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## Technology leadership: Lessons from empirical research

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This paper uses a grounded theory approach to derive key findings from 12 empirical studies on technology leadership. Roles of technology leaders were identified and categorized into four main areas of change: infrastructural, organizational structure and policy, pedagogical, and cultural change. Relationships between technology leadership and other factors were reported: School technology leadership is a strong predictor of the level of technology use in schools; the cultural and structural characteristics of schools could affect the level of computer use in classrooms; and transformational leadership is correlated with the principal's ICT competencies. Issues related to technology leadership and recommendations for future research are discussed.

Keywords: school technology leadership, review, empirical research

### Introduction

Educational researchers are devoting much effort to studying factors affecting technology integration in schools, of which school leadership has been identified as one of the most important factors (Byrom & Bingham, 2001). This concise paper reviews findings from empirical studies on technology leadership in schools. In particular, it summarizes the main types of roles of school technology leadership and the relationships among the constructs related to school technology leadership. While this paper reviews studies of technology leadership in K-12 schools, many of the generic issues related to technology integration will resonate with leaders in institutes of higher education. Knowing what happens in K-12 schools will also benefit technology leaders in higher education in terms of managing students' expectations and leveraging students' entering ICT competencies to achieve higher level goals. Beyond summarizing the key findings, this paper aims to contribute to research in technology leadership by initiating a discussion on key issues that might influence this field of study.

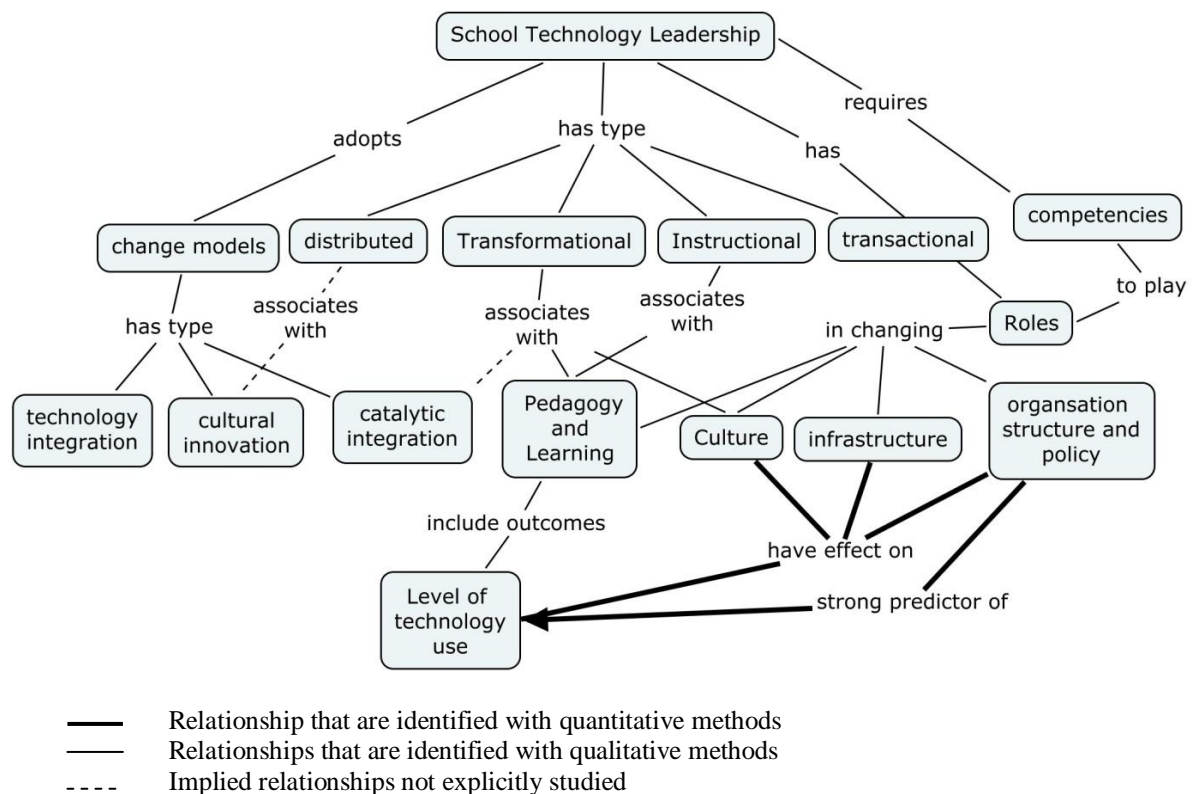
### Method

There were three main phases in this review: identification of relevant literature, identification of key ideas in each paper, and synthesis of frameworks for educational technology leadership. A search was conducted on peer-reviewed journals in five electronic databases, which include Academic Search Premier, ERIC, Educational Research Complete, PsychARTICLES and PsyINFO. Using the keywords "Education and Technology and Leadership", 255 articles were shortlisted. A review of the abstracts led to 9 empirical studies relevant to K-12 schools. This was followed by an expansive snow-balling method of tracing relevant references that were cited in these 9 articles and a further search in two journals: *Technology, Pedagogy and Education*; and *Educational Administration Quarterly*. Ultimately, 12 empirical reports were selected for this review, which are cited in the Findings section. The key themes from the findings of the empirical reports were generated by using a grounded theory approach, in particular, the constant comparison method. The papers were first scanned for their research foci,

