

CHAPTER 5. SUMMARY AND DISCUSSION

This chapter presents a summary of the study along with conclusions drawn from findings presented in Chapter 4. Included in this chapter is a discussion of the implications of these findings for action as well as recommendations for further research.

Summary of the study

This study worked within the field of education technology leadership. The purpose of this study was to develop and validate a survey instrument based on the International Society for Technology in Education's (ISTE) education technology leadership standards. A survey, the Education Technology Leadership Assessment (ETLA) was developed that was designed to assess the extent of the education technology leadership of the survey respondent. The instrument was designed to be used as a web based, self-assessment survey tool. The methods of the study incorporated the use of an expert judgment panel to assist in survey item creation and validation. A field test of the ETLA was conducted and the results from the field test were used to generate findings related to the reliability and validity of the ETLA instrument. Exploratory factor analysis (EFA) was also performed in order to identify underlying structures and patterns in the data gathered in the field test.

Overview of the problem

Education technology leadership has been found to be an important element in the integration of technology with education. Standards that describe the skills required by education technology leaders have been developed. The ISTE Technology Leadership (TL) Standards are an example. The development of an instrument designed to assess the extent to which an individual or group possess education technology leadership skills

would be useful to those interested in the development and study of education technology leadership. The purpose of this study was to develop a reliable and valid assessment of education technology leadership as defined by the ISTE TL Standards that could be used to contribute to the study and development of education technology leadership. The ETLA was designed to address this need.

Review of the methodology

The study was organized into two phases. In Phase 1, an expert judgment panel of existing education technology leaders was formed. The panel consisted of school technology coordinators with education technology leadership credentials. The expert panel reviewed potential survey items and rated their alignment with the TL Standards using a five point scale. In addition to providing an indication of the content validity of the draft ETLA items the feedback gathered from the expert panel assisted the researcher in the refinement and alignment of the items with the eight TL Standards. At the conclusion of Phase 1, the ETLA had been narrowed from 44 draft survey items to 38 survey items. Six of the TL Standard areas were each represented by scales of 5 items, and the other two TL Standard areas were each represented by 4 item scales.

Phase 2 of the study involved a field test of the ETLA. The field test of the survey was conducted with a convenience sample of educators from the Des Moines Public School District, an urban district of approximately 32,000 students located in Des Moines, Iowa. The information collected in the field test was used to statistically evaluate the reliability and validity of the ETLA survey and to examine the underlying data structures inherent in the data set generated by the ETLA survey.

Across the two phases of this study were the following accomplishments:

1. A literature review was conducted of current and emerging education technology leadership standards and sources. This review provided information that aided the researcher in the construction of draft ETLA survey items.
2. The creation of final form survey items using the assistance of an expert panel was conducted and completed.
3. Collection of data from a convenience sample population of 300 participants through a field test of the survey was completed. The data obtained was used in analyses of the ETLA survey's reliability and validity. The structure of the data set was also examined using exploratory factor analysis methods.

Major findings

The study's primary purpose was to create a reliable and valid education technology leadership survey tool. Major findings that provided evidence of ETLA survey reliability and validity emerged from both the expert judgment panel review phase and the field test phase of this study.

Expert Panel

The main findings from the study's work with the expert judgment panel were related to the face validity of ETLA items. The expert panel's primary purpose was to review draft ETLA items and rate each item's alignment with a technology leadership standard. Results from the work of the expert panel provided evidence to support a claim of alignment of ETLA survey items with the TL Standards. For example, all 44 draft items had expert panel ratings higher than 3 on a five point scale. The score of 3 was associated with the opinion that the item was "Somewhat" aligned with the TL Standard. Twenty three items had expert panel ratings higher than 4 on the five point scale. The

score of 4 was associated with the expert opinion that the item was “Strong” in its alignment with the TL Standard. These findings indicated to the researcher that the expert panel believed the draft ETLA items were all at least somewhat aligned with a TL Standard. Using this information, the researcher worked to strengthen ETLA item alignment with the TL Standards. Using the feedback from the expert panel, the researcher reviewed and revised 21 draft ETLA items, and in doing so created the study’s final version of the ETLA survey.

Reliability and Validity

Several major findings concerning the reliability and validity of the ETLA survey were discovered based on the results reported from the field test phase of the study. Measures of survey reliability provided an indication that the survey would produce similar results for similar sets of respondents. If the ETLA was to be used to compare groups of respondents, it’s was important that ETLA results were reliable so that the comparisons are fair and accurate. To examine ETLA survey reliability, Cronbach’s Alpha (Alpha) statistics were generated for the survey using a data obtained in a field test of the ETLA survey. For this study, Alpha scores above 0.70 were considered to provide a strong indication of reliability. Alpha scores were created for the survey overall, and for each item scale within the survey. The survey overall had an alpha score of $\alpha = 0.97$. Within the survey, seven of eight item scales had an alpha score greater than 0.75. The Alpha scores found through the analysis of the field test data provided evidence that the ETLA items were generating statistically reliable results.

