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Exploring Teacher Readiness: What Features of Professional Development Enhance Motivation to Implement Technology Innovations?

Robert S. Markle
University of South Carolina

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by

Robert S. Markle

Bachelor of Science, 2009
Clemson University

Master of Arts
University of South Carolina, 2013

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Accepted by:

Abraham Wandersman, Major Professor

Mark Weist, Committee Member

Kimberly Hills, Committee Member

Mitchell Yell, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

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Abstract

Several studies suggest that if evidence-based school innovations are to be successful, schools must possess adequate capacity to implement them with quality. This paper utilizes a framework of organizational readiness called $R=MC^2$, positing that readiness to implement with quality consists of three components: general capacities, innovation-specific capacities, and motivation. Specifically, this paper investigates whether certain key characteristics of professional development (active learning, integration, time for practice, collaboration, tailoring, coaching, and provision of feedback) can impact teacher motivation to implement novel educational practices. The paper answers two major research questions: 1) Which characteristics of quality professional development (PD) are related to each of the components of motivation described in the $R=MC^2$ model? and 2) Is motivation a significant mediator of the relation between quality professional development and teacher implementation of new practices? Data for this study were collected from a district-wide one-to-one computing initiative in a Southeastern school district. The purpose of the initiative was to provide each student in grades 3-12 with a personal laptop or tablet, with the goal of increasing personalized, authentic, collaborative, and tech-integrated (PAC-Tech) learning in the district. Data were collected from two sources: 1,509 teachers completed a survey relating to PD at their school, their motivation to implement the initiative, and their use of PAC-Tech learning in the classroom. In addition, four district-level Technology Integration Specialists (TIS) provided data concerning PD quality at each of the district's

schools as a secondary source of data. Mediation analyses revealed that motivation was a significant mediator of the relation between PD quality and teacher implementation quality. Using multi-level regression, analyses suggest that the most influential characteristics of PD on motivation are 1) integration of new ideas with teachers' existing knowledge, 2) tailoring PD to teachers' individual needs and preferences, 3) providing opportunities for collaboration among teachers, and 4) providing consistent feedback to teachers. Thus, the present results predict that schools that design PD that integrates new and familiar concepts to make it easy for teachers to learn a new practice, that allow teachers to work together in learning that practice, that provide feedback to teachers during the learning process, and that survey teachers about their specific needs, preferences, and learning styles are more likely to secure buy-in and support from teachers for a particular innovation. Further, this buy-in is subsequently related to the likelihood and quality of teacher implementation of that innovation. These results are likely to be of interest to schools and school districts seeking to enhance implementation of educational innovations and increase teacher buy-in for using novel, evidence-based strategies.

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CHAPTER 1: INTRODUCTION

The Importance of Quality Implementation in Schools

Over the past two decades, there has been a large movement to increase the number of evidence-based practices utilized in schools to improve educational outcomes such as student engagement, academic achievement, physical health, mental health, teacher use of instructional strategies, and parent involvement in school activities, among many others. Several education agencies, including the federal government, have called for schools to incorporate practices that have research support (Crespi & Politikos, 2004; Franklin & Hopson, 2004; Hoagwood, 2001, 2003; No Child Left Behind Act, 2001). Although thousands of school officials have taken note of this movement and have attempted to implement evidence-based innovations, the number of schools that successfully obtain the same positive outcomes that were demonstrated in research trials is far fewer than the number of schools who adopt them (Elliot & Mihalic, 2004; Gager & Elias, 1997; Gottfredson & Gottfredson, 2002). A nationwide survey of 3,691 school-based programs indicated that only half of prevention programs and one fourth of mentoring programs were being implemented according to quality standards that were used in research trials (Gottfredson & Gottfredson, 2002). Further, only 47% of services to families, 69% of counseling programs, and 78% of prevention programs lasted longer than one month. These findings suggest that many programs adopted by schools would

benefit from an analysis of the school's capacities as well as stakeholder buy-in prior to beginning implementation.

It is evident from the number of failed school programs that merely adopting a practice that has research supporting its effectiveness without considering implementation capacity is not sufficient for producing successful outcomes (Fixsen, Naoom, Blase, & Friedman, 2005). Fixsen and colleagues (2005, 2009) note that diffusion and dissemination alone do not lead to outcomes and call for a greater focus on post-adoption events including staff selection, pre-service and in-service training, ongoing coaching and consultation, staff evaluation, and data-informed decision making systems in order to increase the likelihood that an innovation will achieve its goals. Along the same lines, several implementation researchers have posited that in addition to choosing evidence-based practices, organizations must also possess sufficient "readiness" to implement these practices successfully (Armenakis & Harris, 2009; Backer, 1995; Drzensky, Egold, & Van Dick, 2012; Holt, Armenakis, Harris, & Field, 2006; Rafferty, Jimmieson, & Armenakis, 2013; Weiner, Amick, & Lee, 2008). Many implementation frameworks focus on the importance of building general capacities (e.g., strong leadership, resources, relationships, funding) and innovation-specific capacities (e.g., innovation-specific knowledge, skills, and abilities, program champions, implementation climate supports) to achieve readiness (Wandersman et al., 2008). This proposal seeks to add to the implementation science literature by positing that in addition to *general capacity* and *innovation-specific capacity*, schools that wish to successfully obtain their desired outcomes must also possess adequate *motivation* to implement innovations with quality. According to this theory, readiness consists of three major components: general

capacity, innovation-specific capacity, and motivation. This concept can be remembered using the heuristic "$R=MC^2$" (readiness equals motivation times general capacity times innovation-specific capacity; Scaccia et al., 2015).

Why Focus on Motivation?

Although the general and innovation-specific capacities needed to undertake a given innovation (i.e., staff, funding, resources) are typically concrete and identifiable, the factors needed to create staff motivation for implementing new practices (e.g., strong relationships, favorable attitudes, positive climate) are often less tangible. As a result, school leaders may have a more difficult time measuring the degree of motivation that is present among their staff and may not have the knowledge or training that prepare them to promote antecedents of motivation (Barnett & McCormick, 2003; Davis & Wilson, 2000). Given the difficulty associated with promoting staff motivation for adopting new practices in schools, the current proposal focuses on the motivation component of the readiness heuristic as it applies to school environments.

Several studies have investigated precursors of individual motivation to use innovations (Greenhalgh, Robert, MacFarlane, Bate, & Kyriakidou, 2004; Rogers, 2003; Schoenwald & Hoagwood, 2001; Scaccia et al., 2015). One widely cited theory is Rogers' (2003) work on diffusion of innovations. Although Rogers' work focuses mainly on how innovations diffuse throughout a society, many of the concepts can be applied to understanding why and how people in an organization decide to implement new practices. Rogers (2003) posits that diffusion of innovations is affected by five major innovation characteristics: relative advantage (the extent to which users can see a distinct advantage of the innovation over other competing innovations), compatibility

(the extent to which an innovation is perceived as consistent with an individual's goals and values, as well as past and current experiences), complexity (perceptions of simplicity and ease of use), trialability (the degree to which users feel they are able to experiment with an innovation before fully committing to implementing it), and observability (the extent to which positive outcomes of the innovation can be observed). In addition to these five components, Scaccia and colleagues (2015) added a sixth component, priority (perceptions of the extent to which innovation use is expected, prioritized, and meriting attention over other innovations). Despite the wealth of literature on innovation diffusion, however, no research has examined the extent to which these six factors impact teacher motivation to implement school innovations.

The Role of Professional Development

Within school environments, professional development (PD) activities present an ideal opportunity to affect motivation for implementing new practices (Abrami, Poulsen, & Chambers, 2004; Thoonen, Sleegers, Oort, Peetsma, & Geijsel, 2011). For the purposes of the current study, professional development is defined as "processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (Guskey, 2000, p. 16). PD is the major process by which school staff members receive information about new developments in education and learn new skills for implementing evidence-based practices designed to help their students succeed. Despite the purpose of PD, however, not all PD is of equal quality. Researchers have suggested there are several elements that, when incorporated into PD, are likely to increase teachers' implementation of new practices in the classroom. These key elements of quality PD include: active learning

opportunities, integration of familiar and novel ideas, follow-up support, time for practice, tailoring content to staff needs and interests, opportunities for collaboration, and provision of constructive feedback (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Desimone, Porter, Garet, Yoon, & Birman, 2002a; Thoonen et al., 2011; Wei, Darling-Hammond, & Adamson, 2010). Despite evidence that the presence of these characteristics is linked to subsequent changes in teachers' classroom instruction, very few studies of professional development have attempted to elucidate the mechanisms by which this effect operates. Some have suggested that teacher motivation may be a mediating factor in the relation between PD quality and instructional quality (Abrami et al., 2004; Thoonen et al., 2011). However, no studies have investigated how professional development may impact teacher motivation (as defined within the framework of organizational readiness) to implement innovations.

Purpose of the Current Study

Even though PD (which encompasses training and technical assistance) is a critical component for quality implementation (Meyers et al., 2012) and there is substantial evidence identifying the characteristics that make PD effective (Darling-Hammond, et al., 2009), few studies have investigated specific mechanisms by which characteristics of quality PD increases teachers' level of implementation of innovations. Given the gaps in the current literature concerning the role of motivation in the implementation of school innovations, the current study aims to (1) determine the extent to which characteristics of quality PD enhance specific components of teacher motivation to implement a new technology initiative, and (2) investigate whether teacher motivation

is a significant mediating factor in the relation between quality professional development and improved adherence to quality technology-related instruction.

The following literature review provides a more thorough background on the above ideas, including the concept of organizational readiness, the factors that contribute to individual motivation to implement new practices, and the key elements of quality professional development.

What is Organizational Readiness?

Organizational readiness is a concept that is used to delineate the factors that are necessary for organizations to successfully implement innovations (Weiner, 2009). As stated above, Scaccia and colleagues (2015) proposed the heuristic "$R=MC^2$" (readiness is equal to motivation times general capacity times innovation-specific capacity) to explain the relationship between the three major components necessary for organizational readiness. Although the purpose of the current study is to examine motivation specifically, a description of the three readiness components is provided below for contextual purposes.

General capacity. General capacity refers to the processes that are necessary for an organization to run smoothly so that they can implement any innovation successfully. General capacities include aspects of organizational functioning such as leadership, resources, relationships, funding, and organizational structure, and can be divided into human, technical, fiscal, and evaluative categories. Human capacities are the leadership and skills needed for an organization to get things done, technical capacities are those that require being able to use various program tools and materials (such as implementation tools or curriculum manuals), fiscal capacities refer to funding and

resources, and evaluative capacities include the skills and knowledge needed to collect data and evaluate organizational progress.

Innovation-specific capacity. Innovation-specific capacity consists of the human, technical, and fiscal conditions necessary to implement a *particular* innovation with quality (Flaspohler, Duffy, Wandersman, Stillman, & Maras, 2008; Livet & Wandersman, 2005). These capacities include innovation-specific knowledge, skills, and abilities, program champions, and implementation climate supports that are needed for a given innovation to be successful. As each innovation requires its own unique knowledge, skills, abilities, and supports to be implemented well, organizations must ensure that they possess sufficient innovation-specific capacities for the innovations they wish to use. One innovation-specific capacity of particular note with respect to motivation is the implementation climate surrounding a given innovation. Implementation climate refers to the extent to which the innovation is supported, prioritized, and meriting attention in an organization. Positive implementation climate is characterized by the presence of comprehensive, well-informed, and demonstrable management support (Klein & Knight, 2005). As described below, implementation *climate* is an innovation-specific capacity that can impact priority, a component of motivation to implement innovations.

Motivation. Motivation can be conceptualized as the perception of incentives or disincentives that contribute to the desirability of implementing new organizational practices (Scaccia et al., in press). For the purposes of the current paper, motivation includes both the desirability for implementing change in general as well as the desirability of implementing a specific innovation. Since desirability to change is what

lies at the heart of motivation, it is useful to examine both cognitive and affective factors within individuals that contribute to the desirability of implementing change (Rafferty et al., 2013). Cognitive factors include perceptions of the personal or organizational value of change, perceived difficulty of change, and perceived support for the change, both generally and in regard to a specific innovation (Bennett & Bennett, 2003; Dingfelder & Mandell, 2011; Emmons, Weiner, Fernandez, & Tu, 2012; Lai & Chen, 2011; Greenhalgh et al., 2004; Gustafson et al., 2003; Rogers, 1995). Affective factors include emotions that may accompany these thoughts about change, such as feelings of enjoyment, trust, hope, pride, interest, frustration, fear, and anger (Carr, Schmidt, Ford, & DeShon, 2003; Rafferty et al., 2013). In addition, level of excitement and enthusiasm for change also play into the affective component of motivation. These subcomponents of motivation are described in detail in the following section of this proposal.

