-Web 2.0 era, but are now preventing them from learning about and practicing the very skills that can be developed to protect them from Internet-based harms, such as learning digital citizenship skills (Consortium for School Networking, 2011; ISTE, 2007). Similar to individual school districts opening the access to these sites for students 13 and over, the COPPA laws must be revised immediately so that teachers (and even parents) can guide students of all ages to use these powerful tools to practice their critical thinking, collaboration, communication, and creativity skills.

**Curricular focus on 21st century skills and authentic ways of knowing.** With a digital device and all-around wireless access, teachers and students can engage in higher-level lessons integrating content with 21st century knowledge and skills as specified in the Partnership for 21st Century Skills (P21) and ISTE’s (2007) NETS-S (National Educational Technology Standards for Students). Teachers can design lessons for students to use these devices to research, analyze, evaluate, and create (Anderson & Krathwohl, 2001), while keeping in mind Dale’s (1969)
concept of designing varied learning experiences using various tools and methodologies.

Once again, the focus needs to extend toward the higher levels of learning (Anderson & Krathwohl, 2001; ChanLin, et al., 2006; Jones, et al., 2011; Tamim, et al., 2011)—including creativity. Currently, there is little creating or creativity focus in lessons and therefore little deep thinking is occurring, which also translates to little innovation (Zhao, 2009). High test-scoring nations such as China have found that their “success” comes at a cost—the lack of creativity, which Zhao calls the “creativity gap.” One way to integrate creativity into a lesson is to integrate authentic lessons or relate to or simulate real world events that students care about or follow. As Brooks-Young (2010) explains, “It is incumbent upon educators to create engaging learning environments that mirror the real world and to ensure that students acquire the skills needed to function in these settings” (p. 2).

Policy of Funding Excellence

Schools and public education are in dire need of an overhaul to meet the needs of the 21st century (Brooks-Young, 2006, 2010; Darling-Hammond, 2008; Duncan, 2010a; U.S. Department of Education, 2004, 2010; Warlick, 2004). Changes are occurring, but primarily in small pockets of individual schools and districts, not nationally. What is needed in order to make these proposed recommendations become reality in order to affect and create sustainable change is a national Policy of Funding Excellence. In other words, rather than legislate unfunded mandates such as NCLB where schools need to redirect funding in order to comply, create funded mandates for educational excellence such as Virginia did with their ITRT program (Coffman, 2009). Perhaps governors will heed President Obama’s (2012) most recent call to “Invest more in education. Invest more in our children and our future…” (¶ 13) because “…No issue will have a bigger impact on the future performance of our economy than education” (¶ 8).
In order to change teacher practices, embedded, continual professional development and reflection in CPTaLK is needed, which requires time (Murphy, 2005) as well as money (Becker, 2000). Due to the need for fundamental educational change or transformation because of globalization, Becker (2000) realized the importance of financial investment in public education over a decade ago (format modified):

It will take money to:

• make computer-based education become a more widespread effective teaching practice;
• provide staff development to create a critical mass of computer-using teachers through which the ideas conducive to exemplary teaching practice will germinate;
• staff schools with support personnel who have sufficient expertise and stature to provide the intellectual resources and technical support other computer-using teachers will need;
• provide teachers with computers for home use and, even more importantly, to provide them with time at school to develop computer-based lessons and plans that can be used in the most profitable ways;
• reduce class sizes;
• solve the many new problems that extensive and inventive use of computer facilities will itself provoke; and
• recruit more people into teaching—who have both a potential talent for classroom teaching and a personal interest in using interactive technologies such as computers. (p. 290)

Monies will certainly be limited, so schools will still need creative and innovative leaders from the classroom, administration, and financial offices to work collaboratively to find ways to fund a transformation toward 21st century education, along with assistance from state governors
(Obama, 2012). One place schools can start, as Becker (2000) points out, is by funding professional development, “districts choosing to invest larger fraction of available funds in staff development and support engender more sophisticated and accomplished computer-using teachers” (p. 281). Similar results came out of the ACOT research from the late 1980s (Dwyer, et al., 1991; Dwyer, 1994; Sandholtz, et al., 1997) where staff learning was a priority. Again, computer-using teachers are most often leaders in integrating technology for higher levels of learning (Becker, 2000a; Coffman, 2009; Riel & Becker, 2008).

Perhaps Dewey in 1897 was correct well over a century ago when he proclaimed, “I believe that education is the fundamental method of social progress and reform” (McDermott, 1981, p. 452). Or more recently, Secretary Duncan (2012) stating, “I am absolutely convinced that the future of the teaching profession and the future of our nation are inextricably linked” (¶ 50).

In looking toward the future, our new national goal should be to transform public education by 2020 so that students are prepared for the remaining 80 years of this century. Unfortunately, this transformation will require an ongoing financial investment (Becker, 2000; Coffman, 2009). But to modify a common saying, “If you think 21st century education is expensive, try 21st century ignorance.” Now is the time for society to truly invest in our future. Otherwise, how else can today’s students thrive in the rapidly changing globalized society, let alone survive (Friedman, 2005; Warlick, 2004)?

**Recommendations for Future Study**

Some suggestions for future related research have already been presented in other sections and are listed again in Table 58. Therefore, this area will include more broad aspects of future research and a summary of the other suggestions listed elsewhere.
Table 58

**Summary of Factor-based Future Research Suggestions for Group Differences in Overall Technology Integration and Teacher Leadership Practices Inventory (T-LPI)**

<table>
<thead>
<tr>
<th>Factor or Variable</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Experience</td>
<td>Obtaining a larger sample of teachers for each age group (especially new teachers) would be critical to perform stronger statistical analyses</td>
</tr>
<tr>
<td>Social Trait (Introvert – Extrovert)</td>
<td>Measure teacher attitudes toward computers; examine group differences between extroverts and introverts</td>
</tr>
<tr>
<td>College/University Teaching</td>
<td>Compare full-time university faculty with K-12 teachers who teach college</td>
</tr>
<tr>
<td>Teacher Attitudes</td>
<td>Add a measure for teacher attitudes, since behavior is a function of attitudes</td>
</tr>
<tr>
<td>Technology Professional Development</td>
<td>Add an item to measure how much technology-related PD they participated in (either voluntary or mandated) (Hastings, 2009)</td>
</tr>
<tr>
<td>Gender</td>
<td>Obtaining a larger, more diverse sample of teachers to more fully examine possible connections between gender, teacher leadership, and technology integration</td>
</tr>
</tbody>
</table>

The first overriding suggestion for future research, which is also a goal of other researchers (Mishra & Koelher, 2006; Moersch, 2010), is to examine the specific types and quantities of Technology Integration and Digital Tool Use, such as in what types of activities or lessons are these tools being used. Additionally, these tools and strategies could be compared with the NETS-S (ISTE, 2007) or P-21 outcomes (Partnership for 21st Century Skills, 2009) to quantify or qualify each type of use. Determining how much creativity and higher order thinking (Anderson & Krathwohl, 2001; Zhao, 2009) is being addressed or how often student-centered, teacher-as-facilitator learning that requires higher level thinking, would help paint a more accurate picture of the levels of use in the classroom. These measures could be obtained utilizing
the different digital technologies, such as through observations, interviews, and possibly surveys to help generate greater understanding of actual practices.