The Productivity and Professional Practice item scale showed the lowest reliability compared to the other item scales. Even though this item scale’s Cronbach

Alpha score ($\alpha = 0.71$) was acceptable, it was the lowest of all item scale Alpha scores. Also, all ETLA items that had been aligned to the Productivity and Professional Practice standard had item-rest correlations lower than 0.5. And the mean score for the inter-scale correlations within this standard area was the lowest of all eight of the ETLA item scales. These measures provided evidence to the researcher that the reliability measures associated with the Productivity and Professional Practice item scale were lagging behind the other seven item scales.

The ETLA was modeled after an education technology leadership survey designed for school administrators, called the Principal Technology Leadership Survey (PTLA) (Center for the Advanced Study of Leadership in Education, 2005). Where the ETLA was based on NETS TL Standards (Twomey et al., 2006), the PTLA was based on the NETS-A Standards (ISTE, 2004). Both standard sets included a Productivity and Professional Practice standard. It is interesting to note that PTLA results for Productivity and Professional Practice showed lower reliability, similar to the ETLA.

One possible explanation for the lower reliability of the Productivity and Professional Practice item scale is that the respondents may have had lower consensus as a group about the nature of the standard area. A lack of a common understanding of the standard area could have resulted in more varied responses, which would tend to generate lower reliability scores.

Even though they were lower, the reliability indicators for the Productivity and Professional Practice scale were within acceptable ranges. However, the indication of a lower reliability of the Productivity and Professional Practice scale when compared to the seven other standard areas indicate that, although the ETLA items aligned with the

Productivity and Professional Practice standard may be appropriate when considered in the context of the overall instrument, this scale of items is weaker than the other item scales as an independent measure of their specific education technology leadership skill set.

While a goal of this study was to develop a survey that was both reliable and valid, the ability to conduct rigorous analysis of survey item validity was limited. A strategy used by the researcher in the search for evidence of ETLA survey validity was to examine the Field Test Data Set through the lens of various theoretical constructs. This concept of construct validity is concerned with the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts that are being measured (Carmines & Zeller, 1979, p. 23). In this study, three separate assessments were conducted to support the researcher's analysis of construct validity: (1) the Job Group Assessment, (2) the Not Applicable Assessment, and (3) the Matched Data Assessment.

All three construct validity assessments generated findings providing evidence of ETLA item validity. For example, in the job group assessment analysis the theoretical construct that job group mean scores would vary was supported by the statistical results generated from the Field Test Data Set. Principals as a job group had the high overall mean scores for five of the eight TL Standard item scales. Building Technology Specialists as a job group had the top overall mean scores for the other three TL Standard item scales. The Principals rated themselves the highest in the TL Standard area of Teaching, which would align with the expectation that Principals are the instructional leaders of their schools. The Building Technology Specialists rated themselves highest in

the TL Standard area of Productivity. This would be expected; given that the Building Technology Specialists' primary job role was helping others use technology effectively. The evidence of construct validity in the Job Group Assessment indicates that a potential future use of the ETLA could be to help explore and differentiate the nature of education technology leadership across job groups.

The hypothesized theoretical construct for the Matched Data Assessment was that the item scores of the Principal would relate to the item scores of the Teacher. For this assessment, the indicators of primary interest to the researcher were (1) the ETLA item mean scores of Principals compared to Teachers, and (2) the correlation of the matched responses between Principals and Teachers. The a priori expectation was that a claim for ETLA item construct validity would be supported if item mean scores for Principals and Teachers varied similarly and if item scores were highly correlated. While it was important to be cautious in interpreting the results of the small Matched Data Set sample, the findings did report that the item scale mean scores for the Principals were consistently higher than the item scale mean scores of the Teachers.

The ETLA item rating scale included a *Not Applicable* selection. The Not Applicable Assessment was designed by the researcher to discover if ETLA items garnered many Not Applicable responses. The hypothesized theoretical construct was that the response set for valid items would not contain more than 5% of Not Applicable responses. As reported in the study's findings, only two ETLA items exceeded this threshold. These findings provided evidence of construct validity for the ETLA survey overall.

In research associated with the use of surveys, the assessment of a survey's reliability and validity is an ongoing exercise. While the reliability and validity assessments incorporated into the methods of this study are constrained by a limited amount of data for analysis, they have provided a basis for the continued consideration of the ETLA's reliability and validity.

Factor Analysis

Major findings were reported tied to information developed through exploratory factor analysis (EFA) of the data collected in the field test of the ETLA survey. The EFA results of most interest to the researcher included the factors generated by the factor analysis and the ETLA item inter-relationships associated with those factors.