Prior to discussing the factors that contribute to motivation, however, it is relevant here that some distinctions should be made regarding concepts relevant to motivation and readiness. First, some authors have suggested that there is a distinction between individual and organizational motivation (Rafferty et al., 2013; Marshak, 2004; Whelan-Barry et al., 2003). Rafferty and colleagues (2013) propose that just as individuals may possess different levels of motivation to implement new practices, organizations as a whole may also exhibit varying levels of motivation to implement these practices based on the shared motivation of the individuals within the organization. Some evidence suggests that organizational and individual factors interact to promote teacher change such that organizational conditions (including leadership and PD opportunities) impact individual motivation, which, in turn, impacts teacher practices (Karabenick & Conley,

2011; Thoonen et al., 2011). Since the purpose of this study is to examine effects of professional development on teacher motivation to implement a new technology initiative, the current study focuses on individual motivation, rather than organizational motivation.

A second distinction that should be made regarding motivation is that unlike capacity, each of the components of motivation (see next section) are perceptions rather than an objective reality (Armenakis, Bernerth, Pitts, & Walker, 2007; Eby, Adams, Russell, and Gaby, 2000; Holt, Armenakis, Feild, & Harris, 2007). As Holt and colleagues (2007) state, motivation in the context of readiness is "the extent to which an individual or individuals are cognitively and emotionally inclined to accept, embrace, and adopt a particular plan to purposefully alter the status quo" (p. 235). These perceptions are derived from an individual's personal experiences and are conveyed by interpersonal networks (Rogers, 2003). Because motivation among organizational staff often changes over time, evaluators must periodically assess individual motivation and determine how to enhance it if it is low.

Finally, it is important to note that motivation does not exist in a vacuum, separate from other readiness components (Thoonen et al., 2011; Weiner, 2009). In fact, the current paper proposes that motivation, general capacity, and innovation-specific capacity are interdependent and can reciprocally influence one another (Scaccia et al., in press). For example, when an organization receives a grant that provides additional funding and resources to implement an innovation (an innovation-specific capacity), service providers often become more motivated to use the innovation than they were before the additional

funding was obtained. Therefore, increases and decreases in capacity may directly lead to increases or decreases in motivation.

What Contributes to Motivation?

Research has identified several components that contribute to the motivation to implement novel practices in organizations (Emmons et al., 2012; Greenhalgh et al., 2004; Rogers, 2003; Rafferty et al., 2013). Based upon motivation literature, the cognitive components reviewed in this paper include: relative advantage, compatibility, complexity, observability, trialability, and priority. Affective factors reviewed in this paper include emotions and attitudes toward change, both positive and negative, such as feelings of enjoyment, trust, hope, pride, interest, consternation, surprise, and annoyance. In readiness terms, it is important to note that some of these factors include components of general and innovation-specific capacity, which can influence motivation, as described above. The influence of each of these factors on motivation to implement innovations is discussed below.

Relative advantage. For individuals to be motivated to implement an innovation, they must perceive the benefit/cost ratio of implementing the innovation to be greater than the benefit/cost ratio of their current practice (Aubert & Hamel, 2001; Greenhalgh et al., 2004). Therefore, relative advantage is the extent to which an innovation and its associated activities are perceived as being superior and more advantageous than the current activities being performed. Available evidence suggests that relative advantage is one of the best predictors of the rate of adoption of an innovation (Rogers, 2003). Perceived benefits of innovations might include anticipated positive outcomes for the population being served, reduced time, effort, and stress (in the long term), anticipated

prestige or accolades that may accompany certain highly regarded evidence-based innovations, while perceived costs may include extra time, effort, and anticipated negative outcomes. In addition, perceptions of costs and benefits of an innovation can change over time as a result of individuals receiving more information about the innovation, building skills to implement the innovation, or feeling that they have support from others who help them in implementing the innovation.

Compatibility. Compatibility is the extent to which an innovation is perceived as consistent with an individual's goals and values, as well as past and current experiences (Rogers, 1995). The more compatible a new practice is with an individual's current practices and with the individual's values, the greater the motivation to implement the practice (Aubert & Hamel, 2001; Denis, Hebert, Langley, Lozeau, & Trottier, 2002). Although it is clear that individuals in an organization each have different personal goals and values, there are often shared values within an organization. For example, teachers in a school often highly value their planning period, because it is one of the only times during the day when they can plan for lessons away from the responsibilities of managing students. An innovation that requires teachers to use time allotted for their planning period to work with students is likely to be received poorly and motivation for its use would remain low. Thus, organizational leaders must take steps to design innovations that are compatible with shared values of their employees if they wish for those innovations to be successfully implemented.

Organizations must also be careful to design and use innovations that are consistent and integrated with previously adopted ideas (Gustafson et al., 2003). Older ideas and practices serve as the foundation for adopting new practices. The extent to

which a new practice builds upon older practices and existing initiatives is a key determinant of individual motivation to implement the new practice (Darling-Hammond et al., 2009). In school settings, research suggests that new initiatives that take into account the context of the school and school system including existing resources, curriculum guidelines, and accountability systems (such as state and federal standards) are more likely to have an impact on teacher learning and motivation (Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Supovitz, Mayer, & Kahle, 2000). Thus, training for new innovations must link the new procedures and ideas with current practices to demonstrate the relevance of the innovation and to ensure a smooth transition in the way that the practitioner changes their current behavior. However, problems may arise when individuals experiment with new innovations but still apply old methods that are not compatible with the new innovation (Rogers, 1995). Organization leaders who feel a need to implement radical changes may find best results occur when they do so gradually and in stages, first introducing a new practice that is highly compatible with the old practice, then slowly transitioning to another practice that is compatible with the one before it, and so on down the line until the final result looks nothing like the original practice (Rogers, 1995). This method allows for significant change but does so in a manageable way that does not overwhelm the individuals who are implementing the innovation.

Complexity. Needless to say, innovations that are perceived by users as simple are more likely to foster motivation to use them than innovations that are perceived as complex (Plsek, 2003; Rogers, 1995). It is important to remember that it is the individual's perception of complexity that influences motivation to implement, rather

than any objective standard of complexity. Thus, it is not sufficient for change agents to introduce an innovation that they themselves perceive as simple. Instead, change agents must assess the potential users' perceptions of simplicity/complexity, and tailor their innovation to these perceptions. Perceived complexity of an innovation can be reduced by providing thorough training and technical assistance with opportunities for demonstration rather than purely didactic instruction, active rather than passive learning, and direct practical experience (Plsek, 2003). One way to increase the perceived simplicity of an innovation is to break the larger implementation process down into smaller and simpler parts that can each be executed incrementally. Dividing an implementation process into smaller components increases motivation by reinforcing individuals after each smaller part is successfully completed. This process of implementing innovations in a piecemeal fashion has demonstrated success in several contexts including healthcare (Plsek, 2003).

Trialability. Trialability is the degree to which users feel they are able to experiment with an innovation before fully committing to implementing as part of their routine practice. In organizations, service providers need time to learn and practice an innovation under their own conditions to reduce any apprehensions, work out the "kinks," and seek answers to questions that may arise in the implementation process. According to Rogers (1995), early adopters of an innovation typically place a higher value on trialability than later adopters because they are pioneering its use, compared with later adopters who can use the early adopters' behaviors as a model to guide their practice. Thus, when first introducing an innovation, change agents must provide opportunities for extensive practice and technical assistance to ensure the survival of an innovation. If an

innovation is introduced but not fully implemented due to low motivation or low capacity, it becomes much more difficult to introduce future innovations in that organization because service providers can become averse to the change process (Greenhalgh et al., 2004).

Organizational policies often require service providers to implement new innovations but provide very little time for practicing the use of new knowledge and skills required by the innovation before needing to implement it. The consistent adoption of new educational trends in schools is a prime example of how organizational leaders can introduce many new innovations but provide very little time for organizational staff to practice before fully implementing them. Teachers often have very little time to plan and practice during the school day, but are required to keep up with the latest pedagogical trends and implement them relatively quickly. As a result, teachers often become stressed, dissatisfied with the work climate at their school, and may only partially implement an innovation so that it is not carried out with quality. In turn, student outcomes may suffer, leading the school administrators to adopt even more new innovations to combat the problem. Thus, a cycle of inadequate training, poor teacher implementation, and poor student outcomes continues.

An additional consideration with trialability is that some innovations are more difficult to practice than others. Innovations that require interacting with another person and responding to that person's behaviors often require several people to act out a practice scenario. Thus, it is critical that change agents provide these opportunities for simulated practice as part of the training and technical assistance associated with the innovation. Robust evidence indicates that the provision of opportunities for active

learning is one of the best predictors of teacher implementation of innovations as well as student outcomes (Gerard, Varma, Corliss, & Linn, 2011; Ingvarson, Meiers, & Beavis, 2005; Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2010; see below for ideal characteristics of professional development).

Observability. Observability refers to the visibility of the results of an innovation. Generally speaking, the greater the extent to which the positive outcomes of an innovation are visible to both the implementers as well as outside observers, the greater the motivation to use that innovation. Observability encompasses both the meaningfulness of the results as well as the immediacy with which the results are visible. Innovations that allow outside observers to view large, positive effects of an innovation increase motivation for service providers to implement it. In this way, observability functions as a personal incentive for service providers in that they may wish to receive praise for their efforts and feel pride for being associated with a successful endeavor. In addition to meaningfulness of results, speed with which innovation results are observed also plays an important role in determining motivation. If results are able to be observed quickly, motivation is typically higher because the temporal relation between the change in practice and observed results creates an association between process and outcome, reinforcing motivation and commitment to the innovation. This property of relative advantage is a major reason why preventive innovations and large-scale organizational changes often have a very slow rate of adoption. Large-scale innovations, especially those involved with prevention, often do not achieve results until years after they are initially adopted. Thus, it is difficult for individuals working within the organizations to observe tangible benefits of the innovation immediately, leading to lower motivation.

When implementing innovations with delayed results, organizations are advised to find ways in which "small wins" can be demonstrated to the innovation's users to reinforce their current efforts and indicate that progress is being made.

Observability also includes the extent to which the service provider perceives that other individuals within their organization and in other similar organizations use the innovation. The observation that a large number of people are implementing the innovation or have favorable attitudes toward the innovation communicates a powerful social norm that the innovation is desirable. As individuals gauge the quality of their own practices by comparing their actions to the actions of others, it is difficult to resist using an innovation when many of one's colleagues are buying in. If change agents can demonstrate that (1) others are using the innovation and (2) others are obtaining positive outcomes as a result of the innovation, they can bolster service providers' motivation for change. These actions incorporate some of the most effective and widely used principles of marketing: to sell a product or idea, advertisers can demonstrate that others are on the "bandwagon," and provide potential consumers with a picture of how their situation would be improved if they buy the idea or product. These properties of motivation are a testament to the importance of measuring process and outcomes of an innovation so that benefits can be demonstrated. Not only are process and outcome evaluation important for ensuring that clients benefit from an innovation, but they are also essential for creating motivation among service providers within the organization. Thus, observability has a large potential to increase motivation and therefore, use of innovations (Denis et al., 2002; Ovretveit et al., 2002).

Priority. For the purposes of the current paper, priority is defined as the extent to which innovation use is expected, prioritized, and meriting attention over other innovations. Although priority can be considered an innovation-specific capacity, evidence suggests that priority beliefs also play a role in motivation to implement innovations (Carr, Schmidt, Ford, & DeSchon, 2003; McCormick, Steckler, & McLeroy, 1995; Nystrom, Ramamurthy, & Wilson, 2002; Parker et al., 2003; West & Anderson, 1996). For example, McCormick and colleagues (1995) found that the priority placed on innovations was positively associated with the extent to which teachers implemented tobacco prevention curricula. When thinking about implementing change, service providers consider how people in their organization view and supports change in general as well as how they view and supports the change associated with the specific innovation at hand (Greenhalgh et al., 2004). Overall, service providers are more likely to be motivated to change their practices if they perceive that the organization's leaders generally encourage and support change, experimentation, and continuous quality improvement in all endeavors. However, the feeling of priority and positive climate surrounding specific innovations is also important and often occurs within smaller teams who are responsible for implementing the innovation (Ekvall, 1996). Regarding a particular innovation, if the leaders within the organization make their grand vision clear and provide the support (e.g., time, resources, technical assistance, involvement of all staff in decision making) necessary to achieve that vision, then motivation for change is likely to be enhanced (Ekvall, 1996; Nystrom, Ramamurthy, & Wilson, 2002; West & Anderson, 1996).

Champions and key opinion leaders. An organization's climate for implementing innovations is also influenced by champions and opinion leaders, who can impact the perceptions of priority with respect to a particular innovation (Locock, Dopson, Chambers, & Gabbay, 2001; Markham, 1998; Shane, 1995). Champions and key opinion leaders are examples of innovation-specific capacities that can directly influence service providers' motivation to use innovations. Champions are individuals in an organization who believe in the potential of an innovation and work to increase the ease with which service providers are able to implement it. Examples of champion efforts include increasing communication between service providers and official leaders, working to adapt the management's rules and policies to give service providers more freedom to problem solve, and creating intra-organizational coalitions to enhance formal and informal networks (Shane, 1995). Often, these individuals are not in official leadership positions, but still exert a high degree of influence on service providers within the organization. Research suggests that if the number of innovation supporters outnumbers or is more strategically placed than the innovation's opponents, service providers are more likely to be motivated to implement it (Champagne, Denis, Pineault, & Contandriopoulos, 1991; Gustafson et al., 2003; Rogers, 1995).