A second consideration for future study is to conduct longitudinal studies of teachers or schools over several years, following teachers’ technology integration and leadership practices in relation to their professional development and reflection experiences. The factors measured in this study with the 21-TITL survey could be reassessed yearly or more often, to track teacher growth in various areas, as well as comparisons to student achievement.

Lastly, regarding the data collected from this survey, a suggestion for future research is to conduct a path analysis of the factors involved in order to determine specific relationship and connections between the variables. These results would help educational leaders determine the specific needs of their teachers in order to focus improvement efforts and faculty development plans.

**Recommendations for the 21-TITL online survey.** A suggestion for improvement of the online survey would be to examine more factors related to the school environment. One example would be to include a Background/Environment section question about computer lab availability. In most elementary and other school buildings, a computer lab may be the only location for students to work independently with digital technologies. So if there is limited access to a computer lab and there are no computers in the classroom itself, the teacher has another constraint or obstacle and therefore is very limited in providing digital technology opportunities for their students, thus limiting both the teacher and the students in their future technological and curricular advancement. For this study, the survey only included one item about the number of computers in their classroom.
A second survey revision would include a modification to the Overall Technology Integration Scale (OTIS) section to include a written descriptor in the pull down menu for selections 2 and 4 (rather than none; see Figure 15) since few respondents selected these values. Responses 1 through 5 represented a range from “Teacher Centered” or 1 through to “Student-Centered” or 5. In most cases, there were great differences in responses between the selections for 1, 3 and 5 compared to 2 and 4. For example, for Word Processing, the values selected were: 1=102, 2=26, 3=173, 4=15; 5=33. In all cases (for all tools), the 2 and 4 values were selected less than the value above or below. In other words, selections 2 and 4 were always the lowest values compared to the values on either side of them. It would be expected that it would be a gradual progression from 1 to 5, not varied. So they may have been confused that there was no descriptor, so they selected only from the 1,3,5 responses.

![Type of Integration](image)

*Figure 15. 21-TITL survey items to modify: Overall Technology Integration Scale responses.*

**Conclusions**

In closing and in conjunction with the recommendations presented earlier, the following three conclusions summarize the research findings from this study.
Technology Integration is Teacher Leadership

Teacher leadership is defined by a myriad of experiences, skills, and knowledge bases (Crowther, et al., 2002; 2009; Danielson, 2006; Fullan, 1994; Katzenmeyer & Moller, 2001; Riel & Becker, 2000). But the one teacher skill that has created leaders in schools across the country over the past twenty years is technology integration. Technology-using teachers are teacher leaders because they reinforce the ideal concept of TPACK+L (or 21st-CPTaLK due to the integration of and focus on 21st century skills and practices). In addition, they are teacher leaders because they have incorporated 21st century skills before other teachers (Becker, 2000a; Riel & Becker, 2000), therefore taking the forefront in a new dimension in teaching and learning.

Several factors in this study show connections between teachers’ various technology and leadership-related factors or traits and reinforce the concept that technology-integrating teachers are teacher leaders. Higher score/values in technology or computer-related factors such as Technology Efficacy, Stage of Technology Adoption, Computers in the Classroom, and Total Computing Hours Per Week were all associated with higher Leadership Practices scores. Higher score/values in leadership-related factors, such as Reflection, Professional Development, Total Leadership Positions, and College Teaching Experience were all associated with higher Overall Technology Integration scores. One Total T-LPI subscale, Challenge the Process, was even found to be a predictor of teachers’ Overall Technology Integration, again showing a connection between both practices. In short, these scores can be monitored by individual teachers themselves or by their administrators to continually monitor how they are progressing as 21st century educators. As the research and national reports show, today’s teachers require both technology integration and leadership skills in order to successfully prepare students for their

**Model for teacher leadership through technology integration.** In 2011, ISTE finalized their NETS for Coaches, a list of standards for technology coaches, integration specialists and other school or district leaders (most often licensed teachers). Along with TPACK (Mishra & Koehler, 2006) or PCTaLK models for teacher knowledge, the NETS•C (ISTE, 2011b) provide a more specific framework for leading, supporting, and mentoring fellow teachers in 21st century teaching and learning. Figure 16 shows the six standards for NETS•C, which are natural extensions of the NETS for Teachers (2008): Student Learning and Creativity, Digital Age Learning Experiences and Assessments, Digital Age Work and Learning, Digital Citizenship and Responsibility, and Professional Growth and Leadership.

*Figure 16. ISTE’s 2011 National Educational Technology Standards for Coaches (technology coaches, integration specialists, etc.). From: http://www.iste.org/standards/nets-for-coaches.aspx*
Leading in leadership and closing the technology gender gap. In addition to thinking about technology integration and leadership in a general sense, there is also evidence that gender differences in these areas are blurring. Female teachers have often lagged behind males in technology use (Becker, 2000a)—until now. Results from this study indicate that there is no longer a significant difference between male and female teachers regarding their levels of technology integration for student learning. Furthermore, regarding teacher leadership, female teachers had significantly higher Total T-LPI scores, which corroborates Riel and Becker’s findings (2000) that females made up a greater proportional percentage of those teachers identified as teacher leaders. With females participating in more voluntary professional development, they will potentially continue their growth in the area of technology integration, which could be examined in future research studies.

Embedded, Needs-Based Professional Development

Embedded professional development focused on teachers (and student) needs is the key to improved teacher practice in technology integration and leadership (Becker, 2000a; Beglau, et al., 2011; Dwyer, 1991, 1994; Fullan, 1995; Hastings, 2009; ISTE, 2011b; Kopcha, 2010; Sandholtz, et al., 1997; Vannatta & Fordham, 2004). Embedded, needs-based, reflective professional development becomes the means to:

- Increase female teachers’ technology use and male teachers’ leadership practices (Becker, 2000a; Riel & Becker, 2000);
- Improve teacher practice in 21st century pedagogies through focused and targeted professional development in CPTaLK, NETS, P21, and state/local content standards (ISTE, 2007, 2008, 2009, 2011b; Mishra & Koehler, 2006; Mishra, Koehler, &
Henriksen 2011; Partnership for 21st Century Skills, 2009; Riel & Becker, 2000; Vannatta & Fordham, 2004; ); and
- Preserve institutional knowledge (DeBose, et al., 2012; Fullan & Smith, 1999; Kopcha, 2010).

Finally, Figures 17 and 18 show how this process of professional learning looks and progresses from a cycle for self-improvement (Figure 17) into a self-perpetuating, bi-directional “flywheel” where teachers learn from each other as co-leaders (Figure 18). The process includes:

1. Increase professional development through job-embedded, continual, collaborative, reflective learning with colleagues,

2. In these professional development sessions, learn more about 21st century teacher skills (CPTaLK) as well as content standards, NETS-S, P21 outcomes,

3. Over time, student learning begins to improve (thus teaching improves), which provides evidence to the teacher that change for the better is occurring,

4. That “evidence” of effectiveness grows teacher confidence and efficacy, and finally

5. Teachers teach other teachers through sharing and challenging each other in their collaborative professional development sessions.
Figure 17. Initial process for 21st century teacher professional development.
Figure 18. Outcome: Bi-directional processes for 21st century teacher professional development.