In EFA methodology, a factor is defined by the set of correlated items that are associated with the factor as part of the factor analysis process. This is the "factor" part of factor analysis methodology. Once the factors are generated, the associated item scale can be examined by the researcher and conclusions can be drawn about the nature of the factor. This is the "analysis" part of factor analysis methodology. The EFA methods used in this study generated six factors. Each factor was defined by a scale of ETLA items generated by the factor analysis. It was interesting to note the EFA result that each factor had item scales that contained ETLA items from more than one TL Standard area. This finding indicated that, based on data obtained in the field test, various ETLA items were correlated across the TL Standard areas. This inter-relationship between TL Standards and factors was depicted in Figure 14.

The TL Standard framework was used by the researcher in creating the ETLA survey. The finding of a factor structure based on groupings of correlated ETLA items

provided an alternative framework from which to consider education technology leadership. The discovery of the alternative framework was not unexpected. A suggestion of this alternative framework had been found in the literature and is discussed in more detail in the next section.

Findings Related to the Literature

This section of Chapter 5 will relate the findings of this study to the education technology leadership topics found in the literature. The review of literature for this study, found in Chapter 2, presented information about various aspects of education technology leadership, including a review of standards that have been developed for education technology leadership. This review of standards helped the researcher to identify the essential characteristics of education technology leadership.

The discussion of education technology leadership in the literature was not confined to the definition of education technology leadership standards. The various sources of education technology leadership were also described in the literature. Several sources of education technology leadership were identified by the researcher in the review of the literature, including the education technology leadership of school administrators, teachers, and technology coordinators. Included in this study's report about education technology leadership sources was the case for collaborative leadership as a form of leadership that lends itself well to organizations seeking to build education technology leadership capacity.

Education Technology Leadership Frameworks

The researcher's review of performance standards related to education technology leadership identified a set of standards developed by the ISTE organization as part of its

NETS Project work. These standards, known as the Technology Leader (TL) Standards (Twomey et al., 2006), were designed to define the framework of skills required for effective education technology leadership. This framework was considered by the researcher to be well suited for the purposes of this study, and the TL Standards framework was used to provide the underlying structure for the ETLA survey. The TL Standards were also useful to the researcher by providing a primary reference for the variety of skill sets required for effective education technology leadership. The TL Standards provided the researcher a “Standards View” framework for use in the consideration study results related to education technology leadership.

Within a framework of education technology leadership standards, the standard’s indicators do not necessarily exist independent of each other. As described in the review of literature, Twomey (2006, p. 69) recognized that indicators of the TL Standards had common threads serving as “unifying features that, viewed together, create a complete and complex picture of a Technology Leader”. Twomey suggested the use of technology leader themes to better understand the inter-relationships of the technology leadership standards.

The exploratory factor analysis (EFA) used in this study provided a useful method to identify education technology leadership themes. The factors generated through factor analysis methods consisted of groupings of ETLA items with high inter-item correlation. In terms of these inter-item correlations, the factors were fairly distinct from each other. The use of EFA to identify themes in the form of correlated data structures provided the researcher with a “Thematic View” framework for use in the consideration of education technology leadership.

The main components of both the Standards View and the Thematic View are represented and measured with ETLA item scales. For the Standards View, item scales aligned with the TL Standards with the assistance of an expert panel already existed. These item scales can be separated out and used to evaluate attainment of specific education technology skill sets as defined by the TL Standards. Mean scores for these item scales would be an indicator of relative strength or weakness of the respondent related to the associated TL Standard skill set.

The Thematic View framework is based on factors discovered using exploratory factor analysis. In this framework, the factors represent the education technology leadership themes. The factor loadings generated by factor analysis can be used to identify ETLA item scales associated with these education technology leadership themes. Mean scores for these item scales would be an indicator of relative strength or weakness of the respondent related to the associated theme.

The Standards View would be useful when the ETLA user's focus is on the development and assessment of skill sets aligned with each TL Standard. For example, an education technology leadership development program might choose to provide instruction related to technology planning. This instruction would be designed with a goal of developing skill related to TL Standard 2 (Planning and Designing Learning Environments). In this example, the ETLA survey would be used to measure student achievement relative to the ETLA Planning and Designing Learning Environment indicators. From the Standards View, the TL Standard 2 item scale would be the main ETLA measure for the Planning and Designing Learning Environments skill set.

By contrast, the Thematic View framework is based on collections of items that are highly correlated, but may be otherwise somewhat unrelated. Rather than representing a specific skill set, such as Planning and Designing Learning Environments, the Thematic View is based on themes that provide theoretical constructs representing areas of general purpose aptitude related to technology leadership. Continuing the example above, the use of a technology planning thematic constructs would be done in recognition that indicators of technology planning exist in TL Standards other than TL Standard 2. In the Thematic View, the ETLA item scale associated with the Planning factor would be the primary measure of technology planning.