Key opinion leaders are individuals within an organization who have a high degree of influence on the beliefs and actions of their colleagues (Locock et al., 2001; Fitzgerald, Ferlie, Wood, & Hawkins, 2002; Greenhalgh et al., 2004). Although key opinion leaders are not necessarily the same as champions, it is possible for individuals to act as both of these types of leaders. According to Locock and colleagues (2001), there are two major types of opinion leaders. Expert opinion leaders exert influence through

their authority and status, whereas peer opinion leaders exert influence as a result of their credibility and common experiences with service providers. Based on their assessment of an innovation, opinion leaders can either enhance or detract from service providers' motivation to implement that innovation (Locock, 2001). Thus, identifying key opinion leaders and designing an innovation to secure the buy-in of these individuals is an important task for change agents.

Affective factors. Evidence from social psychological research suggests that cognitive and affective attitudes differentially affect behavior (Hidi, Renninger, & Krapp, 2004; Lawton, Conner, & McEachan, 2009). In essence, what service providers think about an innovation may differ from how they feel about it. For example, an employee may hold the cognition that an innovation will ultimately be positive for their own job as well as the organization as a whole (high relative advantage), but may still have feelings of fear about abandoning their old routines and their ability to learn new skills. In these situations, one of these processes tends to win out and will be a better predictor of behavior. Thus, sometimes cognitions are more predictive of behavior and sometimes affect is more predictive of behavior (Hidi & Renninger, 2006; Lawton et al., 2009). Therefore, it is important to examine both cognitive and affective components of motivation to implement innovations. Consistent with this idea, Rafferty and colleagues (2013) maintain that in addition to cognitive processes, the assessment of motivation for change in organizations should also incorporate affective antecedents of motivation by using discrete emotion items that capture individual positive affect concerning a specific change event. This includes emotions such as enjoyment, trust, hope, and pride as well as negative emotions such as consternation, surprise, annoyance, and fear. In addition to

discrete emotions, Liu and Perrewe (2005) maintain that motivation is also associated with the level of arousal, or the degree of excitement and enthusiasm for change. When positive emotions such as hope, joy, and pride are coupled with a high level of enthusiasm and cognitions that the change will be beneficial, easy, and supported, service providers are highly likely to be motivated and initiate change processes.

How Does Professional Development Affect Teacher Motivation?

In the field of education, the professional development that is provided to school staff is a key component of successful implementation of innovations. Guskey (2000) defines professional development as "processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (p. 16). A wealth of evidence has linked quality professional development with teacher change and higher student performance (Darling-Hammond et al., 2009; Desimone et al., 2002a; Wei et al., 2010). Further, a large body of research has identified the specific characteristics of PD that lead to teachers' use of innovations and positive student outcomes (Darling-Hammond et al., 2009; Desimone et al., 2002a; Thoonen et al., 2011; Wei et al., 2010; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007), but few studies have examined how these characteristics are related to subcomponents of motivation such as observability, trialability, relative advantage, complexity, compatibility, and climate, which can affect use of skills in the classroom. Identifying how the characteristics of high quality PD affect teachers' motivation has the potential to illuminate the mechanisms behind this relationship and can inform the development of PD in ways that maximize teacher motivation to implement new practices. Notably, some of these PD characteristics may lead to increases in teachers'

innovation-specific capacity, thereby leading to enhanced motivation to implement the innovation. The current section reviews the characteristics of high quality PD identified in the PD literature and discusses the way in which these characteristics might enhance the various components of motivation.

Active learning and engagement. Active learning opportunities are experiences that allow teachers to be active participants in their own learning and acquisition of skills. Active learning in professional development includes activities such as being observed and receiving feedback, practicing in simulated conditions, collaboratively developing lesson plans and reviewing student work, and presenting or leading discussions (Birman, Desimone, Porter, & Garet, 2000). Numerous studies support the benefits of active learning for professional development for increasing teacher knowledge and skills (Desimone et al., 2002a; Gerard, Varma, Corliss, & Linn, 2011; Ingvarson, Meiers, & Beavis, 2005; Lieberman, 1996; Loucks-Horsley et al., 2010). When teachers are engaged in the discussion, planning, and practice of new ideas and skills, they retain more knowledge and transfer a greater percentage of the skills into their classrooms (Garet, Porter, Desimone, Birman, & Yoon, 2001; Desimone et al., 2002a).

Another variable that serves to increase teacher engagement is the use of innovation-specific PD, rather than generalized PD that is not focused on a particular pedagogical strategy (Cohen & Hill, 2001; Desimone et al., 2002). Cohen and Hill (2001) found that PD that emphasized pedagogy specific to a particular innovation was far more effective in changing teachers' practice than PD that focused on general pedagogical strategies, suggesting that teachers need specific information that helps them understand exactly what changes are needed to implement an innovation. For example,

instead of offering a PD workshop that centers around the question "What is project-based learning?," PD facilitators could offer a workshop that centers around a more specific action, such as "How to facilitate project-based learning using Google sites." The latter method of teaching skills is far more specific and gives teachers a tangible tool they can use to implement the pedagogical strategy of project-based learning. Desimone and colleagues (2002a) investigated the influence of innovation-specific PD related to technology use in the classroom and found that when opportunities for active learning are combined with the use of innovation-specific technology use strategies, teachers are significantly more likely to implement these strategies in the classroom than when either one of these strategies is used in isolation.

Evidence from research on the role of relative advantage and complexity in the diffusion of innovations would suggest that the increased innovation use associated with active learning and innovation-specific PD occurs through the influence of these activities on teacher motivation (Aubert & Hamel, 2001; Bandura, 1997). Active learning experiences and receiving specific information about an innovation may lead teachers to perceive a greater degree of trialability in the innovation, a lower level of complexity, and, if the active learning involves collaboration, a greater degree of support from colleagues and PD facilitators. In addition, active learning experiences have the potential to foster greater positive affect among teachers by increasing interest, enjoyment, and enthusiasm for the innovation. The greater motivation, in turn, may increase teachers' implementation of new practices in their classrooms. Although no studies have investigated how these PD qualities relate to teacher motivation, the current study seeks to empirically test this proposed relationship.

Integration of old and new ideas. Effective PD facilitates the transfer of knowledge and skills into the classroom. One way to accomplish this transfer is by integrating new knowledge and skills with familiar ideas and important goals, a finding that is consistent with the idea of compatibility in enhancing motivation (Rogers, 1995). Evidence indicates that when PD aligns with teachers' personal goals as well as state and district curriculum standards, teachers are more likely to use new educational practices (Darling-Hammond et al., 2009; Desimone et al., 2002a; Hirsh, 2009). Specifically, Desimone and colleagues (2002a) found that the more teachers felt that PD was commensurate with their personal goals and state and district standards, the more likely they were to use computers in their classroom. Based on this premise, the knowledge-integration framework (KIF) advocates four major processes that have been demonstrated to enhance teacher learning: eliciting existing ideas, adding new ideas, using evidence to distinguish among ideas, and reflecting and integrating ideas (Linn, 1995; Sisk-Hilton, 2009). Eliciting ideas involves examining teachers' beliefs that they have developed as a result of their training and experience in the profession (Gerard et al., 2011). Every teacher has a set of ideas about their own capabilities, the capabilities of their students, what constitutes effective pedagogy, and the best ways to use technology to enhance student learning. These ideas are based on teachers' perceptions of student success, standardized test scores, and feedback from students, parents, administrators, and other colleagues (Davis, 2004). Eliciting ideas as part of PD involves asking questions about teaching practices and opening ideas up for discussion and debate so that they can be analyzed and refined (Gerard et al., 2011).

After eliciting existing ideas, quality PD adds new ideas that build upon or refine the old ones. Often, this involves collaborating with peers to develop lesson plans, watching videos of the new ideas in action, or having teachers role-play as students so that they learn the material as their students would. As is the case with general learning, new ideas introduced during PD must be linked to the existing ideas that were elicited earlier in PD or they are likely to be forgotten and will not transfer into the classroom (Borko, 2004). Further, PD has a greater chance of transferring into practice if PD facilitators can demonstrate how potential new practices and ideas improve student engagement, achievement, and standardized test scores in order to pique motivation for implementing the new practices (Tosa & Martin, 2010).

Although adding ideas allows teachers to become familiar with them, it is often not sufficient to ensure that teachers incorporate these ideas into their teaching practices. As existing habits and routines can be difficult to break, the third step in the knowledge integration framework involves assisting teachers in distinguishing between more effective and less effective teaching practices. This process often involves helping teachers to collect data on how teaching practices affect students' learning and engagement in their classrooms. The final step is to help teachers reflect on what they have learned in PD and to guide them in integrating all of their knowledge into a coherent practice. For example, PD for technology must provide information on how teachers can integrate the use of technology tools (such as web applications) with their pre-existing knowledge of the way that students learn (Mishra & Koehler, 2006; Niess, 2005). This may involve giving teachers opportunities to practice using technology to provide students with more personalized, collaborative, and authentic learning experiences that

allow students to grasp traditional concepts in an entirely new way. Along with active learning and time for practice (see below), this integration of new and old ideas facilitates use of new instructional methods and contributes to significant improvements in student learning outcomes. Taken together, these findings support evidence from the implementation science literature indicating that an innovation's compatibility with older ideas and current goals increases motivation to implement new practices (Denis et al., 2002; Gustafson et al., 2003). Teachers may take comfort in knowing that a new change will not be stressful because it builds on current practice, leading to positive emotions surrounding the innovation. Although these findings suggest that integration is important, few studies have examined the causal process by which integration increases use of innovations, and none have examined whether this component of PD operates by enhancing motivation.

Practice and Collaboration. Much of the professional development that takes place in schools and school districts is conducted in a "workshop" format, occurring outside the classroom and involving didactic presentation about new information and ideas (Wei et al., 2010). Despite the prevalence of this kind of PD, a growing body of evidence suggests that this method is often inadequate for ensuring that teachers transfer knowledge and skills effectively into their classroom instruction (Garet, Porter, Desimone, Birman, & Yoon, 2001; Loucks-Horsley & Matsumoto, 1999; Penuel et al., 2007). Although traditional workshop formats can be useful in many instances, PD often needs to be supplemented by what Garet and colleagues (2001) term "reform" methods, which include mentoring and coaching, collaborative groups in which teachers can talk and learn from one another, and any informal networks that allow teachers to acquire new

knowledge and skills (Joyce & Showers, 2002). Using a national sample of teachers, Garet and colleagues (2001) found that teachers who had more opportunities to participate in reform PD activities, including more contact hours with PD coaches and more collaboration with colleagues, were more likely to gain new knowledge and skills than teachers who did not have these opportunities. Greater knowledge and skills were, in turn, associated with greater changes in teacher practice, reinforcing the idea that trialability can improve motivation and use of innovations in the classroom. Therefore, there is evidence that reform PD facilitates the transfer of knowledge and skills into tangible instructional changes.

Despite the association of reform PD methods with greater time for practice and more effective transfer of skills, Penuel, Fishman, Yamaguchi, & Gallagher (2007) maintain that it is not the *type* of PD (workshop or individual coaching) that matters so much as it is the *design*. The key variable for PD according to Penuel and colleagues (2007) is "proximity to practice," meaning that when teachers are given time to experiment and practice for their classroom instruction, they are more likely to use innovations in their classrooms, regardless of whether they attend a workshop or receive coaching (Darling-Hammond & McLaughlin, 1995). Thus, Penuel and colleagues acknowledge that workshops are sometimes designed using more effective reform methods that allow for practicing new skills, while coaching is sometimes conducted using less effective traditional methods that are less conducive to practice. Taken together, these findings suggest that regardless of PD type (i.e. workshop or coaching), reform activities that occur in the classroom and allow for practice, collaboration, and experimentation are significantly more likely to lead to teacher behavior change. These

findings are consistent with the notion of trialability, and corroborate the results of studies that show trialability is related to motivation for using innovations (Ovretveit et al., 2002; Yetton, Sharma, & Southon, 1999).

Continuous support and feedback. Another consistent finding throughout the PD literature involves the duration of the PD over the long-term (i.e. how long support for new practices is provided over the years). Because innovations often require large changes in teacher behavior, teachers may only have the capacity to implement small pieces of a new innovation into their current practice or avoid using the new method altogether (Coburn, 2004). The difficulties of large-scale change call for "cycles" of persistent PD that allows for teachers to gradually implement the pieces of an innovation, reflect on their practices, and continue implementing more of the innovation until they are proficient (Blumenfield, Fishman, Krajcik, Marx, & Soloway, 1991). Overwhelmingly, research suggests that when teachers receive PD related to a specific innovation that is sustained beyond just one school year, they are far more likely to use that innovation effectively in their classrooms (Desimone et al., 2002; Garet et al., 2001; Gerard et al., 2011; Ingvarson, Meiers, & Beavis, 2005; Penuel et al., 2007; Supovitz & Turner, 2000). Though this may be an indirect effect, the time span of a PD program increases the amount of time teachers spent meeting informally with other teachers to engage in activities such as joint lesson planning or developing curriculum materials (Ingvarson et al., 2005). In terms of motivation to use new practices, introducing innovations in a piecemeal fashion and providing continued support likely increases compatibility and trialability, decreases complexity, and conveys a climate of long-term support and commitment to innovation.