Again, professional development and improvement is essentially about change—learning is change (Leypoldt, 1971) and change is difficult, therefore learning is difficult. Strong administrative leadership, a community-driven vision, hard work and a commitment to excellence from teacher leaders is the final drive that is needed to transform schools for the remainder of this century. For “(o)only in the hands of innovative, informed, and committed professionals in supportive educational cultures can technology serve as a medium for helping children advance confidently into the future” (Vannatta & Fordham, 2004, p. 263), preparing them for college, careers, and citizenship in the 21st century. For this to occur, teachers will need to take on more explicit leadership roles within their districts and communities in order to facilitate massive change efforts due to technology-driven forces affecting education and
student’s success. With a 21st century education learning community infrastructure (total wireless access and digital devices for all teachers and students) plus a comprehensive, embedded professional development plan in place with leadership and support included from all levels, schools will be able to truly begin their transformation toward effective 21st century learning. Furthermore, along with the establishment and support of an embedded, needs-based professional development program, such as with Professional Learning Communities (PLCs) (DuFour, DuFour, & Eaker, 2008) or mentoring (Kopcha, 2010), these three main areas focused on teacher improvement will begin the transformation of schools and teacher practices toward the kind of skills and knowledge our students need for their future. But it won’t be easy.

A Long Road Ahead to Realizing 21st Century Outcomes

As this study and others over the past decade or two have found (Becker, 2000a; Beglau, et al., 2011; Hastings, 2009; Moersch, 2010; Stoltzfus, 2009; Tamim, et al., 2011; Vannatta & Fordham, 2004), many teachers still do not yet know how to use certain digital classroom technologies effectively for higher levels of teaching and learning. Generally speaking, educational technologies can “make good teaching better or bad teaching worse” (Sandholtz, et al., 1997, p. 174). Therefore, the goal is not just to “use technology.” What has been found to be most effective is when technologies are used with a student-centered teaching approach focused on higher levels of thinking, such as critical thinking and problem solving rather than memorization of factual knowledge (Beglau, et al., 2011; Borthwick & Pierson, 2008; ChanLin, et al., 2006; Hastings, 2009; Sandholtz, et al., 1997; Tamim, et al., 2011). Paired with student-centered, authentic pedagogical strategies (Brooks-Young, 2010; Prensky, 2009) and supportive professional environments that cultivate and sustain ongoing collaborative professional development (Fullan, 2007; Guskey, 2002), technology tools can become the means to
transforming schools into more effective and efficient “learning factories” of the early 21st century (for those who still like the factory analogy), or making a reality of what Curtis Bonk (2009) calls “the learning century” (p. 365).

Therefore, a simplified formula has been derived to summarize the proposed factors needed to “create” effective 21st Century Teachers (See Figure 19). In other words, professional development is the key or the path to continual improvement for teachers in an ever-changing world. CPTaLK-focused, collaborative, needs-based professional development along with support and a common vision, teachers can increase their technology efficacy, generate effective ways to integrate technology for higher levels of learning (aligned with NETS, P21, and content standards) and develop more confidence in their pedagogical skills, which can be shared with others and/or used to solve problems, such as for local leadership roles or teach future teachers, (e.g., college teaching).

Figure 19. Formula for effective 21st century teachers.

In closing, the 2010 U.S. Department of Education’s National Educational Technology Plan (NETP) outlines a policy and direction for the next five years. The importance is clear—"As we enter the second decade of the 21st century, there has never been a more pressing need to transform American education, and there will never be a better time to act” (p. 7). According to
this report and plan, in order to successfully transform our educational system, one of the major initiatives of change will need to be on the continual development of current and future teachers in the areas of leadership and technology integration. For one without the other provides diminished returns for our students, future workers and citizens, and communities. Together, strong leadership practices and technology integration focused on student learning will mutually benefit teachers’ standards of professional excellence as well as student learning excellence through improved practice, which will lead to compounding returns that benefit students and their communities for years to come.
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APPENDIX A. PARTNERSHIP FOR 21ST CENTURY SKILLS


21st Century Student Outcomes

The elements described in this section as “21st century student outcomes” (represented by the rainbow) are the skills, knowledge and expertise students should master to succeed in work and life in the 21st century.

1. Core Subjects and 21st Century Themes
2. Learning and Innovation Skills
   - Creativity and Innovation
   - Critical Thinking and Problem Solving
   - Communication and Collaboration
3. Information, Media and Technology Skills
   - Information Literacy
   - Media Literacy
   - ICT Literacy
4. Life and Career Skills

21st Century Support Systems

The elements described below are the critical systems necessary to ensure student mastery of 21st century skills. 21st century standards, assessments, curriculum, instruction, professional development and learning environments must be aligned to produce a support system that produces 21st century outcomes for today’s students.

1. Standards
2. Assessment of 21st Century Skills
3. Curriculum and Instruction
4. Professional Development
5. Learning Environments
APPENDIX B. ISTE NETS (STUDENTS, TEACHERS, ADMINISTRATORS, AND COACHES)

The ISTE National Educational Technology Standards (NETS•S) and Performance Indicators for Students ©2007

1. Creativity and Innovation
Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
   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. Students:
   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. Students:
   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. Students:
   a. identify and define authentic problems and significant questions for investigation.
   b. plan and manage activities to develop a solution or complete a project.
   c. collect and analyze data to identify solutions and/or make informed decisions.
   d. use multiple processes and diverse perspectives to explore alternative solutions.

5. Digital Citizenship
Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students:
   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. Students:
   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 of new technologies.
The ISTE National Educational Technology Standards (NETS•T) and Performance Indicators for Teachers ©2008

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. Teachers:
   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. Teachers:
   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 assessments 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. Teachers:
   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 behavior in their professional practices. Teachers:
   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 in 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. Teachers:
   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.
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. Educational Administrators:
   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. Educational Administrators:
   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. Educational Administrators:
   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. Educational Administrators:
   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. Educational Administrators:
   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
The ISTE National Educational Technology Standards (NETS•C) and Performance Indicators for Coaches ©2012

1. Visionary Leadership
Technology Coaches inspire and participate in the development and implementation of a shared vision for the comprehensive integration of technology to promote excellence and support transformational change throughout the instructional environment.
   a. Contribute to the development, communication, and implementation of a shared vision for the comprehensive use of technology to support a digital-age education for all students
   b. Contribute to the planning, development, communication, implementation, and evaluation of technology-infused strategic plans at the district and school levels
   c. Advocate for policies, procedures, programs, and funding strategies to support implementation of the shared vision represented in the school and district technology plans and guidelines
   d. Implement strategies for initiating and sustaining technology innovations and manage the change process in schools and classrooms