The availability of two education technology leadership frameworks based on the same set of ETLA indicators provide users of the ETLA survey alternative views from which to consider ETLA data. The Thematic View would provide a more comprehensive measurement of technology planning compared to the Standards View. The Standards View measure would provide more information about specific skills related to technology planning.

As noted in the review of literature for this study, the work by ISTE in developing the NETS-A Standards and the TL Standards relied on forming a consensus view of what the makeup of the standards should be. The NETS-A Standard and TL Standard sets are considered to represent the common wisdom about what technology leadership means to the practitioners in the field. While there has been research exploring technology leadership based on these standards sets, there is limited research aimed at validating the standard sets themselves. Thus there is the possibility that there are gaps in the standards. The results from this study showing lower scores associated with ETLA items aligned to

the Productivity and Professional Practice Standard area is an indicator that this standard area may have room for improvement. The finding in this study that the eight TL Standards could be reduced to five factors provided evidence that the standards for technology leadership could be further condensed.

Sources of Education Technology Leadership

In the review of literature for this study several different sources of education technology leadership were identified. School administrators, school teachers, and school technology officers were identified as sources often expected to provide education technology leadership to schools. In the field test of the ETLA survey, there were indications that the ETLA results were able to differentiate the various types of education technology leadership sources (administrator, coordinator, and teacher). For example, this study reported a finding that the mean ETLA item scale scores for Principals, Building Technology Specialists, and Teachers were different. It is important to note that this finding was limited by the availability of one data set for evaluation. Additional research would be required to determine the ability for a researcher to use ETLA results to guide categorization of education technology leadership by job role.

Regardless of the individual's job role, the ETLA would appear to be a useful tool for education leaders to use as they consider their own technology leadership strengths and weaknesses. When used as a self-assessment, the ETLA survey provides respondents with a reminder of the skills important for effective education technology leadership. The resulting ETLA data in the form of item mean scores and item scale mean scores help the respondent to identify individual areas of education technology leadership strengths and weakness. The education technology leadership information can serve to inform both

respondent and also inform the broader organization that the respondent is associated with.

The concepts of leadership capacity and collaborative leadership were described in the study's review of literature. Leadership capacity was defined as "an organizational concept meaning broad-based, skillful participation in the work of leadership that leads to lasting school improvement" (Lambert, 2005, p. 38). In a school's pursuit of collaborative leadership, a desired outcome was the development of organizational leadership capacity (Elmore, 2000). While the source of leadership may come from several or many, the goal in collaborative leadership was to limit gaps in the collective essential leadership skills.

The ETLA survey would be a useful tool for those responsible for the development of collaborative education technology leadership capacity in a school. The ETLA could be used to assess the collective education technology leadership of a group of school staff, and results of the ETLA could be used to identify education technology leadership strengths and weaknesses for the group. The ETLA results could be analyzed using item scales from both the Skill and the Thematic framework views, and based on the analysis a strategic plan could be developed designed to build the education technology leadership capacity of the group across the full range of the ETLA frameworks. In this way, the ETLA could serve as an assessment tool useful for providing feedback for a school's data-driven continuous improvement process.

The study's review of literature reported that education technology leadership was considered by many experts to be an important factor in the effective technology integration with teaching and learning. Given this, the ability to measure and assess

education technology leadership would be important to efforts focused on the use of technology to support teaching and learning. Based on the results and findings reported in Chapter 4, it appears that ETLA results could provide a useful measure of education technology leadership, both for specific individuals and for groups of individuals responsible for leading education technology initiatives.

Implications for Action

As discussed in Chapter 1, education technology leadership has been identified as an important factor in the integration of technology with teaching and learning. The purpose of this study was to develop a reliable and valid web-based survey tool, the ETLA, to assist in the assessment of education technology leadership. The ETLA is based on the International Society for Technology in Education's (ISTE) Technology Leadership (TL) Standards framework. The ETLA survey was designed to be used to help identify the strengths, weaknesses, and gaps associated with the TL Standards. The ETLA survey could be used across a variety of education settings as either an individual or group assessment tool. This section will provide three examples of potential ETLA use: (1) as a tool to guide professional learning community activities, (2) as an activity to incorporate into pre-service teacher preparation, and (3) as a survey to provide feedback to district technology planning efforts.

Using the ETLA with Professional Learning Communities

The term Professional Learning Community (PLC) is typically used in school settings to describe a collegial group of administrators and school staff who are united in their commitment to student learning. The ETLA survey would be a useful tool in support of PLC work related to education technology. Typically a PLC develops a shared

vision, work and learn collaboratively, visit and review other classrooms, and participate in decision making (Hord, 1997). The benefits PLC related efforts provide to the staff and students include a reduced isolation of teachers, better informed and committed teachers, and academic gains for students. Hord noted, "As an organizational arrangement, the professional learning community is seen as a powerful staff-development approach and a potent strategy for school change and improvement."