In a meta-analysis of 43 studies on professional development programs for technology, Gerard and colleagues (2011) found that programs that supported teachers for one or fewer years had little impact on teachers' effective use of technology, regardless of the degree of support they provided for teachers. The authors noted that this was likely due to a steep learning curve and first year "hiccups" related to technical and instructional issues. These results suggest that many innovations encounter an initial period in which "growing pains" are experienced, but that persistence and continued support beyond the first year significantly increase the success of the innovation over the long term. In three rare cases, PD programs that were more short-term were able to facilitate effective use of technology, but this only occurred when teachers had time to cultivate new practices, test the practices in their classroom, examine outcomes with colleagues, and evaluate and refine their practices (Tan & Towndrow, 2009; Trautmann & MaKinster, 2010; Yerrick & Johnson, 2009). Consistent with the notion of trialability, these findings suggest that sustaining support for an innovation over time and providing opportunities for teachers to experiment, practice, receive feedback, and refine their methods is associated with greater innovation success.

Research on teacher support suggests that long-term support should consist of *in-classroom* coaching in addition to group-oriented PD (Darling-Hammond et al., 2009). Regardless of how much planning, preparation, and learning teachers undergo when they are implementing new practices, it is when they are actually implementing in the classroom that they encounter the largest issues and possess the greatest fears, doubts, and concerns about the change (Guskey, 2000). It is during this process of classroom implementation that teachers need individual assistance, support, and feedback on their

performance. Individual assistance or coaching includes answering questions, providing encouragement, reinforcing what the teacher does well, and exerting positive pressure to persist until the new practice becomes habitual (Guskey, 1994). Available research demonstrates that the extent to which teachers receive individual assistance and follow-up support after learning about new practices is related to their use of the innovation (Ingvarson, Meiers, & Beavis, 2005). Across 80 different professional development programs, Ingvarson and colleagues discovered that the level of follow-up support and ongoing assistance they received in their classrooms significantly increased teachers' knowledge and use of novel educational practices. Thus, bolstering teachers' innovation-specific capacities by providing ongoing technical assistance and feedback likely leads to increased trialability, compatibility, and decreased complexity, leading to greater motivation to implement new instructional innovations.

Another necessary component of long-term support involves providing specific and constructive feedback to teachers. Although time for practice and experimentation with a new practice facilitates learning and skill acquisition, research suggests that teachers can only improve so much by experimenting on their own (Bronkhorst, Meijer, Koster, & Vermunt, 2011; Ericsson, 2006; Marzano, 2011). The actualization of true expertise arises only when teachers can receive high quality feedback and guidance from someone who is already familiar with how to implement the practice. Consistent with this idea, evidence indicates that teachers are more motivated to persevere with a new practice if they receive specific feedback demonstrating that the practice actually works for helping students to learn better (Guskey, 1994; Ingvarson, Meiers, & Beavis, 2005). Ingvarson and colleagues (2005) found that teachers' feelings of self-efficacy regarding

new instructional practices were most strongly dependent upon the extent to which they encountered evidence that student learning outcomes have improved as a direct result of the new practice. Ingvarson and colleagues' finding provides support for the hypothesis that the observability of an innovation is positively related to innovation use. Despite benefits of feedback, however, opportunities for feedback are rarely provided (Invgarson et al., 2005), suggesting that schools and districts must work to identify barriers to providing effective feedback to teachers and develop plans for overcoming these challenges. Identifying barriers to the observability of an innovation may require collaboration between principals, teachers, and district officials to revise the school schedule, change teachers' planning times, create new staff positions within the school, or revise existing staff's job descriptions to include this kind of follow-up support.

Tailoring. Rather than employing a "one size fits all" approach, several studies suggest that offering PD opportunities that are customized to teachers' needs and allow for teacher-centered learning has positive effects on teacher performance in the classroom as well as teacher satisfaction with their jobs (Blase & Blase, 2000; Desimone, Porter, Birman, Garet, & Yoon, 2002b; Nir & Bogler, 2008). There are several methods that schools can use to ensure that PD is meeting teachers' individual needs. One method involves conducting a needs assessment and using the results to determine strengths and weaknesses for each teacher. Teachers can then be placed into learning teams based on their interests and skills levels. This arrangement can help to facilitate peer coaching and collaboration (Hinson, Laprairie, & Cundiff, 2005), which in turn enhances learning and motivation for implementation in the classroom (Garet et al., 2001; Ingvarson et al., 2005). The effect of tailoring on motivation likely occurs through the enhancement of

perceptions of support, compatibility, and trialability, as well as feelings of confidence, satisfaction, and gratitude.

Another option for tailoring PD to teachers' needs is to involve teachers directly in the design and provision of PD in their school (Ball, 1996; Blase & Blase, 2000; Desimone et al., 2002b). In a survey of over 800 teachers in the U.S., Blase and Blase (2000) found evidence that allowing teachers to have a degree of control over the planning and implementation of PD activities is linked with motivation to participate in PD. As one teacher in their study stated, "by giving us voice and choice, we are more motivated to go to in-services and learn new things that we can try out" (p. 135). Desimone and colleagues (2002b) studied 363 school districts and found when teachers are involved in the planning of PD at both the school and district levels, there is a significantly greater likelihood that the PD will involve high quality PD characteristics (greater reform methods, active learning, longer time-span, opportunities for collaboration), which are related to greater motivation to implement practices in the classroom. In sum, research suggests that involving teachers in designing policies and procedures that affect them serves to empower teachers and increase ownership of their own PD, resulting in higher motivation for implementing new practices they learn as part of their training.

Evaluation. Quality PD incorporates evaluation methods to ensure accountability and continuous quality improvement (Desimone et al., 2002b; Garet et al., 2001). Determining the strengths and weaknesses of PD helps to provide direction toward next steps for enhancing the effectiveness of PD. In their nation-wide study of 363 school districts, Desimone and colleagues (2002b) found that continuous quality improvement

efforts are significantly related to increased opportunities for active learning and increased tailoring of PD. However, very few schools and districts actually engage in continuous quality improvement activities, as Desimone and colleagues found that only 18% of teachers are in districts that currently collect data on performance indicators that have been established to guide PD efforts. In addition, less than 25% of districts are aware of their state's indicators for PD and the federal requirement to develop them. Moreover, the districts that do establish performance indicators typically offer minimal guidance to schools about how to collect and use data to inform PD efforts. The lack of PD evaluation across the nation underscores the need for quality assurance and accountability processes to ensure that teachers are able to effectively use new knowledge and skills in their classrooms. By collecting data to evaluate PD, schools can identify the areas in which their PD is lacking and take actions to improve it.

Evaluation of PD can be divided into process evaluation and outcome evaluation. Process evaluation assesses the methods used to conduct PD (such as the format of the PD), whereas outcome evaluation assesses the impact of the PD (teacher use of the innovation, student outcomes). There are several ways to evaluate the PD process, including a brief assessment after each PD interaction, soliciting vocal feedback from teachers by interview or group discussion, or evaluation by a neutral party who observes the PD activities. Each of these methods has pros and cons. Teacher surveys allow for more information but are subject to misinterpretation or inaccurate information. In-person vocal feedback is easier to interpret than survey responses but may induce desirability bias if the PD facilitator is present. A neutral observer has a more objective perspective, but may only be able to observe a small portion of the actual PD that is

provided throughout the school year. Thus, each method provides something the others cannot. An ideal strategy is to use a combination of these methods, although many schools may lack the capacity for thorough evaluation of PD.

In addition to process indicators, there are several types of outcomes that provide information about the effectiveness of PD, including both teacher and student outcomes. Although the short-term goal of PD is to affect teacher behavior, the ultimate objective is to improve student outcomes. To achieve this goal, it is imperative that schools collect data on both teacher and student outcomes to assess the impact of their PD. Shaha, Lewis, O'Donnell, and Brown (2004) discuss three major types of outcomes at both the teacher and student levels that are relevant to PD: learning impacts, attitudinal impacts, and resource impacts. Comparisons can be drawn between these three impacts of PD and the notions of capacity and motivation. Learning impacts are measures of knowledge gained, skills achieved, or teaching-relevant behaviors acquired and (Lewis & Shaha, 2003). Attitudinal impacts are the affective attitudes that teachers and students hold and are a critically important component of motivation (Killion, 2002). Though attitudes are often overlooked in favor of actual learning outcomes, they are equally important in determining the likelihood of behavior change and should not be overlooked (Lawton et al., 2009). Finally, resource impacts include any resources gained or lost in the process of PD (Guskey, 2002). Resources impacts result in changes in general and innovation-specific capacity such as participation time, time spent preparing, or loss of productivity. Evaluating resource impacts allows schools to understand the sacrifices that are being made by teachers in order to achieve behavior change and may help put slow progress in perspective, as changes in capacity can often lead to changes in motivation as well.

Although evaluation of PD is important for continuous quality improvement, it can also decrease teachers' motivation if it gives them the impression that they are being scrutinized by powerful others. However, participatory methods of evaluation such as empowerment evaluation (Fetterman & Wandersman, 2005) can address this issue by allowing teachers to have control over the evaluation of their own PD. Empowerment evaluation allows schools to conduct the rigorous evaluation necessary for quality PD, while potentially enhancing teacher motivation to implement innovations in the process. Empowerment evaluation seeks to involve all stakeholders in the process of evaluation so that they own, design, and implement the evaluation themselves, along with minimal guidance from evaluators (Fetterman, 2002). The process of empowerment evaluation involves collaboratively establishing a program's vision and mission, identifying and prioritizing significant program activities, and establishing goals and strategies to assess goal progress. Although no research has attempted to link empowerment evaluation to subcomponents of motivation, empowerment evaluation may enhance motivation by influencing cognitive components such as relative advantage, complexity, compatibility, and observability and affective components such as enthusiasm, optimism, and pride. When teachers are able to design their own evaluation, they are more invested in the innovation such that they see the relative benefits, possess more knowledge about how the innovation works and fits with prior practice, and can observe the outcomes of the innovation that are obtained through the evaluation process. They also exhibit more positive emotions toward the innovation such as feelings of optimism that the change will work because of evaluation efforts and a feeling of pride that they are involved with an innovation that seeks to create bottom-up change. Although a comprehensive review of

the activities involved in empowerment evaluation is outside the scope of this paper, see Fetterman and Wandersman (2005) for more information on this approach.

The 1TWO1 Innovation

In 2011, the Richland Two School District in Columbia, South Carolina launched an initiative called the 1TWO1 innovation in order to enhance academic achievement, student engagement, and personalized, authentic, and collaborative (PAC) learning by providing every student in grades 3 through 12 with their own personal laptop or tablet device (i.e., iPads, Google Chromebooks). 1TWO1 is not just about providing devices, but focuses on changing classroom instruction by allowing teachers to integrate technological tools and resources with their current pedagogy to enhance student learning. Perceiving a need for evaluation of the 1TWO1 project, Richland Two partnered with the GTO evaluation team, a group of university faculty, graduate students, evaluation consultants, and education specialists from the University of South Carolina (USC). Together, the Richland Two Technology Integration Specialists and members of the GTO evaluation team have designed and implemented several evaluation measures (including focus groups, surveys, and interviews) to assess both the processes (including provision of support, teacher use of PAC-Tech learning strategies, teacher integration of technology) and outcomes (student engagement, achievement) of the 1TWO1 innovation.

1TWO1 Logic Model

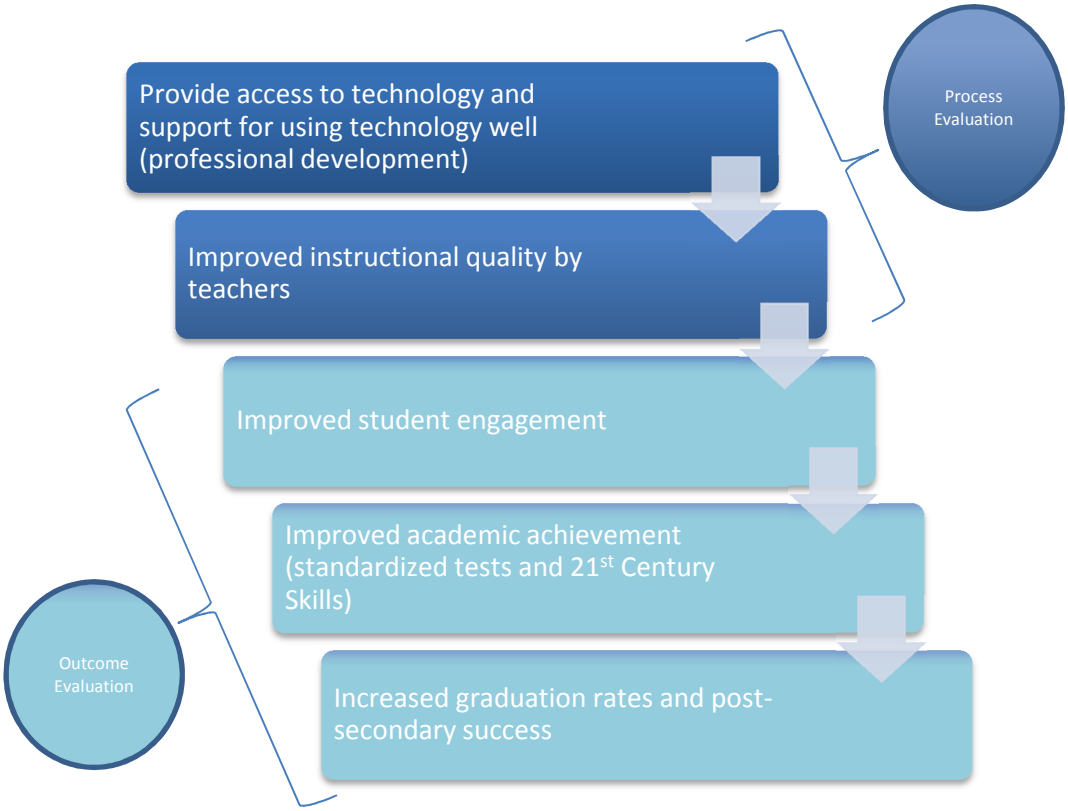

Figure 1.1: Logic model for 1TWO1 initiative.