2. Teaching, Learning, & Assessments
Technology Coaches assist teachers in using technology effectively for assessing student learning, differentiating instruction, and providing rigorous, relevant, and engaging learning experiences for all students.
   a. Coach teachers in and model design and implementation of technology-enhanced learning experiences addressing content standards and student technology standards
   b. Coach teachers in and model design and implementation of technology-enhanced learning experiences using a variety of research-based, learner-centered instructional strategies and assessment tools to address the diverse needs and interests of all students
   c. Coach teachers in and model engagement of students in local and global interdisciplinary units in which technology helps students assume professional roles, research real-world problems, collaborate with others, and produce products that are meaningful and useful to a wide audience
   d. Coach teachers in and model design and implementation of technology-enhanced learning experiences emphasizing creativity, higher-order thinking skills and processes, and mental habits of mind (e.g., critical thinking, metacognition, and self-regulation)
   e. Coach teachers in and model design and implementation of technology-enhanced learning experiences using differentiation, including adjusting content, process, product, and learning environment based upon student readiness levels, learning styles, interests, and personal goals
   f. Coach teachers in and model incorporation of research-based best practices in instructional design when planning technology-enhanced learning experiences
   g. Coach teachers in and model effective use of technology tools and resources to continuously assess student learning and technology literacy by applying a rich variety of formative and summative assessments aligned with content and student technology standards
   h. Coach teachers in and model effective use of technology tools and resources to systematically collect and analyze student achievement data, interpret results, and communicate findings to improve instructional practice and maximize student learning

3. Digital Age Learning Environments
Technology coaches create and support effective digital-age learning environments to maximize the learning of all students.
   a. Model effective classroom management and collaborative learning strategies to maximize teacher and student use of digital tools and resources and access to technology-rich learning environments
   b. Maintain and manage a variety of digital tools and resources for teacher and student use in technology-rich learning environments
   c. Coach teachers in and model use of online and blended learning, digital content, and collaborative learning networks to support and extend student learning as well as expand opportunities and choices for online professional development for teachers and administrators
   d. Select, evaluate, and facilitate the use of adaptive and assistive technologies to support student learning
   e. Troubleshoot basic software, hardware, and connectivity problems common in digital learning environments
   f. Collaborate with teachers and administrators to select and evaluate digital tools and resources that enhance teaching and learning and are compatible with the school technology infrastructure
   g. Use digital communication and collaboration tools to communicate locally and globally with students, parents, peers, and the larger community
The ISTE National Educational Technology Standards (NETS•C) and Performance Indicators for Coaches ©2012

(CONTINUED)

4. Professional Development & Program Evaluation
Technology coaches conduct needs assessments, develop technology-related professional learning programs, and evaluate the impact on instructional practice and student learning.
   a. Conduct needs assessments to inform the content and delivery of technology-related professional learning programs that result in a positive impact on student learning
   b. Design, develop, and implement technology-rich professional learning programs that model principles of adult learning and promote digital-age best practices in teaching, learning, and assessment
   c. Evaluate results of professional learning programs to determine the effectiveness on deepening teacher content knowledge, improving teacher pedagogical skills and/or increasing student learning

5. Digital Citizenship
Technology coaches model and promote digital citizenship.
   a. Model and promote strategies for achieving equitable access to digital tools and resources and technology-related best practices for all students and teachers
   b. Model and facilitate safe, healthy, legal, and ethical uses of digital information and technologies
   c. Model and promote diversity, cultural understanding, and global awareness by using digital-age communication and collaboration tools to interact locally and globally with students, peers, parents, and the larger community

6. Content Knowledge and Professional Growth
Technology coaches demonstrate professional knowledge, skills, and dispositions in content, pedagogical, and technological areas as well as adult learning and leadership and are continuously deepening their knowledge and expertise.
   a. Engage in continual learning to deepen content and pedagogical knowledge in technology integration and current and emerging technologies necessary to effectively implement the NETS•S and NETS•T
   b. Engage in continuous learning to deepen professional knowledge, skills, and dispositions in organizational change and leadership, project management, and adult learning to improve professional practice
   c. Regularly evaluate and reflect on their professional practice and dispositions to improve and strengthen their ability to effectively model and facilitate technology-enhanced learning experiences
APPENDIX C. 21ST CENTURY TECHNOLOGY INTEGRATION AND TEACHER LEADERSHIP (21-TITL) SURVEY
(EXPORTED PDF VIEW; DIFFERENT LOOK ONLINE)

SCHOOL ENVIRONMENT & BACKGROUND (6 questions)

**DIRECTIONS:** For each of these questions, select the number from 0-8 that best represents an honest assessment of your environment or your background/experiences based on the full range described, including in between. (For example, "Happiness Level" from 0-8; if very happy, but not completely blissful, that would be a "7")

![Image of Technology Equipment/Software Access and Availability](image_url)
1. **Technology Equipment/Software Access and Availability** in your school (see descriptors above)

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2. **Website/Online Access to Educationally Purposeful Resources/Tools** in your school (such as YouTube, Twitter, Amazon.com, Edmodo, Google Docs, or even Facebook, etc.) -- see descriptors above

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<tr>
<th>NA/Unsure</th>
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</table>
3. **Overall Support** for technology integration/digital learning (support from administration, tech support staff, colleagues) -- see descriptors above

4. **Technology Integration Efficacy** – Your perception of your ability to reach the goal to fully and effectively integrate technology into teaching and learning.
4. **Technology Integration Efficacy** – Your perception of **your ability** to reach the goal to fully and effectively integrate technology into teaching and learning (see descriptors above).

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5. **Social Trait – Level of Introversion vs. Extroversion** - Select the number that best represents the “real you” - not your “at work” persona (NOTE that there is NO “best” or “preferred” answer) -- see descriptors above

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</table>
6. **Level of Reflection about Teaching Practice** - Select the number that best represents how reflective you are with your teaching *(see descriptors above)*.

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**TEACHER LEADERSHIP PRACTICES (1-6 of 18 items)**

7. **DIRECTIONS**: For each item, select the level that BEST describes your role as a teacher (with interactions with your colleagues).

<table>
<thead>
<tr>
<th></th>
<th>Almost Never</th>
<th>Rarely / Seldom</th>
<th>Once in a While / Occasionally</th>
<th>Sometimes</th>
<th>Fairly Often / Usually / Very Frequently</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I actively listen to diverse points of view (or perspectives other than my own).</td>
<td></td>
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<tr>
<td>I ask for feedback on how my actions affect other people's performance.</td>
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<tr>
<td>I challenge people to try out new and</td>
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<tr>
<td><strong>innovative ways to do their work.</strong></td>
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<tr>
<td><strong>I develop cooperative relationships among the people with whom I work.</strong></td>
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<tr>
<td><strong>I seek out and attend learning opportunities to develop my professional skills.</strong></td>
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<tr>
<td><strong>I experiment and take risks, even when there is a chance of failure.</strong></td>
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</table>

**TEACHER LEADERSHIP PRACTICES (7-12 of 18 items)**

8. **DIRECTIONS:** For each item, select the level that BEST describes your role as a teacher (with interactions with your colleagues).

<table>
<thead>
<tr>
<th><strong>I find ways to celebrate accomplishments.</strong></th>
<th>Almost Never</th>
<th>Rarely / Seldom</th>
<th>Once in a While / Occasionally</th>
<th>Sometimes</th>
<th>Fairly Often / Usually / Very Frequently</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>I follow through on the promises and commitments that I make.</strong></th>
<th>Almost Never</th>
<th>Rarely / Seldom</th>
<th>Once in a While / Occasionally</th>
<th>Sometimes</th>
<th>Fairly Often / Usually / Very Frequently</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>I give people a great deal of freedom and choice in deciding how to do their work.</strong></th>
<th>Almost Never</th>
<th>Rarely / Seldom</th>
<th>Once in a While / Occasionally</th>
<th>Sometimes</th>
<th>Fairly Often / Usually / Very Frequently</th>
<th>Almost Always</th>
</tr>
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<tbody>
<tr>
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</tbody>
</table>
I reflect on (think, write, or talk about) my teaching practices based on my own observations as well as after receiving feedback from my colleagues or administrators.  