The PLC experience is based on the central tenant of the PLC's collective knowledge existing in the process of "becoming". PLC learning can be viewed as an on-going "Brunerian Spiral"; i.e., a learning spiral which is constantly increasing in depth and sophistication. The basic premise of the Brunerian Spiral concept is that, the first time content is presented to a learner; it is introduced in fairly broad strokes. Later, the content will be provided again, but at a deeper level with additional detail. Over time, the content will be repeated, each time building upon what the learner already knows, so that additional layers can be provided. When viewed from above, it would appear to be a spiral, with each iteration passing over and reviewing the same content, but also providing new content to extend prior knowledge and experience (Bruner, 1966). The concept of PLC learning as a spiral that is continually expanded through study, practice, professional development and reflection, offers a powerful theoretical model of the stages that PLC members go through in becoming leaders. The development of the spiral ultimately leads to greater sophistication in the PLC members' pursuit of life-long continuing professional development.

PLCs can be formed in school settings to address any topic related to student learning, including those with elements of education technology. PLCs and education

technology integration are both strategies that can be used to support school change and improvement. There is synergy inherent in combining them in the form of a PLC interested in exploring the use of education technology to impact school improvement.

Schools often choose to use PLCs as a strategy to develop their culture by deepening their collective learning related to specific topics, such as the effective integration of technology with learning. Culture refers to norms of behavior and shared values among a group of people (Kotter, 1996). Norms of behavior are common ways of acting that persist because group members teach the behavior to new members. Shared values are goals shared by most of the people in the group, and these values shape the groups behavior. For schools, culture is defined by Deal and Peterson (1999) as:

A school's own unwritten rules and traditions, norms, and expectations that seem to permeate everything: the way people act, how they dress, what they talk about or avoid talking about, whether they seek out colleagues for help or don't, and how teachers feel about their work and their students (p. 2-3).

A school with a culture infused with PLCs would be focused on continuous learning. Therefore, self-assessment and reflection would be important elements of the PLC experience. For a PLC interested in considering education technology related topics, their understanding of education technology could be strengthened through the development of the PLC's education technology leadership capacity. As a self-assessment tool designed for use by any educator, the ETLA survey would lend itself to the assessment needs of a PLC interested in education technology. The ETLA survey could be used by a PLC to assess their collective education technology leadership strengths and weaknesses.

The ETLA could be used as a self-assessment of education technology leadership by each PLC member. The results of the ETLA could then be used to support a reflective discussion by the PLC about education technology and education technology leadership. For example, ETLA results from each TL Standard item scale could be reviewed by the PLC, and they could discuss their answers to the following questions:

- Based on ETLA results, what are the education technology leadership strengths of our PLC?
- Based on the ETLA results, what are the education technology leadership weaknesses of our PLC?
- What opportunities do our collective education technology leadership strengths provide to our PLC goals to improve student learning via the integration of education technology?
- What risks do our collective education technology leadership weaknesses present to our PLC goals to improve student learning via the integration of education technology?

The ETLA could be used just once, or multiple times over the period of PLC work. Use of the ETLA multiple times would help the PLC determine if growth related to education technology leadership was occurring, and to provide useful information to support the continued PLC reflection related to their collective education technology leadership strengths and weaknesses.

Using the ETLA with pre-service teacher preparation

The TL Standards, which served as the framework for the ETLA, emerged from work by National Council for the Accreditation of Teacher Education (NCATE). The

NCATE technology leadership program evaluation process was based on a performance-based outcomes model. Evaluation of teacher education program effectiveness required evidence of program alignment and responsiveness to NCATE standards. Teacher preparation programs interested in NCATE accreditation were required to integrate activities aligned with the TL Standards where appropriate into their curriculum. It would be possible to design such an activity based on the ETLA survey.

In this example, the ETLA survey could be introduced in the early stages of the pre-service teacher preparation program that is associated with education technology. The ETLA survey does not necessarily require development of knowledge related to education technology prior to its use as a self-assessment by an individual. Therefore, the pre-service teacher learning experience could be supported by using the ETLA survey as an education technology advanced organizer.

An advance organizer is defined as “information that is presented prior to learning and that can be used by the learner to organize and interpret new incoming information” (Mayer, 2003). Using this definition in this example, the ETLA would be used to introduce pre-service teachers to knowledge about education technology leadership. This knowledge would then serve as an umbrella framework for new material related to education technology to be taught in the pre-service program.

To be used effectively with pre-service teachers as an advanced organizer of education technology leadership knowledge, it might be best to not use the ETLA as a self-assessment. While the ETLA survey does not necessarily require knowledge of the TL Standards, it does expect real school-place experience. Pre-service teachers would have limited school experience to draw from when responding to the survey items.