In the process of designing an evaluation plan for the school district, the GTO team developed a logic model to guide their efforts. This model is displayed in Figure 1. The model includes both processes and outcomes. The first two bars represent the process portion of the model, and posit that the provision of access to technology and professional development lead to improved instructional quality. The latter three bars represent the outcome portion of the model and posit that improved instructional quality leads to improved student engagement, which leads to improved academic achievement, ultimately leading to improved graduation rates and post-secondary success.

The current study seeks to expand the process evaluation portion of the 1TWO1 logic model by investigating a potential mechanism by which the provision of professional development leads to improved instructional quality by teachers (see Figure 2). Specifically, we hypothesize that quality PD increases teacher motivation to use technology in their classrooms, in turn increasing teacher instructional quality indicators such as the provision of PAC-Tech learning opportunities.

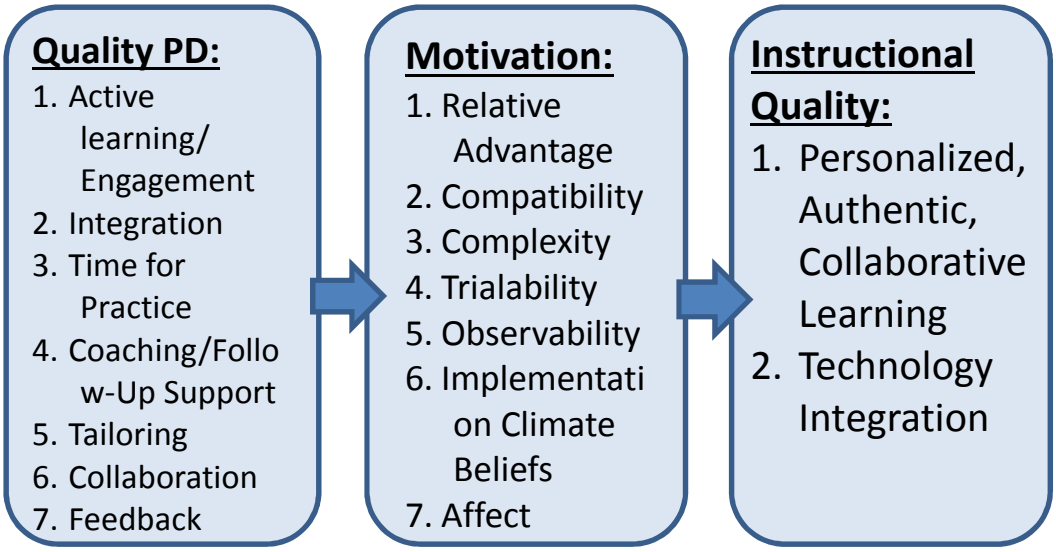

Figure 1.2: Proposed mediating role of motivation in the relation between quality PD and improved instructional quality.

Components of Ideal Instructional Quality

Personalized, authentic, collaborative, and technology-integrated (PAC-Tech) learning. One of the major process goals of the 1TWO1 initiative is for teachers to increase their use of technology to provide opportunities for personalized, authentic, and collaborative learning. Personalized learning refers to learning that is tailored to students' individual needs and skill levels (Magoulas & Chen, 2006; Riecken, 2004). Teachers who administer separate assignments to students with different interests or skill

levels, and who keep increasing the difficulty of tasks after students have mastered simpler material are engaging students in personalized learning. Authentic learning opportunities are activities that provide a high level of applicability to real-world situations (Renzulli, Gentry, & Reis, 2004). The idea is that students should engage in the same or similar activities that they will eventually be required to engage in later as part of future responsibilities or a potential career (Koschmann, Kelson, Feltovich, & Barrows, 1996). Collaborative learning activities require students to work in groups to solve problems. According to Roschelle and Teasley (1995), collaboration is a process by which individuals *negotiate and share meanings* relevant to the problem-solving task at hand. Collaborative learning can take place within a classroom, between classrooms, or between a classroom and any other setting via the internet (Stahl, Koschmann, & Suthers, 2006). These three types of learning are linked with greater student engagement and achievement (Colliver, 2000; Dochy, Segers, van den Bossche, & Gijbels, 2003; Kalyuga & Sweller, 2005).

The final component of ideal teacher instructional quality as part of the 1TWO1 initiative is technology-integrated learning. One framework that is designed to conceptualize ideal technology integration is the TPACK (technology, pedagogy, and content knowledge) framework (Koehler & Mishra, 2009). Building on Shulman's (1986) work on pedagogy and content knowledge, the TPACK framework is centered around the theory that ideal teaching with technology involves the intersection of three components: technology knowledge (the ability to use technology tools in a competent, flexible, and adaptive manner), pedagogical knowledge (knowledge about teaching methods, how students learn, classroom management, etc.), and content knowledge

(knowledge about the subject matter being taught). The TPACK framework specifies that these three components can be combined in different ways to produce technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge, and finally, the ideal intersection of technological pedagogical content knowledge. This framework serves as a model for professional development to help teachers integrate these three components effectively.

Rationale for the Current Study

A significant piece of the 1TWO1 implementation process is to ensure that teachers are motivated to use the 1TWO1 innovation and integrate technology into their classrooms to enhance student engagement and provide more opportunities for PAC-Tech learning. Professional development is one aspect of the 1TWO1 innovation that has potential to impact teacher motivation. However, the mechanisms by which PD influences teachers' motivation to use innovations is not clear. Given that there is considerable variability among schools and teachers regarding the quality with which 1TWO1 is being implemented, it is important to determine how PD can enhance teachers' motivation to integrate 1TWO in their classrooms. This type of research can inform the development of motivation-enhancing PD activities to ensure quality implementation of 1TWO1 and ultimately, positive gains in student learning and achievement.

The totality of evidence reviewed in this paper suggests that both motivation and quality PD are related to the success of innovations. However, no study to date has examined how the characteristics of quality professional development can enhance teacher motivation to use technology innovations. The current study aims to (1) evaluate

the extent to which teachers' perceptions of whether they received each of the seven characteristics of quality professional development are associated with their reported level of seven subcomponents of motivation (relative advantage, compatibility, complexity, observability, trialability, implementation climate beliefs, and positive affect) and (2) investigate whether teachers' self-reported motivation is a mediator of the relation between perception of PD quality and teachers' self-reported use of PAC-Tech learning strategies. The hypothesized relations between quality professional development characteristics and motivation components are as follows:

1. Increases in teachers' reports of each of the following seven quality characteristics of professional development will be associated with significant increases in the seven components of self-reported motivation.
    a. Active learning/engagement will account for unique variance in relative advantage and complexity.
    b. Integration will account for unique variance in compatibility.
    c. Time for practice will account for unique variance in trialability.
    d. Coaching/feedback will account for unique variance in observability, trialability, supportive climate, and positive affect.
    e. Tailoring of PD will account for unique variance in supportive climate, compatibility, and trialability.
    f. Collaboration with others will account for unique variance in supportive climate, complexity, trialability, and positive affect.

g. Teacher feelings of control over evaluation processes will account for unique variance in relative advantage, complexity, compatibility, and observability, supportive climate, and positive affect.

2. Teachers' self-reported motivation to integrate technology into their classroom practices will significantly mediate the relation between perceived quality of professional development and improved instructional quality as measured by teachers' self-reported use of PAC-Tech learning strategies.

CHAPTER 2: METHOD

Participants

Teachers. The current study involves 1,509 teachers who are employed by the 39 schools in Richland School District Two. This sample represents approximately 60% of all teachers in the school district. Participants were recruited through emails from the administrators at their school, as well as by word of mouth from the instructional technology staff in each school. The sample included teachers from elementary, middle, and high schools, as well as alternative schools and learning centers within the district. The breakdown of teachers by grade level is as follows: Elementary (50.2%), Middle (24.9%), High (23.7%), Alternative Schools/Learning Centers (1.3%). The average length of teacher service in the sample was 12.5 years. Female teachers made up 83.1% of the sample, while male teachers represented 16.9% of the sample. The racial breakdown of the teacher sample is as follows: White/Caucasian (67.3%), African-American/Black (21.8%), Hispanic/Latino (1.7%), Multiple races/mixed race (1.3%), Asian (0.7%). One point two percent of teachers stated their race was "Other", while 5.8% of teachers preferred not to provide their race.

Technology integration specialists (TIS). In order to obtain an additional data source besides teacher self-report, the current study also involves interview data related to professional development quality collected from four Technology Integration Specialists (TIS) employed by Richland School District Two. These individuals oversee

the implementation of the 1TWO1 innovation at the district level. The TIS participants were recruited through monthly meetings that were held with the GTO evaluation team.

Procedure

Teachers. Teachers were asked to complete a 15 to 20-minute survey designed to evaluate several process and outcome indicators of the 1TWO1 innovation. The analyses for the current study involved adding items (see Appendix B) to an established survey that was disseminated to teachers in the Richland Two School District in May 2012 and May 2013. Motivation, professional development, and PAC-Tech learning are three areas among several that were assessed by the survey. Due to district limitations in the frequency with which they administer teacher surveys, only one data point was able to be gathered for the construct of motivation. Therefore, the analysis for this paper will focus on the relation between PD quality and motivation at the end of the 2013-2014 school year rather than assess changes in the relationship between these variables over time.

Teachers were given a window from May to June 2014 to complete the survey using surveymonkey.com. Each school in the district provided their teachers with a link to the online survey. In an effort to increase participation, schools with the highest participation levels received a technology gift basket that includes several technology devices that teachers can use in their classrooms. Teachers were informed via the survey title screen that their responses will be anonymous and will not be used to evaluate their individual job performance. Data from the surveys were gathered and collected by the beginning of June 2014.

Measures

Perceived PD quality. The teacher survey contained several items that assess the extent to which teachers perceive that the PD they receive for 1TWO1 includes seven quality PD characteristics: active learning, integration, time for practice, coaching/follow-up support, tailoring, collaboration, and feedback (see Appendix A). These items were developed by the researcher based on characteristics of quality PD identified in education literature (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Desimone, Porter, Garet, Yoon, & Birman, 2002a; Thoonen et al., 2011; Wei, Darling-Hammond, & Adamson, 2010) and were demonstrated to have adequate internal consistency reliability as a scale (Cronbach's alpha = 0.86). These items were piloted with a group of 10 teachers, who provided feedback on the items' face validity and informed revisions in wording and relevance to their experiences.

Self-reported motivation. The survey contained items relating to teachers' motivation to use technology to provide opportunities for PAC-Tech learning in the classroom (see Appendix B). These items were designed to assess the extent to which teachers report that they possess six cognitive subcomponents of motivation: relative advantage, compatibility, complexity, observability, trialability, and climate as well as teachers' affect regarding the 1TWO1 innovation. The motivation items were developed by the researcher based on motivation literature (Rafferty et al., 2013; Rogers, 2003) and were found to possess adequate reliability (Cronbach's alpha = 0.90). In addition, these items were piloted using a small sample of eight teachers and were modified based on teacher feedback prior to administering them to the larger sample.

Self-reported use of PAC-Tech learning. In order to measure personalized, authentic, and collaborative learning, the survey contained 15 items relating to the extent to which teachers report using each of these strategies in their classrooms (see Appendix C). The 12 PAC learning items are derived from the International Society for Technology in Education (ISTE) standards for teacher instruction using technology and have been previously administered to teachers in the Richland Two district. The three technology integration items are adapted from Schmidt and colleagues' (2009) instrument for measuring teachers' development of TPACK. These items possess sufficient reliability, as indicated by a Cronbach's alpha of 0.89.

Data Analyses

1. Relation of PD quality characteristics and motivation components. To determine the relationships between each of the characteristics of perceived PD quality and each self-reported motivation component, a path model that estimates the proportion of variance in each motivation component that is accounted for by each PD quality characteristic was specified (see Figure 3).