I make it a point to let people know about my confidences in their abilities.  

I paint the “big picture” of what we (our class, school or district) aspire(s) to accomplish.

### TEACHER LEADERSHIP PRACTICES (13-18 of 18 items)

#### TEACHER LEADERSHIP PRACTICES (13-18 of 18 items)

**9. DIRECTIONS:** For each item, select the level that BEST describes your role as a teacher (with interactions with your colleagues).

<table>
<thead>
<tr>
<th></th>
<th>Almost Never</th>
<th>Rarely / Seldom</th>
<th>Once in a While/ Occasionally</th>
<th>Sometimes</th>
<th>Fairly Often/ Usually/ Very Frequently</th>
<th>Almost Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I praise people for a job well done.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I set goals for my professional development and take action to improve my practice.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I seek out challenging opportunities that test my own skills and abilities.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I talk about future trends that will influence how our work gets done.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I set a personal example of what I expect of others.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>I speak with genuine conviction to colleagues about the higher meaning and purpose of our work.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</table>

**TECHNOLOGY INTEGRATION & USE (1-5 of 10 items)**

**Technology Integration & Use**

**DIRECTIONS:** For each of these 10 low-cost or free technology tools listed, indicate 2 things:

1) **TYPE OF INTEGRATION USE (1-5)** for learning on the teacher/student continuum from 1-5, OR select

- Not Sure (?) = You do not know about the tool or are not sure if you have access to it
- No Use (0) = You do not use the tool or you do not have access to it

2) **FREQUENCY of USE**

- If you selected “?” (Not Sure) or “0” (No Use), there is NO NEED to complete the frequency column selection.

**Example (for Presentation Software, such as PowerPoint):**

- Select “1” = If you use PowerPoint to display notes/images for students that you created and **students only view it**
- Select “3” = If you use PowerPoint for student projects where **students add to your presentation**
- Select “5” = If you have students create their own PowerPoint for an assignment or project from scratch with NEW, synthesized information (not just copied and pasted).
- **NOTE:** If you use a tool in **more than one way**, choose the most often used method or type of use
<table>
<thead>
<tr>
<th><strong>TEACHER-CENTERED</strong></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th><strong>STUDENT-CENTERED</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CREATED</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>CREATED</strong></td>
</tr>
<tr>
<td><strong>(TEACHER-ACTIVE)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>(STUDENT-ACTIVE)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher uses ONLY to create materials, show, demonstrate, present. NO hands-on use by students; students only observe teacher demonstration or computer-based information (Ex. video, images, audio book, PowerPoint, etc.)</td>
</tr>
<tr>
<td>Teacher primarily uses technology to answer memorization or fact-based questions (right-wrong, drill &amp; practice) or to follow a teacher-created lesson.</td>
</tr>
<tr>
<td>Teacher AND student use this tool, BOTH do some creating /presenting/ analysis with this tool. &quot;Time with technology&quot; is somewhat equitable. Teacher still provides foundational structure and/or direction. Students have opportunity to create/ develop/ initiate with tool, perhaps on some teacher-created tasks/small assignments or activities.</td>
</tr>
<tr>
<td>Teacher more of a facilitator or guide, but provides some structure or templates; possibly creates a rubric or checklist for students to follow. Students take a primary role in technology use in the exploration or task/ creation/ development; students may use a vague/general instructions (but not detailed, recipe-like instructions)</td>
</tr>
<tr>
<td>Teacher facilitates student use of tool. Teacher may still provide guidelines/rubric but also provides opportunity for student choice, problem solving, problem-based scenario, and/or group or collaborative work setting. Students use tool to synthesize ideas, create NEW knowledge. Students are the primary builders/ creators/ designers and may even be involved in the assessment (e.g. self or peer assess; co-creation of rubric); students often work in pairs or groups</td>
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<th><strong>3</strong></th>
<th><strong>4</strong></th>
<th><strong>5</strong></th>
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<tbody>
<tr>
<td>Teacher-Centered / Created (Teacher-Active)</td>
<td>MOSTLY Teacher-Centered / Created</td>
<td>Teacher &amp; Student Centered / Created (Blenched)</td>
<td>MOSTLY Student-Centered / Created</td>
<td>Student-Centered / Created (Student-Active)</td>
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</tbody>
</table>
10. **Technology Tools: Type of Integration & Frequency**

<table>
<thead>
<tr>
<th>Tools</th>
<th>Type of Integration</th>
<th>Frequency (if used)</th>
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</thead>
<tbody>
<tr>
<td>Blogs (weblogs) and/or Concept Mapping or Graphic Organizers</td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
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<tr>
<td>(computer/handheld-created, not hand-done) Ex. – Inspiration,</td>
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<tr>
<td>Kidspiration, Cmap, SMART Ideas, Visio, etc.</td>
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<tr>
<td>Digital Audio or Podcasts (including finding/using or creating audio</td>
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<td>-- Please Select --</td>
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<tr>
<td>clips; recording/playback of sound/music/voice)</td>
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<tr>
<td>Digital Pictures or Video (TAKEN with own camera &amp; USED)</td>
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<td>-- Please Select --</td>
</tr>
<tr>
<td>Digital Pictures or Video (FOUND &amp; USED – from image website</td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
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<tr>
<td>such as Flickr, Google Images, Picsearch, etc.)</td>
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**TECHNOLOGY INTEGRATION & USE (6-10 of 10 items)**
### TYPE OF INTEGRATION

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<tbody>
<tr>
<td><strong>Teacher-Centered / Created</strong> (Teacher-Active)</td>
<td>MOSTLY Teacher-Centered / Created</td>
<td>Teacher &amp; Student Centered / Created (Blended)</td>
<td>MOSTLY Student-Centered / Created</td>
<td>Student-Centered / Created (Student-Active)</td>
</tr>
<tr>
<td>Teacher uses ONLY to create materials, show. demonstrate, present. NO hands-on use by students; students only observe teacher demonstration or computer-based information (Ex. - video, images, audio book, PowerPoint, etc.)</td>
<td>Teacher primarily uses and is in control of the technology; Students use technology to answer memorization or fact-based questions (right-wrong, drill &amp; practice) or to follow a teacher-created lesson.</td>
<td>Teacher AND student use this tool. BOTH do some creating /presenting/ analysis with this tool; &quot;time with technology&quot; is somewhat equitable. Teacher still provides foundational structure and/or direction. Students have opportunity to create/ develop/ initiate with tool, perhaps on some teacher-created tasks/small assignments or activities.</td>
<td>Teacher is more of a facilitator or guide, but provides some structure or templates; possibly creates a rubric or checklist for students to follow. Students take a primary role in technology use in the exploration or task/ creation/ development; students may use vague/general instructions (but not detailed, recipe-like instructions)</td>
<td>Teacher facilitates student use of tool. Teacher may still provide guidelines/ rubric but also provides opportunity for student choice, problem solving, problem-based scenario, and/or group or collaborative work setting. Students use tool to synthesize ideas, create NEW knowledge. Students are the primary builders/ creators/ designers and may even be involved in the assessment (e.g., self or peer assess; co-creation of rubric); students often work in pairs or groups</td>
</tr>
</tbody>
</table>