Instead of using the ETLA to self-assess the extent of their technology leadership, the activity with pre-service teachers could use the ETLA to evaluate the education technology leadership of a mentor teacher. In this activity, the pre-service teacher would be asked to recall a teacher they believed used education technology effectively, and then use the ETLA to evaluate the extent that teacher exhibited the various aspects of education technology leadership. Presumably, the pre-service teachers would discover gaps in the technology leadership of the teacher they selected, which could then be used in the activity as the foundation for further reflection.

With this activity, the pre-service teacher preparation program would have an opportunity to connect learning related to education technology to the education technology leadership framework designed by NCATE. For these pre-service teachers, their deeper awareness of education technology leadership would support their efforts related to the integration of education technology with learning.

Using the ETLA to inform comprehensive technology planning

The application of education technology in a school district is complex and has the potential to overwhelm district resources. School districts that rely on a reactive, as needed approach in their adoption of education technology run the risk of making costly, personality-driven choices, rather than tactical decisions that align with their larger organizational strategy and goals. It is the education technology plan that assists and guides school districts in the application of education technology. Technology planning can assist school districts in accomplishing their education technology related goals (Fenn, Linden, & Fairchok, 2003).

School technology plans are built upon the district's education technology mission and vision. Comprehensive school technology planning efforts involve the development of both strategic and operational plan components. The ETLA survey could be a useful tool in support of district level strategic and operational technology planning.

The strategic technology plan deals with the “why” and the “when” of technology planning. Strategic planning is often approached from an administrative level and primarily focuses on the broader vision or goals of a project (C. McKenzie & Padayachee, 2001). Strategic planners work to effectively and efficiently manage, administer, and monitor the technology plan to ensure that the plan's outcomes and general direction is in accordance with organization objectives and simultaneously, the vision and mission of the organization. Strategic technology planning uses processes that are designed to determine technology needs and sets priorities for those technology needs. The strategic technology planning process works to help educators consider the connection between program activities and student outcomes. In this age of increasing accountability for schools, it is important for the school's strategic technology planning effort to not only address education technology goals, objectives, and activities, but also include indicators, benchmarks, and data sources.

As discussed in Chapter 1, education technology leadership has been shown to contribute to the effective integration of education technology with learning. Given this premise, it would be expected that the development of education technology leadership capacity would be a component of a comprehensive strategic technology plan. The ETLA survey could be used to measure organizational education technology leadership capacity by providing the survey as a self-assessment to members of the organization. If the

survey was used in this way on an annual basis, the district's strategic technology planners could use the ETLA results to identify strengths and weaknesses of the organization related to education technology leadership. These results would then guide the planners in developing action steps for the operational technology plan related to the development of education technology leadership capacity in the organization.

The operational technology plan component of a school's technology plan targets the "what" and the "how" of education technology integration with learning. The operational plan is sometimes referred to as the current plan, tactical plan, or short-range plan. Contrasted with the futuristic and goal-oriented strategic technology plan, the operational technology plan is results and action oriented. The operational technology plan is designed to support day-to-day operations. The operational technology plan consists of the action steps necessary to implement the prioritized needs flowing from the strategic plan.

For an example of the use of the ETLA survey to inform strategic and operational technology planning, consider the results of this study's ETLA field test. As shown in Table 10, the field test respondents' lowest scores were in the TL Standard area of Leadership. Based on this information, a strategic technology plan goal could be developed to increase the Leadership score as measured by ETLA. In order to carry out this goal, the technology planner could develop action steps associated with the specific ETLA item indicators associated with the Leadership standard. Table 20 provides a list of these indicators and examples of action steps that might be added to the operational technology plan in support of the strategic goal to increase the organization's ETLA score for the Leadership standard.

Table 20. Examples of action steps aligned with ETLA items

Item	Item Description	Action Step
F.I.1	To what extent did you participate in your district's or school's most recent technology planning process?	Solicit feedback about technology needs, and report back out those needs will be address in the technology plan.
F.I.2	To what extent did you communicate information about your district's or school's technology planning and implementation efforts to your school's stakeholders?	Provide information about the district's technology plan in a form that can be shared with parents.
F.I.3	To what extent did you promote participation of your school's stakeholders in the technology planning process of your school or district?	In the information packet designed for parent, provide a feedback form that can be directed back to the technology planning process.
F.I.4	To what extent did you compare and align your district or school technology plan with other plans, including district strategic plans, your school improvement plan, or other instructional plans?	Encourage the inclusion of technology planning artifacts to be included in the employee job performance portfolios.
F.I.5	To what extent did you engage in activities to identify best practices in the use of technology (e.g., reviews of literature, attendance at relevant conferences, or meetings of professional organizations)?	Encourage the inclusion of best practice technology integration artifacts to be included in the employee job performance portfolios.

Progress related to the strategic technology plan goal to improve education technology leadership capacity could be tracked through the administration of the ETLA survey on a periodic basis. Results would be reviewed, and adjustments to the operational plan's action steps could be made. In this way the ETLA survey would serve as a tool to

strengthen the alignment of the strategic technology plan and operational technology plan. This alignment would help ensure the strategic and operational plans are complementary, which would be an indicator of a comprehensive education technology plan.