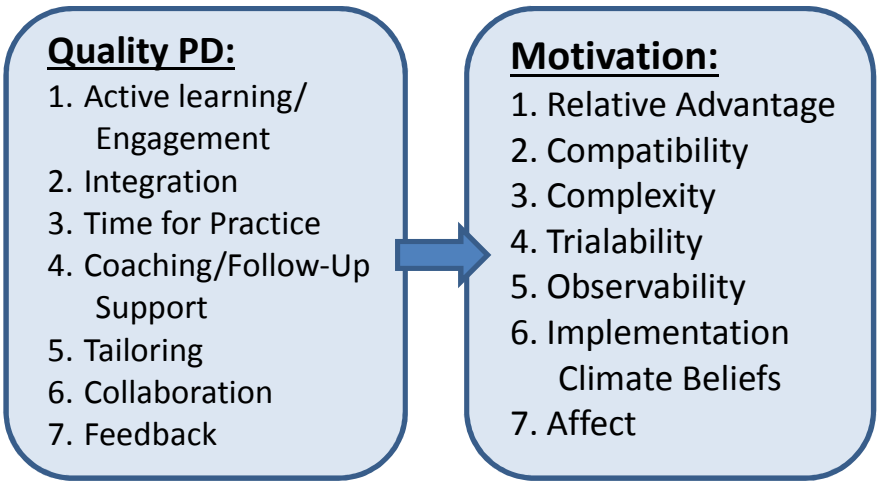

Figure 2.1: Relationships between PD characteristics and motivation components (all PD characteristics will be tested for relationships with all motivation components).

2. Mediation Models. A path mediation model that describes the relation between PD, motivation, and teachers' use of PAC-Tech learning was tested in M*plus* software (Muthen & Muthen, 2013) using data from the teacher survey and TIS interviews (see Figure 4). This path model describes the way in which PD quality may impact teacher motivation to integrate technology, ultimately leading to greater use of PAC-Tech learning.

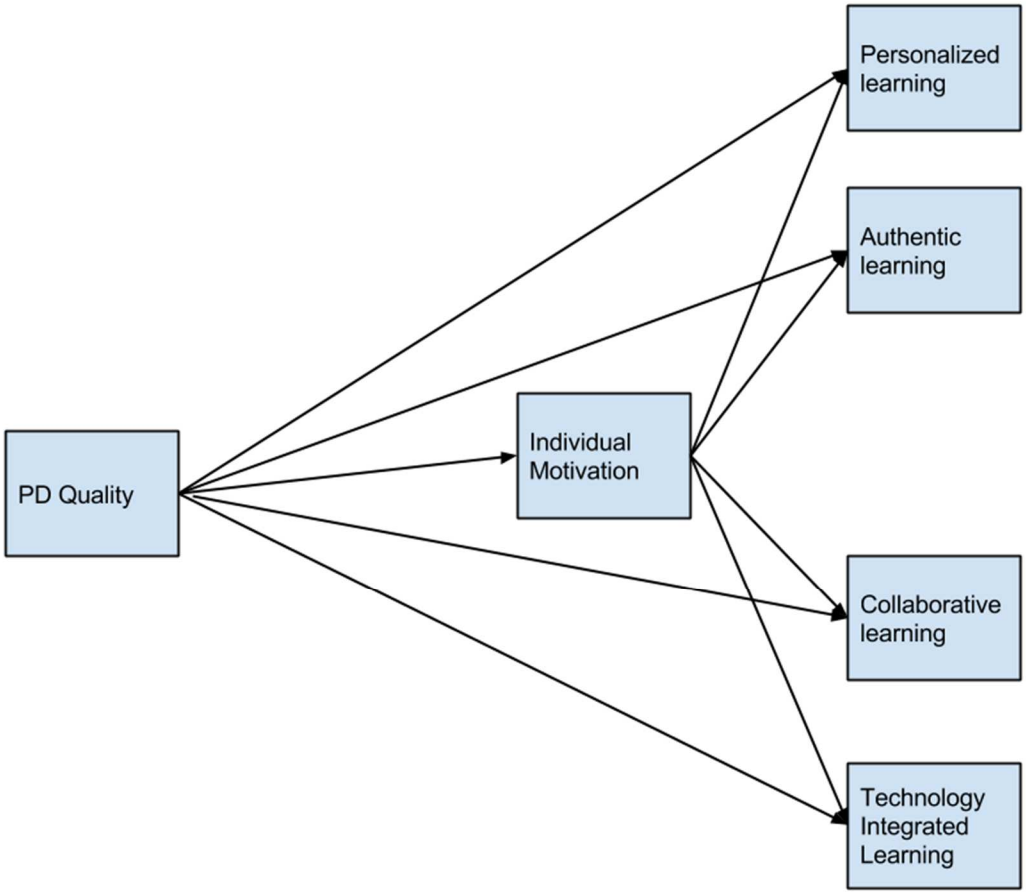

Figure 2.2. Path model showing relationships between PD quality, motivation, and instructional quality outcomes.

For this analysis, the seven PD characteristics were summed into one PD quality scale and items pertaining to the seven motivation components will be summed into one motivation scale. In addition, items measuring personalized, authentic, collaborative, and technology-integrated learning were combined into one variable, termed the "PAC-Tech learning" scale.

Regression equations were then formulated to determine whether the mediating relationships are present. As it is important to capture both the variability within schools as well as the variability between schools to determine how PD quality impacts motivation, the current approach also employed multi-level procedures. Thus, each of the three major regression equations in the mediation models were supplemented by specifying a random intercept to accurately capture variance due to differences among schools in the variables of interest.

The hypothesized relationship between PD quality, teacher motivation, and PAC-Tech learning is displayed in Figure 5.

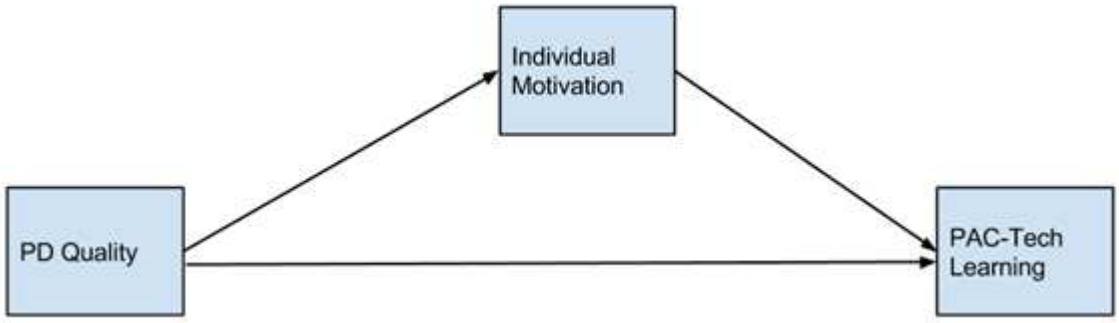

Figure 2.3. Path mediation model depicting the hypothesized relations between PD quality, motivation, and PAC-Tech learning.

Model 1 (see Figure 4) tests the mediating role of motivation in the relation between perceptions of PD quality and teachers' reported use of PAC-Tech learning. To test Model 1, three equations were specified:

$$Motivation_{ij} = \gamma_{00} + \gamma_{10} PD\ Quality_{ij} + e_{ij} + u_{0j} \quad (1)$$

$$PACT_{ij} = \beta_{oj} + \beta_1 PD\ Quality_{ij} + e_{ij} + u_{0j} \quad (2)$$

$$PACT_{ij} = \beta_{oj} + \beta_1 PD\ Quality_{ij} + \beta_2 Motivation_{ij} + e_{ij} + u_{0j} \quad (3)$$

The first equation tests the effects of perceived PD quality on self-reported teacher motivation (the sum of the individual motivation components) to implement 1TWO1 technology in the classroom (the *a* path in mediation analyses; MacKinnon, 2008). The second equation tests the direct effect of perceived PD quality on reports of PAC-Tech. The third equation tests the partial effects of motivation on self-reported use of PAC-Tech learning, holding perceived PD quality constant (the *b* path in mediation). Mediation was tested using the product of coefficients method (MacKinnon, 2008).

CHAPTER 3: RESULTS

Teacher Survey Data

1. **Relation of PD quality characteristics and motivation components.** Multiple regressions revealed that the following characteristics of professional development were significantly related to the following motivation components (See Table 1 for regression coefficients (β) and p values; see Table 2 for a summary of significant relationships): The extent to which teachers reported that PD incorporated active learning was significantly related to trialability, observability, priority, and positive affect. The extent to which teachers reported receiving PD that integrated new and familiar ideas was significantly related to all motivation components (relative advantage, compatibility, complexity, trialability, observability, priority, and positive affect). Teacher reports of the amount of practice that took place during PD were significantly related to compatibility, and trialability. Teacher reports of the amount of individual coaching were related to relative advantage, trialability, observability, priority, and positive affect. Teacher reports of the degree to which PD was tailored to their needs and interests were significantly related to all motivation components - relative advantage, compatibility, complexity, trialability, observability, priority, and positive affect. Teacher reports of the amount of collaboration that took place

during PD were related to relative advantage, complexity, trialability, and observability. Finally, teacher reports of the amount of feedback they received during PD were significantly related to trialability and positive affect.

The PD characteristics that had the largest relationships with each motivation component are as follows (see Table 3): Integration and tailoring had the strongest relationships with relative advantage (whether teachers feel that 1TWO1 is more beneficial than teaching without technology), compatibility (whether teachers feel 1TWO1 is compatible with their current practice), complexity (whether teachers feel that 1TWO1 is simple and easy to implement), observability (the extent to which teachers feel they can see tangible outcomes of 1TWO1), and positive affect toward 1TWO1. Time for practice, tailoring of PD, feedback, and collaboration opportunities had the strongest relationships with trialability (the extent to which teachers feel they have had adequate time to practice 1TWO1). Active learning, integration, and tailoring had the strongest relationships with priority (the degree to which teachers perceive that the 1TWO1 innovation is prioritized and meriting attention in their school).

Table 3.1: *Regression Coefficients (β) and Standard Errors (SE) for PD Quality Characteristics and Motivation Components*

	Relative Advantage	Compatibility	Complexity	Trialability	Observability	Priority	Positive Affect
Active Learning	0.067 (0.042)	0.068 (0.049)	0.039 (0.044)	0.091** (0.027)	0.094* (0.041)	0.158** (0.031)	0.084* (0.039)
Integration	0.271** (0.053)	0.256** (0.056)	0.332** (0.053)	0.167** (0.041)	0.0265** (0.058)	0.181** (0.059)	0.366** (0.062)
Time for Practice	0.017 (0.037)	0.105** (0.037)	0.035 (0.050)	0.357** (0.042)	0.067 (0.045)	0.044 (0.039)	0.065 (0.042)
Coaching	0.062* (0.059)	0.084 (0.032)	0.016 (0.056)	0.115** (0.039)	0.092** (0.071)	0.106* (0.084)	0.240** (0.095)
Tailoring	0.148** (0.134)	0.145** (0.037)	0.233** (0.060)	0.182** (0.041)	0.200** (0.124)	0.180** (0.089)	0.880** (0.176)
Collaboration	0.081* (0.089)	0.075 (0.034)	0.099* (0.060)	0.156** (0.049)	0.087* (0.098)	0.054 (0.069)	0.214 (0.121)
Feedback	0.033 (0.087)	0.071 (0.034)	0.017 (0.084)	0.186** (0.063)	0.016 (0.097)	0.079 (0.084)	0.270** (0.110)

*$p < .05$
**$p < .01$

Table 3.2: *Summary of Significant Relationships between PD Quality and Motivation Components*

PD Quality Characteristic	Motivation Components Influenced
Active Learning	Trialability, Observability, Priority, Positive Affect
Integration	Relative Advantage, Compatibility, Complexity, Trialability, Observability, Priority, Positive Affect
Time for Practice	Compatibility, Trialability
Coaching	Relative Advantage, Trialability, Observability, Priority, Positive Affect
Tailoring	Relative Advantage, Compatibility, Complexity, Trialability, Observability, Priority, Positive Affect
Collaboration	Relative Advantage, Complexity, Trialability, Observability
Feedback	Trialability, Positive Affect

Table 3.3: *Total Variance Accounted for in Each Motivation Component by All Seven PD Quality Characteristics*

Motivation Component	Total R^2 (SE)
Relative Advantage	.065 (.022)**
Compatibility	.086 (.03)**
Complexity	.091 (.024)**
Trialability	.248 (.029)**
Observability	.099 (.03)**
Priority	.111 (.025)**
Positive Affect	.147 (.045)**

*$p < .05$
**$p < .01$

2. **Mediating effect of motivation in the relation between PD quality and teachers' self-reported use of PAC-Tech learning.** Mediation analyses indicate that motivation was a significant mediating variable in the relation between PD quality and teachers' self-reported use of PAC-Tech learning ($ab = 0.016$, $p = .002$). The direct effect of PD quality on PAC-Tech learning was 0.003, $p > .05$, while the indirect effect was .016, $p = .002$. Teachers who received higher PD quality tended to have higher motivation, ($a = .041$, $p = .001$) and teachers with higher motivation tended to incorporate more PAC-Tech learning strategies into their classroom instruction ($b = .39$, $p < .001$).