11. **Technology Tools: Type of Integration & Frequency**

<table>
<thead>
<tr>
<th>Presentation software (Ex. - PowerPoint, Keynote, Google Presentation, etc.)</th>
<th>Type of Integration</th>
<th>Frequency (if used)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-- Please Select --</td>
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</table>

<table>
<thead>
<tr>
<th>Spreadsheets or databases (Ex. - Excel, Access, Work Sheets, AppleWorks database,</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
</tr>
<tr>
<td>Google Spreadsheet/Forms, etc.</td>
<td></td>
<td></td>
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<tr>
<td>--------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Web searching and/or researching (including Webquests)</td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
</tr>
<tr>
<td>Web 2.0 Tools/ websites - Glogster, Wordle, Ning, Delicious, Voicethread, Edmodo, Twitter, etc.)</td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
</tr>
<tr>
<td>Word Processing (Ex. - MS Word, Pages, etc.)</td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
</tr>
</tbody>
</table>

**DEMOGRAPHICS (Part 1 of 3; 22 items in this LAST section)**

12. Grade level range you currently teach (mostly, if more than one level) *

☐ PreK-2

☐ 3-5

☐ 6-8

☐ 9-12

☐ 2 or more of these ranges EQUALLY

☐ Prefer not to answer

13. Subject(s) you currently teach – (no more than 2)

☐ I teach 3 or more subjects (self-contained classroom teacher, such as an elementary teacher)

☐ Arts (music, visual, theater, etc.)

☐ Business

☐ Computer/Technology (or similar)

☐ English/Language Arts

☐ English Language Development (ELD/ELL/ESL)

☐ Family & Consumer Sciences (or Careers)
☐ Foreign Language
☐ Health
☐ Math
☐ P.E.
☐ Science
☐ Social Studies/History
☐ Special Education / Intervention
☐ Prefer not to answer
☐ Other (list here)

14. Your School / District (answer required to summarize district data) *
☐ Bowling Green
☐ Maumee
☐ Perrysburg
☐ Rossford
☐ Springfield
☐ Sylvania
☐ Other: 

15. What year of full-time teaching is this for you (not counting substitute teaching)?
☐ 1
☐ 2-4
☐ 5-9
☐ 10-14
☐ 15-19
☐ 20-24
16. What is the level of reliable wireless Internet access in your BUILDING (not the district) – such as for use with laptops, netbooks, smart phones, and/or iPads/tablets:

☐ Not sure/ I don't know
☐ No wireless access in the building I work in most (we use a cord to connect to the network/Internet)
☐ Some rooms/areas in my building have wireless access
☐ Most rooms/areas in my building have wireless access
☐ ALL rooms/areas in my building have wireless access

17. Which of the following technologies do you use for school-related work: (Select any/all that apply)

☐ School-provided LAPTOP computer (not shared)
☐ School-provided DESKTOP computer (not shared)
☐ School-provided CELL PHONE or SMART PHONE
☐ My personal (non-school) LAPTOP computer
☐ My personal (non-school) DESKTOP computer
☐ My personal (non-school) CELL PHONE (non-Internet)
☐ My personal (non-school) SMART PHONE (Internet access)
☐ None of the above (or only access to shared computers or cell phone)

DEMOGRAPHICS (Part 2 of 3)

18. (For Management-related Tasks) On average, how many hours per week (at work AND home) do you use a computer or other technologies for job-related tasks/management/duties (grade book, IEPs, making seating charts, school/district emails, parent emails or communications, newsletters, etc.)?

☐ Less than 2 hours for “Management Tasks” (on average per week)
☐ 3-5 hours for “Management Tasks” (on average per week)
6-10 hours for “Management Tasks” (on average per week)

11-15 hours for “Management Tasks” (on average per week)

16+ hours for “Management Tasks” (on average per week)

19. (For Instruction-related Tasks) On average, how many hours per week (at work AND home) do you use a computer or other technologies for teaching or student learning-related tasks (finding/preparing lessons or lesson plans, researching, creating assessments, grading, practicing with new tools/strategies, communicating with students, etc.)?

- Less than 2 hours for Instruction Tasks (on average per week)
- 3-5 hours for Instruction Tasks (on average per week)
- 6-10 hours for Instruction Tasks (on average per week)
- 11-15 hours for Instruction Tasks (on average per week)
- 16+ hours for Instruction Tasks (on average per week)

20. How much of this time using a computer for job-related tasks (from the last 2 questions) is completed at HOME or NOT at school?

- 0% at home (all done at school)
- 1-25% at home/non-school
- 26-50% at home/non-school
- 51-99% at home/non-school
- 100% (all at home/non-school)

21. How many working computers are in your classroom and of those, how many are connected to the Internet (have web access)?

<table>
<thead>
<tr>
<th># Computers in Classroom...</th>
<th>TOTAL # in Room</th>
<th># Connected to Int</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-- Please Select --</td>
<td>-- Please Select --</td>
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</tbody>
</table>

22. What other technologies do you have available OR in your classroom? (or select...
"NEITHER" if not available at all

<table>
<thead>
<tr>
<th></th>
<th>AVAILABLE: ACCESS TO USE</th>
<th>IN MY CLASSROOM</th>
<th>NEITHER (not available for use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive white board (SMART, Promethean, eno, Mimio, etc.)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Digital projector (connects to computer, DVD, VCR, etc.)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Document camera</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Digital still camera or video camera</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>&quot;Clickers&quot; – student response devices/remotes and software</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>USB flash drive (memory drive; thumb drive)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

23. On average, over the past three (3) years, how often do you attend **VOLUNTARY** training or professional development opportunities in ANY education-related area (e.g., workshops, conferences, seminars, courses/classes **NOT mandated by your school/district**, but CAN be for license renewal, etc.)?

- ☐ Never
- ☐ Rarely – 1-2 times per year
- ☐ Sometimes – few to several times per year (3 to 6 times)
- ☐ Often – about once per month
- ☐ Frequently – 2+ times per month

**DEMOGRAPHICS (Part 3 of 3) - LAST Section!**

FOR next question set, refer to this list of 7 stages of tech integration...
24. Which of the seven stages (shown above) BEST describes the stage of technology for teaching and learning for...

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>You: Today</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You: 3 Years Ago</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOST Teachers TODAY in your building (on average)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25. How often do you teach or have you taught a course for college or university students (graduate or undergraduate, but NOT including high school PSO- post secondary option courses)?