which resulted in two categories: identification of roles and competencies of technology leaders. The roles of leaders were further regrouped into four categories. Next, the independent and dependent variables in quantitative reports were identified and integrated into the concept map. Relationships depicted or implied in qualitative reports were then incorporated. Consequently, a concept map was developed to summarize the key findings. Through this process, issues related to research on technology leadership were surfaced for discussion.

## Findings

A summary of the findings from the empirical reports on school technology leadership is presented in the concept map (see Figure 1). As the studies were conducted with different types of participants in various contexts, the relationships depicted in this map do not represent generalized principles. It is more appropriate to view this map as a summary of findings and an advanced organizer for the discussion. One of the main foci of the research papers is to examine the functional roles of technology leadership, in other words, what technology leaders do or should do. Through the review, these functional roles were categorized into four areas of change: (1) Infrastructural change, (2) organizational and policy change, (3) pedagogical change and (4) cultural change. These roles and the relationships among various key constructs are explained in the next few paragraphs.



**Figure 1: Summary of relationships among types of school technology leadership and their impact**

School leaders play an important role in providing an infrastructure that is conducive to the use of educational technologies. Technology infrastructure includes hardware (e.g., equipment and network), software (e.g., a learning management system), and resources (e.g., a tutorial program). It is important that the provision of infrastructure is equitable to all staff and students, rather than a selected group of people (Yee, 2000). Organizational and policy change is another common action taken by school leaders. Anderson and Dexter (2000, 2005) identified several indicators for technology leadership that include setting up of technology committees, district support for schools, staff development policy, school technology budget and intellectual property policy. Other organizational change could include the appointment of different levels of technology leaders, setting up of technology support services, and staff appraisal policy. In terms of pedagogical change, learning outcomes of students have been a main point of debate between advocates and opponents of educational technology. Technology leaders

in schools acknowledge their roles in enhancing student learning outcomes and pedagogical quality through the use of technologies. For example, “learning-focused envisioning” and “adventurous learning” were identified as important roles of school leaders (Yee, 2000, pp. 293-294). School leaders indicated that student learning should be the main focus for decision making related to ICT policies in schools, and teachers should be encouraged to experiment (adventurous learning) with the use of technologies in instruction (Yee). Using hierarchical linear modeling, Marks and Printy (2003) found that only when transformational leadership is integrated with instructional leadership, there is a substantial impact on pedagogical quality of teaching and student achievement. Cultural characteristics of a school refer to “the way people perceive, think and feel about things in schools” (Tondeur, Devos, Van Houtte, van Braak & Valcke, 2009, p. 226), or “the basic assumptions, norms and values and cultural artefacts that are shared by school members, which influence their functioning at school” (Maslowski, 2001, pp. 8-9). Yuen, Law and Wong (2003) held that cultural change is one of the most difficult but effective ways to achieve high quality and sustained integration of technology into classrooms.

Besides identifying the key roles of technology leaders, a few important relationships were established in some of these empirical studies through large scale sampling and statistical techniques. Anderson and Dexter (2000, 2005) conducted a nation-wide survey study with 1,150 U.S. schools. They found that technology leadership, compared to infrastructure factors, was a stronger predictor for three different dependent measures on technology outcomes: frequency of use of Internet by students and teachers, frequency of integration of ICT into lessons, and extent to which students use ICT for academic works in the school. The cultural and structural characteristics of schools could affect the level of computer use in classrooms. Tondeur, Devos, Van Houtte, van Braak and Valcke (2009) investigated 68 primary schools in Belgium and categorized them into two clusters based on cultural and structural characteristics of schools. They found that schools (N=41) which are strong in cultural characteristics and structural characteristics (ICT planning, support and infrastructure) have a significant higher mean level of computer use in classroom compared with schools (N=27) that are weak in these two measures. The relationships between types (or styles) of leadership and other factors were the focus in several papers. Ng (2008) developed and validated an instrument based on characteristics of transformational leadership (Leithwood, 1994) with 80 secondary school teachers from Singapore schools. The respondents generally agreed that these eight dimensions of transformational leadership could influence integration of ICT into teaching: identifying and articulating a vision, fostering acceptance of group goals, providing individualized support, offering intellectual stimulation, providing an appropriate model, creating high performance expectations, and strengthening school culture. Afshari, Bakar, Luan, Samah, and Fooi (2009) administered survey to 30 secondary school principals in Tehran. They found significant correlation between the principal’s computer competency level and transformational leadership practices but no such relationship was found with transactional leadership practices. They further suggested that transformational leadership could help to improve the use of technology for teaching and learning. In short, the following relationships were established: (1) School technology leadership is a strong predictor of the level of technology use in schools; (2) The cultural and structural characteristics of schools could affect the level of computer use in classrooms; (3) transformational leadership could influence integration of ICT into teaching; and (4) transformational leadership is correlated with principals’ computer competency.