TIS Interview Data

1. **Relation of PD quality characteristics and motivation components.** Regression analyses revealed that the following characteristics of professional development were significantly related to the following motivation components (See Table 4 for regression coefficients (β) and p values; see Table 5 for a summary of significant relationships): The extent to which TISs reported that PD incorporated time for practice and opportunities for collaboration was significantly related to teachers' perceptions of relative advantage. TIS reports of the extent to which teachers had opportunities for collaboration were also significantly related to teachers' perceptions of compatibility and observability. Finally, TIS reports of the extent to which teachers received consistent feedback as part of PD were related to teachers reports of trialability. See Table 6 for a comparison of teacher and TIS results.

Table 3.4: *Regression Coefficients (β) and Standard Errors (SE) for PD Quality Characteristics and Motivation Components for TIS Data*

	Relative Advantage	Compatibility	Complexity	Trialability	Observability	Priority	Positive Affect
Active Learning	-0.423 (0.287)	-0.116 (0.089)	-0.035 (0.162)	0.093 (0.085)	-0.446 (0.371)	-0.169 (0.166)	-0.465 (0.537)
Integration	-0.096 (0.336)	0.072 (0.100)	-0.116 (0.165)	-0.130 (0.106)	0.004 (0.420)	-0.012 (0.117)	-0.097 (0.614)
Time for Practice	0.434* (0.177)	0.047 (0.066)	0.06 (0.138)	-0.055 (0.095)	0.453 (0.250)	-0.005 (0.131)	0.501 (0.334)
Coaching	-0.918 (0.837)	-0.288 (0.314)	-0.150 (0.291)	0.451 (0.326)	-1.159 (0.745)	0.224 (0.381)	-0.873 (0.834)
Tailoring	0.107 (0.459)	0.061 (0.179)	-0.067 (0.232)	-0.380 (0.224)	0.107 (0.487)	-0.248 (0.211)	-0.387 (0.438)
Collaboration	0.520* (0.260)	0.207* (0.082)	0.169 (0.152)	-0.127 (0.115)	0.842** (0.252)	-0.199 (0.126)	0.665 (0.480)
Feedback	-0.452 (0.465)	-0.196 (0.175)	-0.112 (0.226)	0.506* (0.198)	-0.705 (0.462)	-0.036 (0.230)	-0.194 (0.650)

*$p < .05$
**$p < .01$

Table 3.5: *Summary of Significant Relationships between PD Quality and Motivation Components for TIS Data*

PD Quality Characteristic	Motivation Components Influenced
Active Learning	
Integration	
Time for Practice	Relative Advantage
Coaching	
Tailoring	
Collaboration	Relative Advantage, Compatibility, Observability
Feedback	Trialability

Table 3.6: *Comparison of Teacher and TIS Data for Significant Relationships between PD Quality and Motivation Components*

PD Quality Characteristic	Motivation Components Influenced	
	Teacher Data	TIS Data
Active Learning	Trialability, Observability, Priority, Positive Affect	None
Integration	Relative Advantage, Compatibility, Complexity, Trialability, Observability, Priority, Positive Affect	None
Time for Practice	Compatibility, Trialability,	Relative Advantage
Coaching	Relative Advantage, Trialability, Observability, Priority, Positive Affect	None
Tailoring	Relative Advantage, Compatibility, Complexity, Trialability, Observability, Priority, Positive Affect	None
Collaboration	Relative Advantage, Complexity, Trialability, Observability.	Relative Advantage, Compatibility, Observability
Feedback	Trialability, Positive Affect	Trialability

2. **Mediating effect of motivation in the relation between PD quality and teachers' self-reported use of PAC-Tech learning.** Given the very small number of cases for TIS data (N=30) and the large sample size required to conduct mediation analysis, mediation was not able to be performed using TIS interview data.

CHAPTER 4: DISCUSSION

The results of the present study provide preliminary support for the ideas that (1) characteristics of quality professional development have a significant impact on teachers' motivation to implement novel educational practices, and (2) that motivation is one significant mediating pathway by which PD quality enhances the likelihood that teachers implement these innovations. These results expand upon previous studies that have demonstrated that PD quality is related to instructional quality (Desimone et al., 2002a; Garet al., 2001; Ingvarson et al., 2005; Joyce & Showers, 2002; Markle et al., submitted for publication) by identifying one mediating pathway that explains how this effect operates. These results are likely to be of interest to schools and school districts seeking to enhance implementation of educational innovations and increase teacher buy-in for using novel, evidence-based strategies. By tailoring professional development to teachers' individual needs, schools can increase buy-in and improve the likelihood that teachers implement instructional strategies with quality.

The results of this study are consistent with literature suggesting that proper training can impact motivation if it fosters inclusion of all parties, develops positive attitudes toward new practices, creates meaningful learning experiences, and engenders competence among learners (Deci, Koestner, & Ryan, 2001; Lawler & King, 2000; Wlodkowski, 2003), and literature demonstrating that teacher motivation can impact

implementation quality (Elias et al., 2003; Dusenbury, Brannigan, Falco, & Hansen, 2003; Han & Weiss, 2005; Rogers, 1995; Pankratz, Hallfors, & Cho, 2002; Rohrbach, Graham, & Hansen, 1993). However, this is the first study to examine a pathway by which the effect of professional development on implementation quality operates.

Regarding the specific characteristics of PD that are related to each component of motivation, the current results suggest that certain characteristics of PD may be better suited for influencing particular components of motivation than others. Teacher data, which represent the most robust dataset used in this study due to large sample size and high teacher familiarity with their school's PD practices, suggest that the two most influential characteristics of PD on motivation are 1) integration of new ideas with teachers' existing knowledge and 2) tailoring PD to teachers' individual needs and preferences. These two characteristics were significantly related to all seven motivation components. Other PD characteristics may be more nuanced in their effects (see Table 2). For example, the current results suggest that active learning tends to influence trialability, observability, priority, and positive affect, while collaboration was related to relative advantage, complexity, trialability, observability, and positive affect, and feedback was only related to trialability and positive affect.

TIS data regarding relations between PD quality and motivation differed from teacher data in several aspects, which may be due to the small sample size (N=30) and the fact that TISs are likely to be less familiar with the PD quality at each school since they do not directly participate in it. Regarding agreement between teacher and TIS data, it was difficult to find a high degree of reliability due to the different types of data used. TIS data did not find significant relations between active learning, integration, coaching

or tailoring. However, there was agreement between teachers and TISs that opportunities for collaboration are significantly related to relative advantage, compatibility, and observability and that regular provision of feedback is related to trialability. This agreement, even in the face of low power, suggests that providing ample opportunities for teachers to collaborate with one another and ensuring that teachers receive consistent feedback on their performance are likely to have a positive impact on teacher motivation to implement new practices.

Understanding how PD influences teacher buy-in is critical for implementation, as Durlak and DuPre (2008) note that fostering a supportive climate and training/technical assistance are two of the major tasks involved in quality implementation. Using knowledge about how PD design can impact teacher motivation, schools can design PD in such a way that it incorporates the characteristics necessary to bolster motivation in key areas. In combination with a readiness assessment that measures teacher motivation in each of the seven domains, schools can use this knowledge to design PD so that it positively influences domains of motivation that are low with respect to a particular innovation. For example, if a readiness assessment indicates that teachers scored low in their perceptions of relative advantage, schools can incorporate integration, coaching, tailoring, and collaboration into their PD. Alternatively, if teachers score low on perceptions of trialability, schools may want to consider emphasizing active learning, opportunities for practice, collaboration, and provision of feedback. Schools needing improvement in the area of priority may want to incorporate active learning, integration, and tailoring, as these characteristics accounted for the most variance in priority.

Although the components analysis demonstrated significant and moderate relationships between individual characteristics of PD quality and components of motivation, the mediation analysis using teacher data demonstrated a smaller overall effect of PD quality as a whole on motivation. In mediation analyses using teacher self-report data, PD quality as a whole only explained about 1.5% of the variance in motivation. However, in the components analysis, individual characteristics of PD quality including tailoring and integration of concepts had strong relationships with motivation, indicating that these characteristics may be more important than others for securing buy-in. Although the relation between PD quality and motivation was not as large as expected in the mediation analyses, the effect of motivation on teachers' self-reported implementation of PAC-Tech strategies was fairly large and teacher motivation accounted for 15.3% of the variance in teachers' implementation quality. Therefore, the current results suggest that components of motivation, including relative advantage, compatibility, complexity, observability, trialability, priority, and positive affect) are fairly influential in determining teachers' implementation quality. Given these associations, schools are likely to benefit from bolstering the seven domains of motivation to increase success of programs and practices. A potential process for improving teacher motivation is for school administrators to ask teachers about how they view an innovation, their perceptions of its strengths and weaknesses, and their concerns about implementing the innovation. For example, schools might consider employing Hall and Hord's (2010) Concerns-Based Adoption Model, which addresses teacher concerns in order to enhance buy-in for implementation.

Although the mediating effect of motivation obtained in this study is statistically significant, it is relatively small in nature. There are several possible explanations that may account for the magnitude of the relations found in this study. First, it is possible that the true relation between PD quality, motivation, and instructional quality is larger than the results of this study suggest. A limitation of self-report data is that teachers may sometimes respond inaccurately due to desirability bias or poor memory of the experience about which they are being queried. Although this is a possibility, it is likely that the majority of teachers responded relatively accurately given that the survey was anonymous. Second, it is possible that the relations among constructs described in the current study are relatively close to the true relations. Since there are many other factors that interact with PD quality and motivation and many that also influence teachers' implementation of new practices, it may be the case that PD quality and motivation are diminished when these other factors are at play. Given the complex nature of school environments, schools seeking to improve instruction would be wise to comb the literature for evidence-based practices relating to these factors.

Another possibility that may explain these results is that different characteristics of PD quality may be differentially motivating to different teachers such that successful implementation may require the right combination of PD characteristics to get teachers motivated. This idea suggests that there is a need for schools to identify teachers' values and tailor PD to those needs. Further, this theory is supported by the finding from the current study that tailoring of PD was significantly associated with every component of motivation and had the largest effects of any of the PD characteristics. Thus, a major implication of the present analysis is that schools should consider conducting a thorough

PD needs assessment for all teachers and devise a process for tailoring professional development to each teacher's strengths and weaknesses. Schools can facilitate this process by using practical implementation science tools such as the Getting To Outcomes® framework (Wandersman, Imm, Chinman, & Kaftarian, 2000) for planning, implementing, and evaluating innovations, and the Evidence-Based System for Innovation Support (EBSIS) (Wandersman, Chien, & Katz, 2012) to help guide efforts to support teachers in their pursuit of quality implementation.

Limitations and Future Directions

There are several limitations of the current study. First, the results were obtained from 39 schools located within one school district in the Southeastern United States. As this study did not randomly assign teachers to receive different quantities or qualities of PD, there is a possibility that there are confounding factors that may have blurred the true relations between PD quality, motivation, and instructional quality. Although the analyses employed a multi-level approach as well as accounted for effects of technical problems and school climate, it is possible that there are other unforeseen factors that may have influenced the results. In the future, research using experimental designs with random assignment to conditions and multiple data points spanning several years would help to strengthen the validity of previous conclusions that have been drawn in the literature. However, given that schools are real-world settings and not primarily places of research, this level of experimental rigor is often difficult to achieve.

The current study relied on self-reports of PD quality, motivation, and instructional quality, which may not always provide the same level of accuracy as objective observational data, although this idea has been debated (Desimone, 2009).

Although the instruments used in this study to assess PD quality, motivation, and instructional quality are derived from the education and organizational readiness literature, they were adapted for the evaluation of one district's computing initiative and therefore may limit the generalizability of the results to other districts. The development of validated measures of professional development characteristics would help to unify the field and provide a common language so that findings from different studies can be compared against one another on an even playing field (Desimone, 2009). An additional limitation of the study is that the author was not able to obtain teacher identification numbers and therefore, could not link teacher behaviors to student outcomes. Future work in this area would benefit from the ability to document each step in the causal chain from provision of PD to teacher behavior to student achievement.

Despite the use of self-report for both teacher and TIS data, the teacher data is likely to be more accurate than TIS data due to the larger sample size and increased familiarity of teachers with their school's PD practices. The differences between teacher and TIS data represent a limitation of the study, but are to be expected given the differing type of respondents. It should be noted that the TIS data, even though they were obtained from interviews, are not qualitative data but rather the same quantitative ratings that teachers provided regarding PD quality. Future studies may benefit from using actual qualitative data from interviews to corroborate quantitative findings.

Another limitation of the current study is that there was not enough power to find any effects using data from TIS interviews. Therefore, an additional source of data could not be obtained to corroborate the teacher self-report data for mediation. However, because of the large sample size of teacher self-report data, statistical power to find even

small effects was quite large and thus, it is likely that the effects found using teacher data are relatively representative of true relationships between PD, motivation, and instructional quality.