- Never have taught a college/university course – don't plan to do so
- Never have taught a college/university course – would like to someday
- Have taught, but not currently and don't plan to again
- Have taught, but not currently and I plan to teach again
- Sometimes – 1 course per year or every other
- Often – 2-3 courses per year
- Frequently – 4 or more courses per year
26. During your career, which of these leadership-type positions have you been in (for a year or more) – Select any/all that apply:

- Department Chair or Grade level leader/Head teacher
- Mentor for peer(s) or new teacher(s)
- Teacher union representative/executive committee (elected by peers)
- Coach (teaching, technology, and/or sport coach)
- Co/Extra-curricular adviser
- Other 

27. Gender

- Female
- Male

28. Age Range (years)

- 20-29
- 30-39
- 40-49
- 50-59
- 60+
- Prefer not to answer

29. Highest Education Level Completed:

- Bachelors degree
- Graduate coursework (but no graduate degree yet)
- Masters degree
- Masters +30
- Doctoral/specialist coursework (in an official program; not just taking additional graduate courses after Masters)
30. **What type of Ohio teacher certification do you currently have? (Select one or more, if applicable)**

- [ ] Working toward Senior or Lead professional license (5-year); AND select other(s)...
- [ ] Provisional (2-year) OR Professional license (5-year)
- [ ] Permanent certificate (issued 2003 or earlier)
- [ ] Senior or Lead professional license (5-year)
- [ ] Master Teacher (Ohio designation)
- [ ] Administration certification/license (principal, assistant, superintendent)
- [ ] Not sure OR None of these
- [ ] Prefer not to answer
- [ ] Other

31. **Do you have a Masters degree in Instructional/Classroom/Educational Technology (or similar name)?**

- [ ] No (skip next question)
- [ ] Yes (complete next question)

32. **If you answered "Yes" above (you have a Masters degree in educational technology)**

<table>
<thead>
<tr>
<th>From which institution (college, university, etc.)?</th>
<th>Fill in...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the degree program (such as &quot;Classroom Technology&quot; or &quot;Educational Technology&quot;, etc.)</td>
<td>Fill in...</td>
</tr>
</tbody>
</table>

**Thanks again!**
Thank you for completing this survey!

Your participation and time are *greatly* appreciated.

*Amazon.com Gift Certificate Drawing*

and

*Top 10 Free Tech Tools List:*

In order to maintain confidentiality of your survey data, [CLICK HERE](#) to go to a separate site to enter the drawing for the Amazon.com gift certificate and/or request a copy of the final results (when you submit that form, you'll get a link to download the Top 10 Free Tech Tools List and a link to my dissertation blog about this research).
APPENDIX D. QUESTIONS INCLUDED AND EXCLUDED ON THE TEACHER LEADERSHIP PRACTICES INVENTORY (T-LPI) FROM LEADERSHIP PRACTICES INVENTORY (LPI) (KOZUES & POSNER, 2003)

Leadership Practices Inventory (LPI): Copyright © 2003 James M. Kouzes and Barry Z. Posner. All rights reserved. Used with permission.

<table>
<thead>
<tr>
<th>LPI Practice Category</th>
<th>LPI Questions/Statements <em>Included</em> in T-LPI</th>
<th>LPI Questions/Statements <em>NOT</em> Included in T-LPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model the Way</td>
<td>1. I set a personal example of what I expect of others.</td>
<td>6. I spend time and energy making certain that the people I work with adhere to the principles and standards we have agreed on.</td>
</tr>
<tr>
<td></td>
<td>11. I follow through on the promises and commitments that I make.</td>
<td>21. I build consensus around a common set of values for running our organization.</td>
</tr>
<tr>
<td></td>
<td>16. I ask for feedback on how my actions affect other people’s performance.</td>
<td>26. I am clear about my philosophy of leadership.</td>
</tr>
<tr>
<td>Inspire a Shared Vision</td>
<td>2. I talk about future trends that will influence how our work gets done.</td>
<td>7. I describe a compelling image of what our future could be like.</td>
</tr>
<tr>
<td></td>
<td>17. I show others how their long-term interests can be realized by enlisting in a common vision.</td>
<td>12. I appeal to others to share an exciting dream of the future.</td>
</tr>
<tr>
<td></td>
<td>22. I paint the “big picture” of what we aspire to accomplish.</td>
<td>27. I speak with genuine conviction about the higher meaning and purpose of our work.</td>
</tr>
<tr>
<td>Challenge the Process</td>
<td>3. I seek out challenging opportunities that test my own skills and abilities.</td>
<td>13. I search outside the formal boundaries of my organization for innovative ways to improve what we do.</td>
</tr>
<tr>
<td></td>
<td>8. I challenge people to try out new and innovative ways to do their work.</td>
<td>18. I ask “What can we learn?” when things don’t go as expected.</td>
</tr>
<tr>
<td></td>
<td>28. I experiment and take risks, even when there is a chance of failure.</td>
<td>23. I make certain that we set achievable goals, make concrete plans, and establish measurable milestones for the projects and programs that we work on.</td>
</tr>
<tr>
<td>Enable Others to Act</td>
<td>4. I develop cooperative relationships among the people I work with.</td>
<td>14. I treat others with dignity and respect.</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>9. I actively listen to diverse points of view.</td>
<td>24. I give people a great deal of freedom and choice in deciding how to do their work.</td>
</tr>
<tr>
<td></td>
<td>24. I give people a great deal of freedom and choice in deciding how to do their work.</td>
<td>29. I ensure that people grow in their jobs by learning new skills and developing themselves.</td>
</tr>
<tr>
<td>Encourage the Heart</td>
<td>5. I praise people for a job well done.</td>
<td>15. I make sure that people are creatively rewarded for their contributions to the success of our projects.</td>
</tr>
<tr>
<td></td>
<td>10. I make it a point to let people know about my confidences in their abilities.</td>
<td>20. I publicly recognized people who exemplify commitment to shared values.</td>
</tr>
<tr>
<td></td>
<td>25. I find ways to celebrate accomplishments.</td>
<td>30. I give the members of the team lots of appreciation and support for their contributions.</td>
</tr>
</tbody>
</table>
APPENDIX E. HSRB APPROVAL

DATE: December 9, 2011

TO: Carrie Rathsack, M.Ed.
FROM: Bowling Green State University Human Subjects Review Board


SUBMISSION TYPE: Response/Follow-Up

ACTION: APPROVED

APPROVAL DATE: December 9, 2011

EXPIRATION DATE: October 20, 2012

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category #7

Thank you for your submission of Response/Follow-Up materials for this project. The Bowling Green State University Human Subjects Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The final approved version of the consent document(s) is available as a published Board Document in the Review Details page. You must use the approved version of the consent document when obtaining consent from participants. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that you are responsible to conduct the study as approved by the HSRB. If you seek to make any changes in your project activities or procedures, those modifications must be approved by this committee prior to initiation. Please use the modification request form for this procedure.

You have been approved to enroll 1500 participants. If you wish to enroll additional participants you must seek approval from the HSRB.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must also be reported promptly to this office.

This approval expires on October 20, 2012. You will receive a continuing review notice before your project expires. If you wish to continue your work after the expiration date, your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date.

Good luck with your work. If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsr@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.

Please add the text equivalent to the HSRB approval/expiration date stamp to the "footer" area of the electronic consent form.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Bowling Green State University Human Subjects Review Board's records.
Informed Consent to Participate in the Research Study
(1st Page of Online Survey)

October 2011

Dear Northwest Ohio Teacher,

Introduction & Purpose

The purpose of this study is to examine the relationship between teachers’ leadership practices and their technology integration in their teaching. Data for this study is being collected through an online survey that will take approximately 12-20 minutes to complete. Because of the length of the survey and realizing that your time is extremely valuable, incentives are being offered for your participation. Your participation in this survey is completely voluntary and confidential and you are free to withdraw at any time. You may skip questions or discontinue participation at any time without penalty.