Summary

As discussed in the examples above, the ETLA survey could generate results and information useful for a variety of education situations. When used as a self-assessment of education technology leadership, the ETLA survey would provide results that could be viewed from an intrinsic perspective; i.e., the results would provide information about the extent of education technology leadership related to the individual taking the self assessment. The ETLA results could also be viewed from an outside or extrinsic perspective; e.g., to inform education leaders about the extent of education technology leadership capacity available to a school's education technology related initiatives. The main implication for action related to the ETLA was to use the ETLA survey as a tool to inform the work of educator(s) related to education technology and education technology leadership.

Recommendation for Future Research

If the ETLA is to be used as a reliable and valid assessment of education technology leadership, more research needs to be done with collecting and analyzing ETLA data sets. While the findings reported in this study provide encouraging evidence that the ETLA is a reliable and valid education technology leadership assessment, there were limits in this study's methods associated with the limited number of ETLA data sets available for analysis. One recommendation for future research is that the methods of this

study need to be replicated, and the resulting data sets need to be analyzed to determine if the ETLA survey is generating consistent results.

It would not be difficult to collect additional data for use in the continued evaluation of ETLA reliability and validity. The ETLA could be made available on the Internet as a generally available web-based assessment tool. If this ability was established, the data collected would be available for the further analysis of the ETLA and also useful as a source of immediate feedback to the survey respondent. While this method of data collection would not be random and generalized to a larger population, this strategy for data collection would provide information of similar rigor and usefulness compared to the data used in this study.

Assuming the ETLA continues to display evidence of reliability and validity in these future trials, the potential to incorporate the ETLA into education technology leadership research would emerge. Following is a list of potential research questions that could be explored in part through the use of the ETLA survey.

Future Research Question 1: How does proficiency with education technology impact education technology leadership?

Future Research Question 2: How does proficiency with education technology affect the results of factor analysis of the ETLA data set? Are ETLA responses correlated differently for education technology experts compared to education technology novices?

Future Research Question 3: Does education technology leadership vary in ways similar to education leadership?

Future Research Question 4: How does education technology leadership vary between “high tech” and “low tech” schools?

Future Research Question 5: How would ETLA results contribute to the job performance portfolio of an education leader?

Future Research Question 1 asks for the examination of the relationship between education technology proficiency and education technology leadership. This examination would be relevant in several education settings, including teacher preparation programming. The ISTE TL Standards were developed in part to help inform teacher preparation programs of the skills sets required for effective education technology leadership. It would be interesting to observe if education technology leadership varies (increases) as pre-service teachers become more adapt at the use of education technology. For example, if there was a strong correlation found between education technology knowledge and education technology leadership in pre-service teachers, then teacher preparation programs might conclude that education technology leadership in pre-service teachers was being appropriately nurtured by their education technology training. If a strong correlation was not found, then teacher preparation program might consider adding components into their training designed to develop to a greater extent education technology leadership skills in pre-service teachers.

Future Research Question 2 would be directed at a potential research interest in the nature of the inter-item correlations of the ETLA items. The factor analysis performed in this study generated six factors, based on the ETLA Field Test Data Set. However, factor analysis on additional ETLA data sets generated from different sample populations could produce different factor structures. It would be interesting to observe if the factor

structures generated from ETLA data sets from accomplished education technology leaders would be different than the factors generated using data samples from novice respondents. In other words, do the ETLA item results correlate similarly for experts and novices? If similar factor structures were found, that finding would provide support for a global view of education technology leadership; i.e., all education technology leaders carry the same basic skills. If dissimilar factor structures were found then that information could help identify the “missing ingredients” between expert and novice education technology leaders; i.e., what makes the difference between good education technology leadership and great education technology leadership? In either scenario, this information would help to inform programs designed to develop education technology leadership.

Research related to Question 2 could also easily incorporate tasks designed to continue the assessment of ETLA reliability and validity. This continuing need was identified in the Major Findings section earlier in this Chapter. Data sets generated in support of research related to Question 2 could be examined for evidence of ETLA reliability and validity similar to the way this study evaluated the Field Test Data Set. This study’s examination found the Productivity and Professional Practice section of the ETLA to have lower reliability compared to other ETLA section, and the recommendation of the researcher looking towards the future would be to review and improve the ETLA items associated with this section. The examination of additional ETLA data sets might help to pinpoint other ETLA items in need of improvement.

Future Research Question 3 is based on the premise that the study of education technology leadership isn’t limited to education technology leadership research. Research

could also be conducted in relationship to education leadership programs in general. Education leadership programs are typically focused on the development of education leaders, including Principals and Superintendents. In this context it would be interesting to search for relationships between effective education leaders and effective education technology leaders. For education leadership programs that aspire to include education technology leadership artifacts as a part of comprehensive education leadership portfolio, research efforts related to Research Question 3 would help move those program's efforts towards those ends. At a minimum, the use of the ETLA with participants in education leadership programs as an education technology leadership self-assessment would provide an artifact that would contribute to any education leader's professional portfolio.