Another important line of research focuses on change models in the ICT implementation. Yuen, Law, and Wong (2003) conducted a case study of 18 schools in Hong Kong and identified three change models, based on three criteria: perceived roles and impact of ICT, vision and values of ICT, and culture and history of change in the school. Technology adoption model, a top-down leadership approach, focuses on enhancing ICT competency of students. Catalytic integration model focuses on the use of ICT for curriculum reform; it is associated with visionary leadership that is also top-down. Cultural innovation model focuses on empowering staff and students to create new ideas with ICT; it is associated with distributed leadership.

## Discussion

This review shows the paucity of empirical studies in the field of school technology leadership. While there are many conceptual papers and books on technology leadership that suggest ideas on technology leadership, the warrants for the claims made in many conceptual papers are usually not explicitly declared. Some of these claims apparently were based on personal experience or secondary sources. In addition, among the shortlisted empirical studies, only three attempted to study quantitatively the

relationships among the constructs. The dominance of ideational papers and qualitative study indicate the infancy of this field of study, which is a potentially fertile area for research.

In most studies, the top leaders (the school principals in most cases) were assumed to be endowed with institutional power of technology leadership. This assumption is being challenged by researchers adopting the theoretical lens of distributed leadership. For example, Dexter (2007) found that technology leadership is a school characteristic (rather than individual) and it is distributed across people who have formal authority of decision making. There is a “recursive effect among the leaders, the situation, and the followers” (Dexter, 2007, p.20). Lai and Pratt (2004), for example, revealed how technology coordinators perceived their school leaders as impediment to their works by not providing sufficient time for planning, not providing professional development and not giving recognition to the coordinators. Thus, it would be valuable to examine perspectives of different stakeholders, which might reveal the discrepancies between espoused leadership (by the leader), the enacted leadership (by an observer) and the perceived leadership (by the followers).

Many studies are clearly influenced by theories and concepts of generic educational leaderships, for example, transformational leadership. While there are studies (e.g., Ng, 2008) that validate the applicability of these theories for technology leadership, it will be valuable to examine whether technology leadership possesses unique features or is more prominent in some dimensions of the leadership style. In addition, these different leadership types (or styles) need not be mutually exclusive. For example, Marks and Printy (2003) studied the impact of integrated leadership, which comprised both transformational leadership and instructional leadership.

There remain many relationships among the leadership constructs that can be explored. Each of the areas of change can be explored further, for example, quality of pedagogy and student achievement can be dependent variables and their relationships with leadership styles or change process can be examined. Taking the view of distributed leadership, we will need to expand the unit of analysis from a person (leader), to a group (e.g., a school). It will be valuable to study the complex relationship among various stakeholders in an organization. For example, Spillane, Halverson and Diamond (2001) proposed the use of an activity system to study distributed leadership. Marks and Printy (2003) used hierarchical linear modeling to study different levels of impact of the technology leaders on the teachers and on the students.

## Conclusion

This review set out to facilitate future research on school technology leadership, which is a critical factor that could affect quality of technology integration in schools, but yet an under-explored field of study. In this review, the roles of technology leaders were categorized into four main areas of change: (1) Infrastructural change, (2) organizational and policy change, (3) pedagogical change and (4) cultural change. Several relationships were established between technology leadership and other factors: school technology leadership is a strong predictor of the level of technology use in schools; the cultural and structural characteristics of schools could affect the level of computer use in classrooms; transformational leadership is correlated with principal’s ICT competencies. At least two studies examined the views of middle level leader and explored the reciprocal relationships between the leader and the followers. Possible research areas related to technology leadership include: Examination of technology leadership from perspectives of different stakeholders and investigation of relationships among various leadership factors. The review also uncovers several important methodological considerations, for example, the choice of unit of analysis, the choice of respondents or participants, and assumptions on the order of impact.

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