Benefits and Risks of Participating in this Study

Your participation in this study will help contribute to better understanding the role of teacher leadership and technology integration, which may also contribute to the improvement of teacher education and ongoing professional development for teachers in Northwest Ohio.

There are no anticipated risks to you for completing the survey, but because this is a Web-based (online) survey, there is a minimal chance that individuals not involved with the study could intercept your responses during or after transmission. After completing the survey, please clear the web browser cache and page history to help ensure no information from the survey remains easily accessible. Furthermore, deciding to participate or not will not affect your grades or your relationship with Bowling Green State University, your school district, your job, or any institution involved in the research.

Incentives for Participation

In exchange for your time, twelve (12) people who complete the survey by (DATE = 2-3 WEEKS FROM START DATE) will be randomly selected to receive either a $20 or $50 Amazon.com gift certificate. Those who complete the survey by (DATE=1 WEEK FROM NOW) will be eligible for an “early bird” drawing for one of two (2) $50 Amazon.com certificates. Non-winners of the early bird drawing will get DOUBLE entries in the remaining drawing for one of ten (10) $20 Amazon.com certificates. In other words, it’s BEST to get your survey completed early to improve your chances – plus, you’ll make this researcher very happy! Chances of being selected are based on responses received (this survey will be sent to approximately 1500 teachers in Northwest Ohio, so if all respond, your odds are less than 1 in 100; if only 500 teachers respond, your odds are about a 1 in 42 chance of winning).

At the end of the survey, you will be asked for your choice of entering the gift certificate drawing as well as whether you’d like to receive information about the results of this research – BOTH are optional and voluntary and neither is connected to your survey responses.

Confidentiality

As the primary researcher, I will be the only individual with access to the confidential raw data. All summarized or shared information will be in aggregate or summarized form to protect any personal or identifying information gathered through your participation in this study.
Questions or for More Information
If you have any questions at any time regarding this survey or the overall research project, you can contact me (carrier@bgsu.edu) or Dr. Rachel Vannatta Reinhart, my dissertation chair (rvanna@bgsu.edu). You may also contact the Chair, Human Subjects Review Board, Bowling Green State University at (419) 372-7716 (hsrb@bgsu.edu), if any problems arise or you have concerns about your rights during the course of the study.

Consent
Your completion and submission of this survey indicates your consent to participate. Again, at any time, you can withdraw your consent or discontinue participation in the research without penalty.

Thank you in advance for your time and consideration regarding this research study of Northwest Ohio teachers!

Sincerely,
Carrie Rathsack M.Ed.
Rossford Schools
Bowling Green State University
carrier@bgsu.edu
December 2011
Dear Northwest Ohio Teacher,

My name is Carrie Rathsack and I'm working on my dissertation in Leadership Studies at BGSU. For my research study, I have created an online survey to examine teachers' leadership practices and their technology integration. Your school district has agreed to participate, thus, you're receiving this email invitation.

The survey is voluntary and confidential and takes about 12-20 minutes to complete. If you don't have time right now to complete the survey, please make a note in your calendar to do so some time this week!

Because I know your time is valuable, there are a couple of incentives -- 12 survey respondents will receive either a $50 or $20 Amazon.com gift certificate for completing the survey (awarded in January). In addition, as a small "thank you" for everyone who completes the survey, I've included a link to my list of "Top 10 Websites/Tools" for learning — spend some time over break checking them out!

More information and the official consent form are available below (at the bottom of this message) and on the first page of the survey. To learn more and begin the survey, click the link below (or copy/paste it into your web browser).

SURVEY LINK:


Thank you for your time and sharing a small part of what you do!

~Carrie Rathsack
Integration Specialist, Rossford Schools
Doctoral Candidate, Bowling Green State University
carrier@bgsu.edu

MORE INFORMATION & OFFICIAL CONSENT:

Introduction & Purpose
The purpose of this study is to examine the relationship between teachers’ leadership practices and their technology integration in their teaching. Data for this study is being collected through an online survey that will take approximately 12-20 minutes to complete. Because of the length of the survey and realizing that your time is extremely valuable, incentives are being offered for your participation. Your participation in this survey is completely voluntary and confidential and you are free to withdraw at any time. You may skip questions or discontinue participation at any time without penalty.

Benefits and Risks of Participating in this Study
Your participation in this study will help contribute to better understanding the role of teacher leadership and technology integration, which may also contribute to the improvement of teacher education and ongoing professional development for teachers in Northwest Ohio.

There are no anticipated risks to you for completing the survey, but because this is a Web-based (online) survey, there is a minimal chance that individuals not involved with the study could intercept your responses during or after transmission. After completing the survey, please clear the web browser cache and page history to help ensure no information from the survey remains easily accessible. Furthermore, deciding to participate or not will not affect your grades or your relationship with Bowling Green State University, your school district, your job, or any institution involved in the research.
Incentives for Participation In exchange for your time, twelve (12) people who complete the survey by Saturday, December 31st will be randomly selected to receive either a $20 or $50 Amazon.com gift certificate. Those who complete the survey by Monday, December 19th will be eligible for an “early bird” drawing for one of two (2) $50 Amazon.com certificates. Non-winners of the early bird drawing will get DOUBLE entries in the remaining drawing for one of ten (10) $20 Amazon.com certificates. In other words, it’s BEST to get your survey completed early to improve your chances – plus, you’ll make this researcher very happy! Chances of being selected are based on responses received (this survey will be sent to approximately 1500 teachers in Northwest Ohio, so if all respond, your odds are less than 1 in 100; if only 500 teachers respond, your odds are about a 1 in 42 chance of winning).

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Confidentiality As the primary researcher, I will be the only individual with access to the confidential raw data. All summarized or shared information will be in aggregate or summarized form to protect any personal or identifying information gathered through your participation in this study.

Questions or for More Information If you have any questions at any time regarding this survey or the overall research project, you can contact me (carrier@bgsu.edu) or Dr. Rachel Vannatta Reinhart, my dissertation chair (rvanna@bgsu.edu). You may also contact the Chair, Human Subjects Review Board, Bowling Green State University at (419) 372-7716 (hsrb@bgsu.edu), if any problems arise or you have concerns about your rights during the course of the study.

Consent Your completion and submission of this survey indicates your consent to participate. Again, at any time, you can withdraw your consent or discontinue participation in the research without penalty.

Thank you in advance for your time and consideration regarding this research study of Northwest Ohio teachers!

Sincerely, Carrie Rathsack, M.Ed.
Rossford Schools
Bowling Green State University
carrier@bgsu.edu
APPENDIX G. MODIFIED STAGES OF TECHNOLOGY ADOPTION (MSTA)  
(MODIFIED FROM CHRISTENSEN & KNEZEK, 1999; RUSSELL, 1995)

1) **Awareness** – I am aware that technology exists, but I have not used it - perhaps I'm even avoiding it

2) **Learning the process** – I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers

3) **Understanding and application of the process** – I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful

4) **Familiarity and confidence** – I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer

5) **Adaptation to other contexts** – I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid

6) **Creative application to new contexts** – I can apply what I know about technology in the classroom; I am able to use it as an instructional tool and integrate it into the curriculum in new ways

7) **Assisting others** – I use my skills and knowledge of computers and applications to assist others in various stages of technology adaptation (face to face, conference presentations, &/or via online communities)