Future Research Question 4 would contribute to research efforts in the area of leadership capacity. According to school leadership capacity theory, leadership doesn't have to come from only a school administrator, such as the Principal. It can come from multiple sources. For this potential ETLA research thread, it would be interesting to assess the sources of education technology leadership in schools considered to be effective in the use of education technology. These observations could be compared with observations of the sources of education technology leadership in buildings considered to be less effective in their education technology use. It might be unlikely that this research would discover a "silver bullet" of a certain type of education technology leadership that would be found common in all schools judged to be effective in their technology implementation. However certain patterns or trends in education technology leadership might be found in effective schools compared to less effective schools. This information, if discovered, could contribute in significant ways to school improvement efforts

associated with education technology integration. A report by Anderson & Dexter (2005) outlines research methods that could be adapted to incorporate the ETLA Survey as a data source in the examination of education technology leadership and technology outcomes.

Work related to Future Research Question 5 would contribute to the study of the use of the ETLA as a job performance assessment tool. In the research design of this study, the methods associated with the Matched Data Set provided an example of how the ETLA could be used to assist with job performance evaluation. The Matched Data Set was created by having teachers use the ETLA as a self-assessment, and by having their supervisor use the ETLA to evaluate the teacher's ability related to education technology leadership. While it is beyond the scope of the ETLA survey to be used as the sole source of assessment of education technology leadership, the ETLA could be one of multiple assessments. While the ETLA scores obtained from supervisor and employee would be of interest, also of value would be the discussion between them about education technology leadership that could be facilitated by the use of the ETLA tool. Supervisor and employee could easily review, compare, and discuss ETLA results.

For example, this type of discussion could be based on a shared goal between the supervisor and employee of developing organizational education technology leadership capacity. In this example the discussion would not be "high-stakes", because the purpose would be one of mutually desired continuous improvement, not one of employee discipline or discharge. The ETLA assessment could be used multiple times by supervisor and employee, over a period of time. At first the ETLA results would help the pair to set goals related to education technology leadership capacity. Later the ETLA

results would serve to inform them if progress towards their education technology leadership goals was being made.

Research related to this type of use of the ETLA would be less concerned about internal ETLA reliability and validity related to the quality of the survey items, and more concerned about the external reliability and validity of the assessment related to the responses provided by the participants. As is the case with any self-assessment, honesty from all respondents would be a key to research related to ETLA use as a job performance measurement tool. For research related to Future Research Question 5, ETLA response integrity and fidelity would be important aspects that would need to be considered and controlled for in the research design.

Future research that incorporates the ETLA could explore the questions mentioned above, or other questions related to education technology and education technology leadership. It would be important that this future research to continue to evaluate the ETLA survey's reliability and validity, and to continue to make adjustments to strengthen items when needed. As more confidence in the ETLA survey results is achieved, the more valuable the ETLA survey will become as a research tool.

Conclusions

This research study was intended to contribute to the development of a reliable and valid education technology leadership survey tool. The resulting web-enabled survey, the Educator Technology Leadership Assessment (ETLA) was based on the eight ISTE Technology Leadership (TL) Standards (Twomey et al., 2006). The survey was created with the assistance of an expert judgment panel. The survey was then field tested by asking selected individuals to self-assess their education technology leadership skills, and

also by supervisors to assess the education technology leadership of a member of their staff. This study's findings were generated from the work with the expert judgment panel and from the work related to the study's field test of the ETLA survey. The reported findings in Chapter 4 provided evidence that the ETLA survey items were reliable and valid. However, the researcher's quest for indicators of ETLA survey item reliability and validity was limited by the lack of multiple data sets for analysis.

The review of literature for this study reported that the developers of the TL Standards had hypothesized the occurrence of themes underlying the TL Standards. Exploratory factor analysis (EFA) methods were used in this study to identify a set of education technology leadership themes. The themes, in the form of factors generated from the EFA, were defined by ETLA item scales produced by the EFA. The item scales contained items that were highly correlated with each other. While the results of this study's use of EFA were limited by the lack of multiple data sets for analysis, EFA methods were useful in providing a structured method for identifying and quantifying education technology leadership themes.

Based on the reported findings, the work of this study appears to offer a good start towards the development of a reliable and valid education technology leadership survey tool. For the ETLA to become a useful tool in the study of education technology leadership, further research and testing of the ETLA survey would be required. The methods designed for this study, including item mean score analysis and factor analysis, could be replicated in order to analyze data obtained from use of the ETLA survey with other sample populations. Those results, in turn, could be used to inform further refinement of the ETLA items.