Finally, it should be noted that although motivation was a significant mediator of the relation between PD quality and instructional quality in this study, the effect of PD quality on motivation as a whole was relatively small in the mediation analysis. However, this is an expected occurrence due to the large amount of power that is required to find significant mediating relationships. Regression analyses, which more thoroughly assessed the individual component relationships between PD quality and motivation in this study, revealed that individual PD quality characteristics were found to have fairly strong relationships with motivation components. Therefore, it is logical to conclude that several aspects PD quality significantly impact teacher motivation to utilize new educational practices. However, given the complex nature of school environments, there are also several factors in addition to PD that influence instructional quality (e.g., school climate) and schools seeking to improve instruction would be wise to comb the literature for evidence-based practices relating to these factors.

Future research in this area should explore more sources of data than teacher self-report. Although the current study intended to examine school-level data on professional development in addition to teacher data, there was not a large enough sample size to create sufficient power to find effects of professional development on motivation or of motivation on instructional outcomes. Thus, future studies should plan to gather enough school-level data to power their analyses. In addition, future research should replicate these analyses in several settings, with several diverse populations to determine any

variability in the way that PD affects motivation depending on teacher, student, and school demographic factors such as age, sex, race, neighborhood, socioeconomic status, grade, and subject. There may be additional ways to measure constructs such as PD quality and motivation and future research should explore these to determine which methods are most valid and reliable. Comparisons should be made between self-report, observations, focus groups, interviews, and archival data to ascertain an idea of optimal data collection methods for this area of inquiry. Finally, based on the results of this study, research comparing teacher implementation quality between schools who tailor PD to specific aspects of motivation and those who don't is warranted to determine whether schools can create a significant difference in implementation by targeting motivation during PD.

Conclusion

The results of the present study suggest that characteristics of quality professional development including active learning, tailoring, integration, feedback, coaching, time for practice, and collaboration can have a significant impact on teachers' motivation to utilize novel educational practices. Specifically, this study suggests that the most influential characteristics of PD on motivation are 1) integration of new ideas with teachers' existing knowledge, 2) tailoring PD to teachers' individual needs and preferences, 3) providing opportunities for collaboration among teachers, and 4) providing consistent feedback to teachers. The present results predict that schools that design PD that integrates new and familiar concepts to make it easy for teachers to learn a new practice, that allow teachers to work together in learning that practice, that provide feedback to teachers during the learning process, and that survey teachers about their

specific needs, preferences, and learning styles are more likely to secure buy-in and support from teachers for a particular innovation. Further, the results indicate that teachers who feel that an innovation is relevant to them and their students, has clear benefits for students, is compatible with current practices, is relatively easy to learn, and is supported by school resources and technical assistance are more likely to implement that innovation in their classroom.

These results are likely to be of interest to schools and school districts seeking to enhance implementation of educational innovations and increase teacher buy-in for using novel, evidence-based strategies. An implication of this study is that schools should tailor PD to teachers' specific areas of need in order to increase buy-in and improve the likelihood that teachers implement instructional strategies with quality. Although this effort may require that school administration put in a large degree of work upfront, a host of literature demonstrates that the previously mentioned quality PD characteristics have the potential to significantly enhance the effectiveness of instruction (Borko, 2004; Darling-Hammond et al., 2009; Desimone et al., 2002a; Gerard et al., 2011; Penuel et al., 2007; Wei et al., 2010; Yoon et al., 2007). Ultimately, it is the author's intention that schools and school districts can utilize these findings in conjunction with other research to inform their approach to professional development. Given the current state of evidence, efforts to assess teacher motivation and tailor PD to teachers' needs using the quality characteristics discussed in this paper have the potential to promote effective teaching and learning, preparing students for success in a 21st century world.

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APPENDIX A: PD QUALITY ITEMS FOR TEACHER SURVEY

1. Professional development related to technology provided by my school is tailored to my needs, including skill level and topics that are relevant to me. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
2. I can successfully transfer the information and technology skills I learn through professional development into my classroom. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
3. I have sufficient time to practice technology skills I learn in professional development so that I can become proficient at using these skills in the classroom. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
4. When I have a question related to integrating technology into instruction I can get it answered in a timely fashion. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
5. Technology-related professional development provided by my school's ITS is presented in an engaging and interesting format. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
6. Professional development sessions are supplemented by individual contact to support successful transfer of new skills into the classroom. (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

7. How often do you collaborate with other teachers to share and learn new ways to use technology to enhance student learning? (Never, Rarely, Sometimes, Often, Always)
8. How often do you receive in-class coaching or assistance to support use of technology in instruction from someone in your school or from the district? (For example, someone observes your teaching and then provides you feedback). (Never, Rarely, Sometimes, Often, Always)

APPENDIX B: MOTIVATION ITEMS FOR TEACHER SURVEY

For each of the following items, please describe how you personally feel about the 1TWO1 computing initiative. Keep in mind that these items refer only to the desire to implement 1TWO1, regardless of whether you may have the ability and resources to do it.

Note: In the following items, the term "1TWO1 computing" refers to refer to Richland Two's 1TWO1 initiative, which seeks to provide all students in grades 3-12 with a personal computing device (i.e. Chromebook, iPad) to enhance personalized, authentic, and collaborative learning and facilitate student engagement and achievement.

Note: All of these items can be scored on a scale from 1-5. All items except the affect items (#18a-18h) are on a 1-5 scale from Strongly Disagree to Strongly Agree, while the affect items are on a 1-5 scale from Never to Always.

Factors that increase or decrease motivation

Cognitive Items (SA to SD):

Relative Advantage (Degree to which a particular innovation is perceived as being better than what it is being compared against):

1. I feel that the benefits of integrating 1TWO1 technology into my classroom outweigh the costs (time, device breakage, classroom management difficulties, etc.).

2. My students' ability to learn has been improved as a result of using 1TWO1 technology in my classroom.

3. My students' learning experience would be diminished if my students were no longer able to participate in 1TWO1 activities.

4. The use of 1TWO1 computing is much more effective for increasing students' learning and achievement than teaching without technology.

Compatibility (Degree to which an innovation is perceived at being consistent with existing values, cultural norms, experiences, and needs of potential users):

5. Using technology is an ideal way for me to provide my students with opportunities for
    a. Personalized learning (i.e., tailoring assignments to fit students' individual needs)
    b. Authentic learning (i.e., connecting lessons to real-world issues that are meaningful to students)
    c. Collaborative learning (i.e., providing opportunities for students to share and collaborate with one another on assignments and projects).
6. Based on my beliefs about how students learn, I believe it is important to provide them with opportunities for:
    a. Personalized learning
    b. Authentic learning
    c. Collaborative learning

Complexity (Degree to which innovation is perceived as relatively difficult to understand and use):

7. So far, it has been difficult to use 1TWO1 computing in my classroom.
8. Using 1TWO1 computing makes it easy for me to achieve the learning goals I have for my students.
9. So far, integrating 1TWO1 computing into my curriculum has been relatively easy.

Trialability (Degree to which an innovation can be tested and experimented with):

10. I have had sufficient opportunities to:
    a. Time to practice 1TWO1 activities that I learn in professional development *before* using them in the classroom.
    b. Hone my skills at using 1TWO1 activities *while* using them in the classroom.

11. I have had adequate time to collaborate with other teachers in planning 1TWO1 activities to use in my classroom.
    a. On average, how much time per week would you say you collaborate with other teachers to plan 1TWO1 activities?
        i. Less than 1 hour
        ii. 1 hour
        iii. 2 hours
        iv. 3 hours
        v. More than 3 hours

Observability (If outcomes that result from the innovation are visible):

12. I have noticed that 1TWO1 computing has led to greater student engagement in my class.
13. I have noticed that 1TWO1 computing has led to greater student achievement in my class.

Implementation Climate Beliefs (Extent to which innovation use is expected, prioritized, and meriting attention):

14. My principal has clearly explained the goals of 1TWO1 computing.
15. 1TWO1 computing is a major priority in my school.
16. In my school, it is expected that I use 1TWO1 computing into my classroom on a daily basis.
17. So far, I have not received as much help and support for implementing 1TWO1 computing as I would like.

Affect Items (Never, Rarely, Sometimes, Often, Always)

18. When I think about how 1TWO1 computing has been implemented in my school, I feel: (Never, Rarely, Sometimes, Often, Always)
    a. Frustrated about the time and effort it takes to integrate technology into my classroom effectively.
    b. Happy about helping students learn in more innovative ways.
    c. Uncertain about whether 1TWO1 computing can really improve the way students learn.
    d. Excited about the way my students respond to 1TWO1 activities.
    e. Worried about having the time to learn new technology skills.
    f. Proud to be part of a technology learning initiative.
    g. Confident that I can use technology to enhance my students' learning.
    h. Other: (open-ended)

Items directly relating to motivation itself (Strongly Disagree to Strongly Agree):

For each of the following items, please describe how you personally feel about the 1TWO1 computing initiative. Keep in mind that these items refer only to the desire to implement 1TWO1, regardless of whether you may have the capacity and resources to do it.

19. I want to learn more about how to use technology to enhance the way I teach.
20. I am determined to take the time to learn about new technology so that I can implement 1TWO1 computing in my classroom.
21. I want to use 1TWO1 computing in my classroom.

Collective Motivation (Strongly Disagree to Strongly Agree):

The following two items pertain to how you think your school and your colleagues feel about 1TWO1 computing. Keep in mind that these items refer only to the school staff's desire to implement 1TWO1, not whether they have the capacity and resources to do it.

22. As a whole, our school staff are determined to implement 1TWO1 computing in our school as best as we possibly can.
23. As a whole, our school staff enjoy using 1TWO1 computing.
24. Teachers at my school are determined to take the time to learn about and practice using new technology so that they can implement 1TWO1 computing in their classrooms.
25. As a whole, our school staff want to learn more about how to use technology to provide richer learning experiences for students.
26. On the whole, teachers at my school want to use 1TWO1 computing in their classrooms.

APPENDIX C: PAC LEARNING ITEMS FOR TEACHER SURVEY

Personalized

How often do you:

1. You ask students to move to a more challenging assignment when they have finished their work? (Never, Rarely, Sometimes, Often, Always)
2. You offer personalized assignments to fit a particular student's interests? (Never, Rarely, Sometimes, Often, Always)
3. You offer personalized assignments to fit a particular student's understanding of the material? (Never, Rarely, Sometimes, Often, Always)
4. You offer personalized assignments to fit a particular student's learning style? (Never, Rarely, Sometimes, Often, Always)
5. You customize learning activities to address students' abilities using digital tools and resources? (Never, Rarely, Sometimes, Often, Always)

Authentic

6. Most students think that the work they are doing is relevant to their lives outside school (SD to SA)
7. How often do you ask your students to use digital tools and resources to explore and solve real-world issues? (never, rarely, sometimes, often, always).

8. [How often do] your students complain about the relevance of their school work to their lives (i.e. "why do we have to learn this?")? (never, rarely, sometimes, often, always)
9. How confident do you feel in designing and teaching lessons that have a high level of authenticity (are relevant to students' real-world experiences)? (Very confident, somewhat confident, not at all confident)

Collaborative

10. How often in your class(es) do you model collaboration to your students by engaging in learning or teaching with colleagues and others in face to face or virtual environments? (Never, Rarely, Sometimes, Often, Always).
11. How confident do you feel in designing and teaching lessons that utilize a high level of collaboration between students? (Very confident, somewhat confident, not at all confident).
12. In the past school semester, what percentage of all your classroom tasks and lessons required student to collaborate:
    a. With peers face-to-face? (Almost None, Less than 25%, 25-50%, 50-75%, More than 75%).
    b. With peers online? (Almost None, Less than 25%, 25-50%, 50-75%, More than 75%).
    c. With professionals face-to-face (Almost None, Less than 25%, 25-50%, 50-75%, More than 75%).

d. With professionals online? (Almost None, Less than 25%, 25-50%, 50-75%, More than 75%).

Tech-Integrated

13. I can effectively select technologies to use in my classroom that enhance what I teach, how I teach and what students learn (Strongly Disagree, Disagree, Agree, Strongly Agree).
14. I can effectively help others to coordinate the use of content, technologies and teaching approaches at my school and/or district (Strongly Disagree, Disagree, Agree, Strongly Agree).
15. I can choose technologies that enhance the content for lessons in my subject area(s) (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree).

APPENDIX D: PROFESSIONAL DEVELOPMENT ITEMS FOR TIS INTERVIEW

Now we are specifically interested in the process of how TLCs determine what PD is offered and teacher responses to PD at the school level.

Please rate the next few items on a scale of 1 through 5, with 1 being *not at all,* and 5 being *very much*.

A) Did the TLC tailor PD related to technology to the teacher's needs, including skill level and topic?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5

B) Did the TLC integrate new concepts and skills to familiar ideas so that teachers can learn them more easily?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5

C) Did the TLC provide teachers with sufficient time to practice skills they learned in PD?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5

D) Was technology-related PD presented in an engaging and interesting format?

Strongly Disagree		In the Middle		Strongly Agree1
1	2	3	4	5

E) Were PD sessions at the school level supplemented by individual contact with the TLC?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5

F) Were teachers able to collaborate with each other and share and learn new ways to use technology?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5

G) Did teachers have regular opportunities to proved feedback about the quality of the PD that is provided to them?

Strongly Disagree		In the Middle		Strongly Agree
1	2	3	4	5